Image by Patrick Nieborg

User Manual

ABOUT THEA RENDER

Thea Render is a physically-based global illumination renderer of high quality. It is a unique renderer that is able to render using state of the art techniques with its biased, unbiased and GPU photo-realistic render engines. Thea Render comes with its own standalone application (Studio) for the most intuitive setup and advanced staging operations.

SYSTEM REQUIREMENTS

OpenGL support required for Studio application. Memory 512Mb Ram (2GB or higher recommended for rendering complex scenes). Resolution 1024x768 or higher, 32-bit color, and 3-button wheel-mouse recommended for Studio application. Nvidia CUDA compatible card required for Thea Presto (GPU).

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Home page: http://www.thearender.com

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Thea for 3dsMax (Autodesk): http://www.thearender.com/3dsmax

Thea for Blender: http://www.thearender.com/blender

Thea for Cinema4D (Maxon): http:www.thearender.com/cinema4d

Thea for Fusion 360: http://www.thearender.com/fusion360

Thea for Rhino (McNeel): http:www.thearender.com/rhino

Thea for SketchUp (Trimble): http://www.thearender.com/sketchup

Substance Thea Converter (Allegorithmic): http://www.thearender.com/substance

Solid Iris Technologies: http://www.solidiris.com

Manual Version

Manual Version: v1.5

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phyisically-based unbiased, biased & gpu render engine

Chapter 1: Installing the Application - Licence Details

1. Installing the Application – License Details

1.1 Installation Introduction

Just before running Thea Render for the first time, you have to install it. Installation is necessary so that the executable may locate the needed resources even if you run the application from another folder and all files are transferred in the proper place.

1.1.1 Installing for Windows

You will need administrator privileges to install on Windows operating system. The installer will guide you through the installation steps. On a 64-bit operating system, you can install either the 32-bit or 64-bit version of Thea Render. During installation you can define the application folder and also the data folder in which all necessary Thea data will be installed (materials, IES files etc.).
Additionally, the first time you will run the application, you will be asked to choose the Temp folder location (this folder is per user defined) where Sessions and history files will be saved.

1.1.2 Installing for MacOSX

Thea Render will run on MacOSX 10.6+ version. The installer comes in the form of a dmg image that the user needs to mount. By exposing the contents of this image, you can see the application bundle - simply drag and drop the icon into your Applications folder. You will then need to run at least once the application for installation to be completed. At this point you will be also asked to specify the desired data and temp folder locations.

1.1.3 Installing for Linux

On Linux, Thea Render comes currently in a .tar.gz package that needs to be decompressed into the running folder. In the folder, you will see then two shell files (install.sh and install-x64.sh) - you should run the one that corresponds to the variant of your operating system. Upon executing the script file, the user will be asked for providing the data folder and temp folder for the application.

1.2 Activation

When you purchase a Thea Render license, you will receive a serial number that corresponds to your license. The serial number needs to be entered at the License Form window along with some basic information to activate your license. The automatic activation will need an internet connection (should you not have access, you can still request manually the activation code). Note that this needs to be done only once after installing the software.

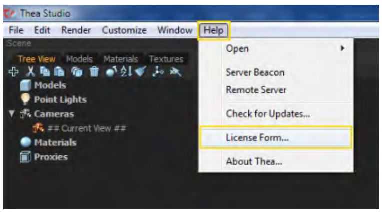


Figure 1-1: Open License Form Window

Note: demo version of Thea Render is fully functional and the only limitations are the appearing watermarks on the rendered images and the limited resolution (1280x720).

The first step to activate your license is to open Thea Studio, go to Help menu and then click on License Form, as seen in Figure 1-1. This will bring up the license Input Form as shown in Figure 1-2.

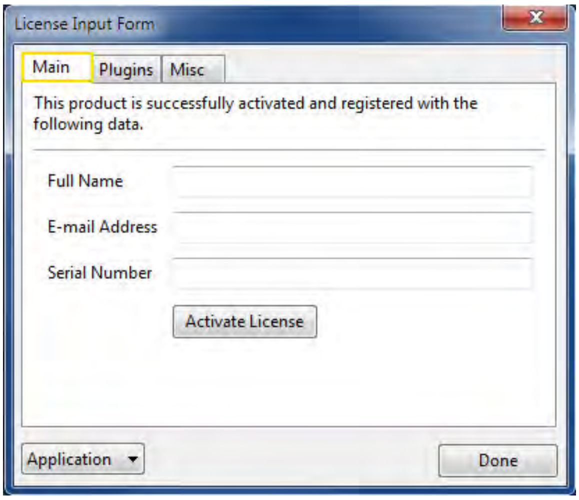


Figure 1-2: License Input Form - Main

Tip: the drop-down menu at the bottom left of the window allows you to choose between Application and Node Activation. In case you want to activate Thea Studio, Application should be used. In case you need to activate a Node and run Thea in client mode to perform Network rendering, please select the Node option and then add your node serials.

Here you can see all the data associated with your license. Please go ahead and type your full name and e-mail address. Both of them need to be written in Latin characters and you should make sure that the e-mail address is valid and correctly typed. Please fill in the serial number that you received as well (Thea Standard License – Studio). For being sure you have entered it correctly, you can copy it from the pdf you received and paste it here. If you want to activate Thea Studio only you can now press the Activate License Button.

Otherwise, if you have purchased a plugin license too, you can switch now to the Plugins panel by clicking on the corresponding tab. The view will change to what is seen in Figure 1-3.

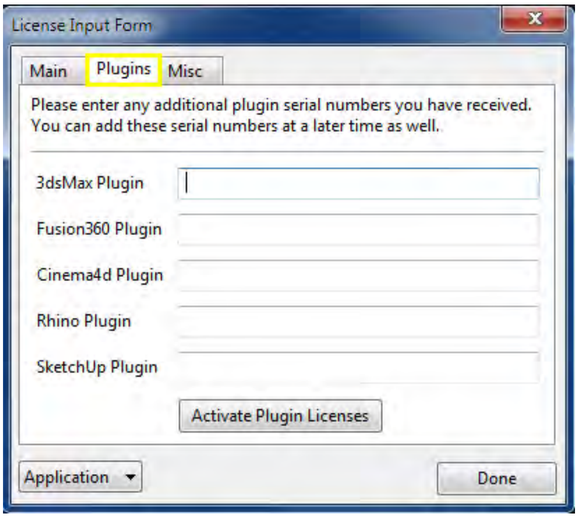


Figure 1-3: License Input Form – Plugins

You can enter here the serial numbers you have received for the plugins.

Tip: with the button Activate Plugin Licenses you can activate any plugin you own at a later point (after activating Thea Studio).

After adding you serials for plugins, you can switch back to the Main panel and click on Activate License button (Figure 1-2). A message box will pop-up then, asking you to type again your email address to be sure that was added correctly (Figure 1-4). Once you type it you can press the OK button.

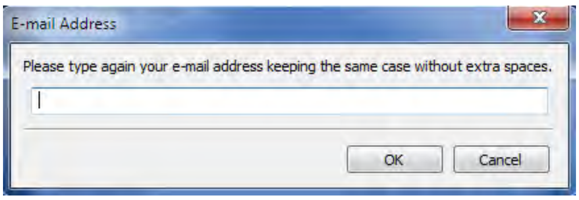


Figure 1-4: Re-entering the email address

Thea Render will contact the web server activating your license. Just afterwards, a message box will appear in your screen informing you that the activation is complete (see Figure 1-5).

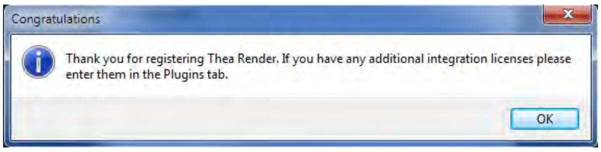


Figure 1-5: Successful Registration

Please note that the first time you activate your license, your data are used for registering the software. It is very important that these data (name and e-mail) are correct as your registered name and e-mail address will be used whenever you need to re-install and reactivate Thea Render.

Some further operations on your license are possible from the third tab, the Misc panel (see it in Figure 1-6).

A typical scenario here is that you export your license data for your archive. The license can then be re-imported whenever you need to re-install Thea Render (or upgrade to a newer version). Please note that re-activation may be needed even if you import a valid license, in case you are installing on a different or upgraded system. Clearing the license should be done only in rare cases, as for example when you need to change serial number of application and plugins or upgrade a client (node) to Studio license. It is important to understand that you cannot change your registered data (name and e-mail) by clearing the license, editing new data and re-activating. You will need to contact us for this purpose to make the change for you.

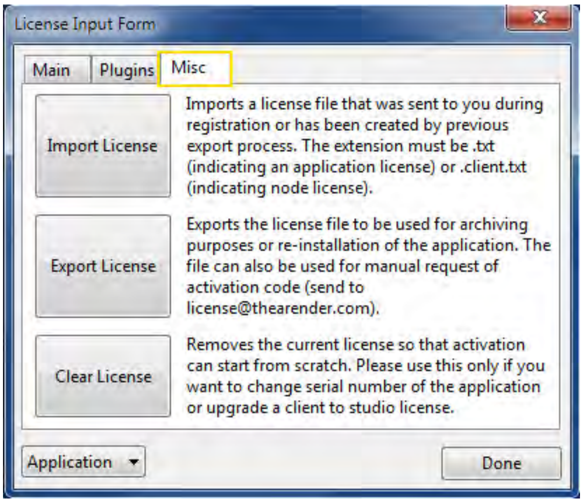


Figure 1-6: License Input Form - Misc

If you have any questions about licensing or any problems with activating your license, please contact us at license@thearender.com.

1.3 Thea Licenses - General

All Thea Render licenses, including academic, are perpetual (non expiring) and contain all features. Academic licenses are per-user, allow single installation and may be used only for educational purposes, by students and teachers. Standard licenses are per-user, allow up to three installations and can be used for commercial purposes. Floating licenses allow unlimited installations and can be used for dynamic license allocation in a multiple-user environment.

1.3.1 Floating License Information

Floating licensing stands for a client-server licensing mechanism where clients can dynamically retrieve and release their license from another site, where the license server resides. This way, multiple users can have the software installed and running with the restriction that no more users/machines than the number of licenses can run the software simultaneously.
In the example of Figure 1-7 below, there are 5 machines where the software has been installed but only 3 floating licenses. This means that no more than 3 machines can run the software simultaneously in licensed mode. In this example, Client #1, Client #2 and Client #4 have retrieved their license from the server but the other 2 clients will not run in licensed mode. Having the floating licensing gives the ability to distribute the licenses dynamically, as needed by the current user requests.

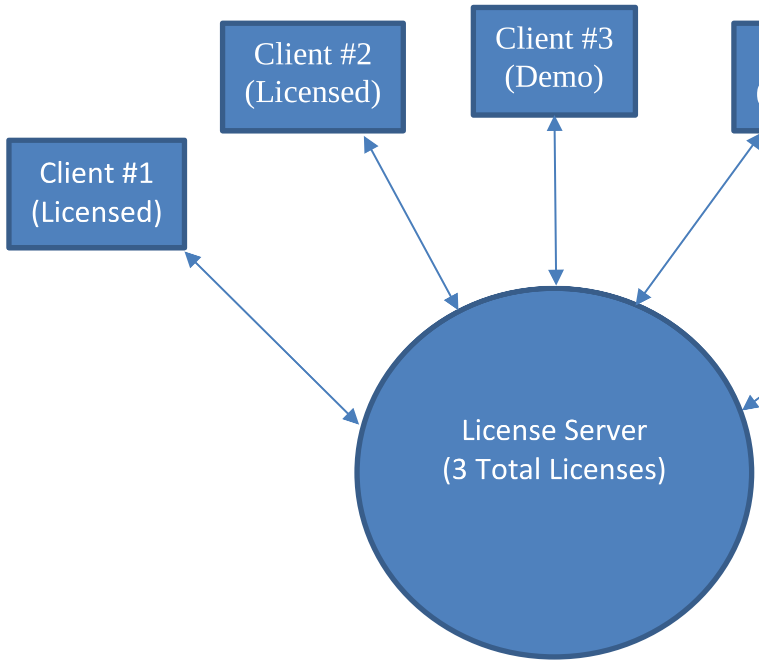


Figure 1-7: Example case with licensing 3 clients from the server

For a license to be dynamically allocated to a particular client, the server must have one such floating license available in its license stock. Should all the licenses are already allocated, a new client request for license will fail and the client will run with all restrictions applied in demo mode (such as resolution limitation and watermarks). In such case, where a client must become licensed when the server has no free licenses in its stock, one of the already licensed clients must release its license to the server, in order to be subsequently acquired to the new client.

1.3.2 Floating Licensing in Thea Render

In Thea Render, instead of a single application, there is a complete product line that includes the standalone product (Thea Studio) along with various integrations, such as Thea for Cinema4D, Thea for SketchUp, etc. All these applications can be simultaneously running on a single machine. Communication of them directly with the license server could result in various issues of synchronization. Instead, the communication is handled by another, intermediate, application called license proxy.

In the figure below, we can see how the applications interact between 2 machines, the client – where the user runs his/her applications – and the license server.

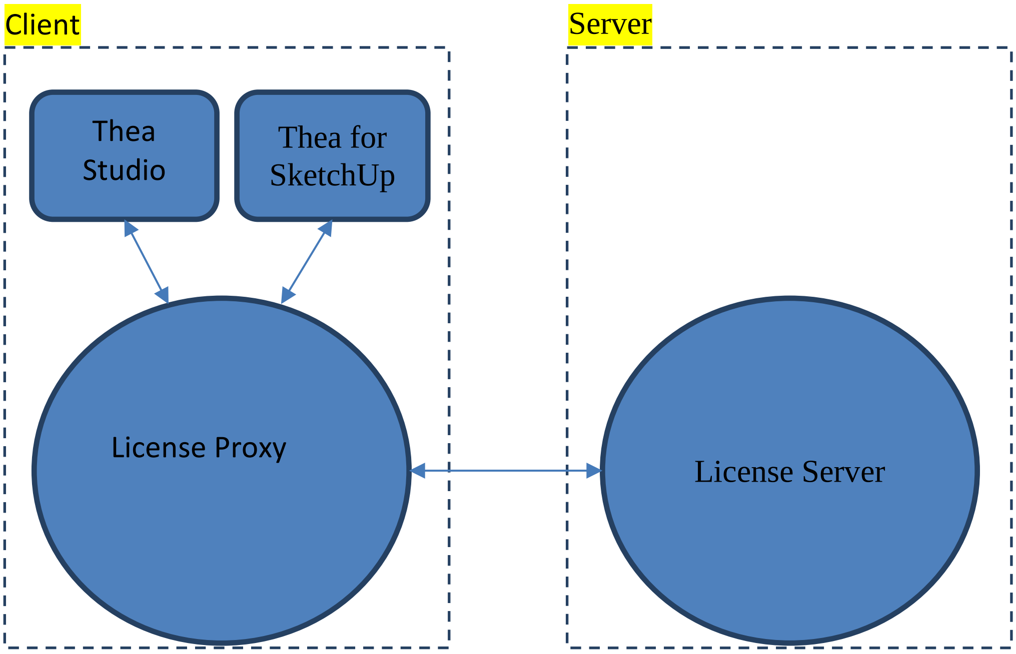


Figure 1-8: Typical topology of applications in the client and server machine.

With the scheme above, it is possible for the user to run multiple applications (for example, Thea Studio, Thea for SketchUp, etc.) without the need to communicate with the license server all the time. Only the first time that such a request takes place, the license proxy will communicate with the server to retrieve a license. Then, this license is reused for all Thea Render applications. Should no such applications run anymore, the proxy can release the license back to server.
The obvious benefits of the above scheme, is that there is a single point of communication between client and server which makes licensing very robust. This scheme also works in the unlucky case of an application crash. Furthermore, the proxy requires a connection to server, only at the beginning when requesting the license for the first time.

1.3.3 Installation

1.3.3.1 Windows

The License Proxy and License Server applications come as components in Thea Studio installer. In the page of choosing components, choose License Proxy (should this is an installation on a user machine), or License Server (should this is an installation on the license server machine).
After installation of these components, the License Proxy and License Server will be placed at Startup menu. This means that these applications will start automatically, immediately after the user login takes place.

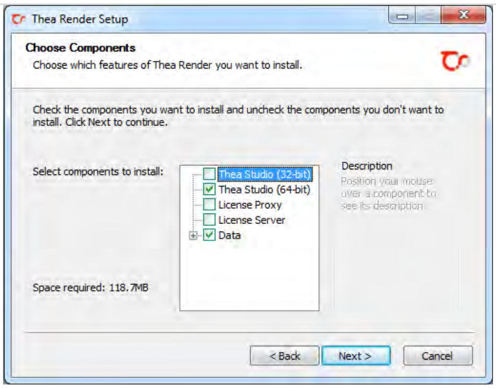


Figure 1-9: Choosing components

1.3.3.2 MacOSX

The License Proxy and License Server applications come as components in Thea Studio installer. These applications must start manually before any Thea Render application starts, in order to be licensed properly. Should this procedure needs to be automated, right click on either application, go to Options and in the popup menu, enable Open at Login.

Figure 1-10: Open at Login

1.3.3.3 Linux

The License Proxy and License Server applications come as components in Thea Studio archive. The application shortcuts will be placed on the desktop once the user installs Thea Studio. These applications must start manually before any Thea Render application starts, in order to be licensed properly.

1.3.4 Floating License Server

1.3.4.1 Using the Application

The floating license server application (titled "Thea License Server") is a small application that is typically installed on a machine that acts as a server, distributing the license on demand to client machines. Check Figure 1-11 to see a representative screenshot of the application. In that figure, there has been already a floating license installed (but not yet allocated to a client).

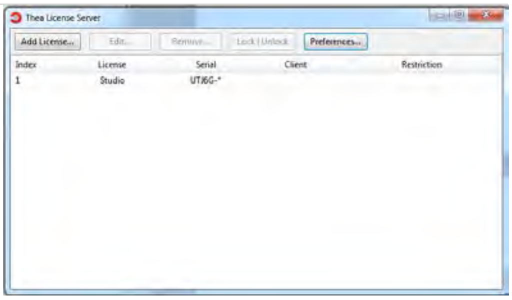


Figure 1-11: License server screenshot

The interface of the license server is quite simple and mainly consists of the list of installed licenses. In this list you can quickly inspect their number and type, along with the client that the license is currently assigned to.

1.3.4.2 Adding a Floating License

The very first thing you will probably want to do in the license server application is to add a floating license that you have already received. In this case, click on the Add License button. The typical Thea license form will open (Figure 12), where you need to enter your organization's name and email address along with the floating license serial. Enter the name, email and serial number and press the Activate License button. Switch to Plugins tab and enter any associated plugin licenses followed by clicking the Activate Plugin Licenses button (Figure 13).

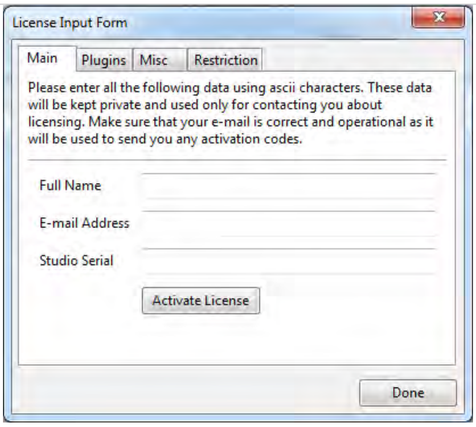


Figure 1-12: Opening license form

After the license has been added and activated, click on the Done button. The license server will display now the newly added license in the list and it can use it already for any client requests.

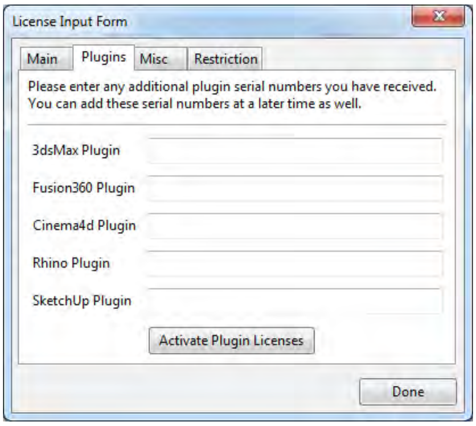


Figure 1-13: Adding plugin licenses

1.3.4.3 Editing a Floating License

If you select a floating license row in the list, you will see that the Edit and Remove buttons become enabled. Clicking then the Edit button will bring up again the license form. You can import, export or clear the license in the Misc tab. You can also assign IP addresses that will be the only ones to be accepted for becoming licensed, or, in reverse logic, IP addresses that will be rejected from becoming licensed (Figure 1-14). This gives you a way to control each license independently, for example, by reserving a license to a particular machine or pair of machines, so as to be always available. These restrictions will appear at the last column of the license list, for quick inspection.

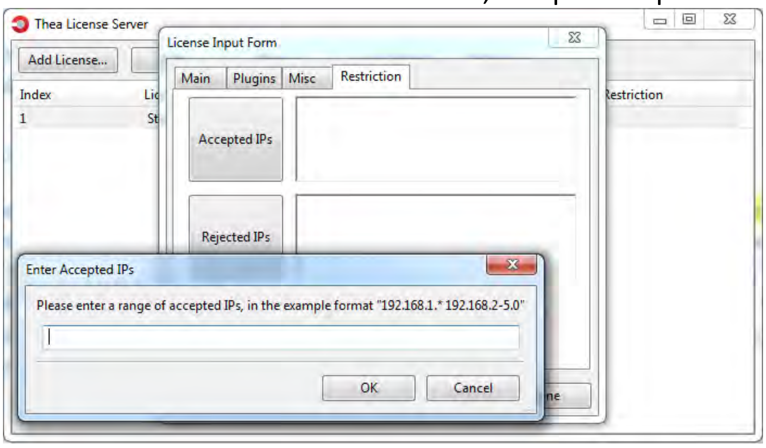


Figure 1-14: Screenshot of license server, during adding Accepted IPs restriction.

Besides editing a license, you can also click the Remove button that will delete the license file from the disk. Finally, you can also Lock / Unlock a license; this may be needed when you temporarily don't want to have a license assigned to anyone. Note that locking a license is not possible when the license has already been assigned to a client.

1.3.5 License Server Preferences

By clicking on the Preferences button, a dialog of settings pops up with a small list of parameters (Figure 1-15). The port refers to the communication port and it must be the same in for the license server as well as the license proxy applications, communicating with the server. Note that if there is a change in the port, the license server must restart in order for the change to take effect.

There is also a global list of accepted IP addresses as well as rejected IP addresses. These can be used to block any unwanted IP addresses for all licenses (should you want to block an IP address for a specific license, you can do it from the license form Connection tab, when editing the license).

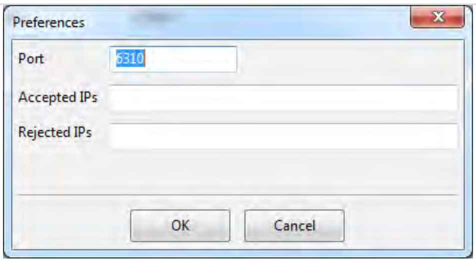


Figure 1-15: License server preferences

1.4 Floating License Proxy

1.4.1 Using the Application

On the client's side, all Thea applications (Studio, Plugins) communicate with the License Server through a small application called Thea License Proxy (Figure 1-16). This application collects all requests from the applications, communicates with the license server and brings back to an application the requested license. It is important to understand that the license proxy can only cope with one license; the first time that it retrieves the license, it reuses that one to license any subsequent application requests.

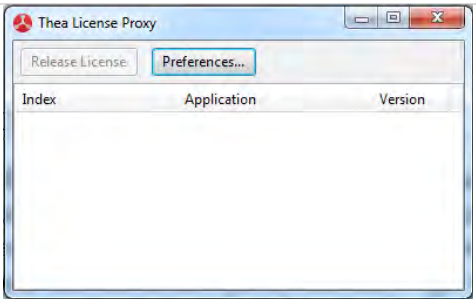


Figure 1-16: License proxy screenshot

If all applications using a license are closed then the license will not be needed anymore. The license proxy will, by default, auto release this license back to server after 10 seconds. The user may also release the license immediately, after pressing the Release License button.

1.4.2 License Proxy Preferences

By clicking the Preferences button, a new dialog pops up with various parameters for the license proxy (Figure 1-17).
The Server Port number is the communication port with the license server. Note that the next port number (i.e. 6311 in this case) is also being used for communication with the applications. Obviously, these two ports should not be in use by any other network application. If the port changes, both license proxy and all Thea applications need to restart for the new port to take effect.
The Server Address is the IP address where the server is located. Since this is a fixed IP address, the server must be located at a machine that its IP is fixed and not dynamically allocated.
The Auto Release, along with the Release Timeout, controls the auto release of a license, after all Thea applications have been closed. You may disable Auto Release if you want to have the license reserved for more time, until for example you restart a Thea application.

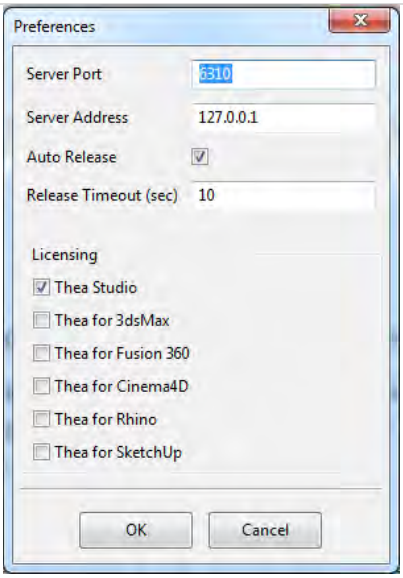


Figure 1-17: License proxy preferences

Finally, the Licensing group has all Thea applications that the requested license should cover. You should check all the applications that may be used at any time (and you know that they can be licensed). For example, if your floating licenses are for “Thea for SketchUp”, then you should check both Studio and SketchUp. A requested license will then include both Studio and plugin, even in the case you run Studio; this way, the license allocated can also be used for the plugin, launched at a later time.

Chapter 2: Menu Bar

Image by Patrick Nieborg

2. Menu Bar

2.1 Introduction

As in the majority of applications, in Thea Studio too, there is a Menu Bar at the top (as shown in Figure 2-1). You can see there five menus, each one with its own sub-menu, with several options that we will analyze in this Chapter.

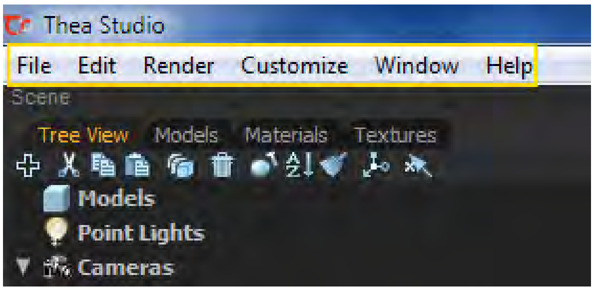


Figure 2-1: Position of Menu Bar

The five main menus that exist are:

1. File
2. Edit
3. Render
4. Customize
5. Window
6. Help

2.2 Accelerator Keys

Before analyzing these menus we can mention here some helpful shortcut keys for accelerating certain operations inside Studio. Here is the list:

Ctrl+Delete: works in all views, deleting current selection
Ctrl+Z: undo
Ctrl+Y: redo
Ctrl+N: new scene
Ctrl+O: open scene
Ctrl+S: save scene
Ctrl+X: cut selection
Ctrl+C: copy selection
Ctrl+V: paste selection
Ctrl+D: duplicate selection
Ctrl+Q: quit application

OpenGL viewport accelerator keys: F5 start IR, F7 stop IR, F9 toggle visibility of OpenGL gizmos/button.

2.3 File Menu

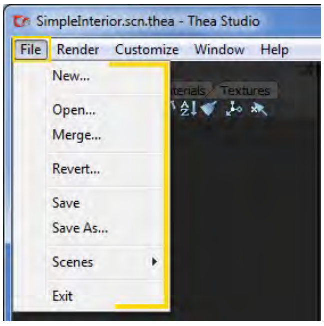


Figure 2-2: File Menu Available Options

File menu, is the first menu we see at the menu bar and includes options related to the opened scene. Once user presses the File menu, a drop down list appears with options for opening, saving a scene etc.. This list is seen in Figure 2-2 and at the next table is analyzed.

2.3.1 New

This option makes it possible for the user to create a new scene and by this way close the one that is currently open. Once user presses the “New” button, a pop up window appears (see it in Figure 2-3) to explain that a complete clean-up will be performed and let user to decide if will continue or not. By pressing OK, the previous scene with all its materials, models, textures, lights, cameras and packages will be cleaned up and a new scene will be loaded, which will be empty. By pressing Cancel, the pop-up window closes and no changes are being made.

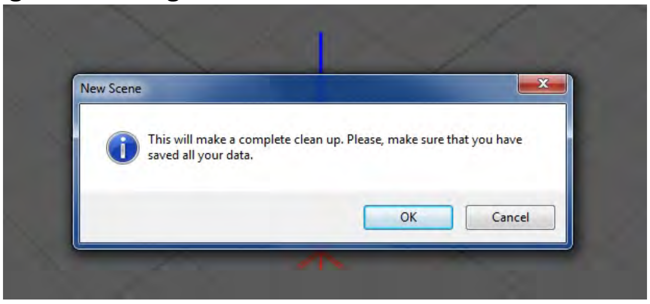


Figure 2-3: New Scene Pop-up Window

2.3.2 Open

This menu helps you open in Thea Studio a file, among all the available supported file formats. A pop up window appears that lets you browse your disk and locate the desired file. As we also see in Figure 2-4, there are many file formats associated with Thea. At the next table there is a description for each of these formats.

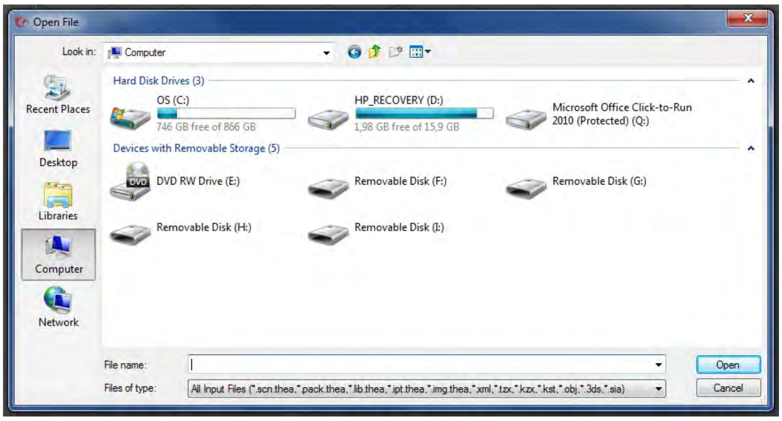


Figure 2-4: Open File Pop-up Window

Format	Description
*.scn.thea	*.scn.thea file, is the file that contains all the information related to your scene, so that you can reopen it later. It is actually the binary format of the *.xml file, which may not be readable, but is compatible to all operating systems and is much faster in saving and loading terms. Note though, that bitmaps and all the other external files used in a scene (IES, IOR, CRF, MED files) are saved as links in that format.
*.pack.thea	In cases you need to send a scene to another user or open it to another machine, links showing the bitmaps and the external files used in the scene, will not work properly. *.pack.thea file, creates a zip file (in binary format, compatible to all OS) that consists of the scene and its related files: the bitmaps, the IES, IOR, CRF, MED files.
*.lib.thea	With this button, you can open and see the “Install Library” window, which helps you install a Thea Library to your computer. This kind of file consists of a set of models or materials, zipped together under the same folder and once opened and installed (to the default or another directory), the included files will be added at the corresponding folder that you can open at the Studio Browser. If the library for example has materials in the folder with name “Wood”, a new sub-folder will now be visible in the Materials folder with the name “Wood”, with all the included materials.
*.ipt.thea	This kind of files are text files (saved in *.ipt format) that are used for scripting reasons.
*.img.thea	This file is actually a rendered image, previously saved in this format from Thea Darkroom. By opening the *.img.thea and the corresponding *.scn.thea file, you can continue the rendering from where you have stopped it or make any changes at its display via Darkroom options.
*.xml	This file, contains all the information of the scene (like the *.scn.thea files but this time is a readable file) and is possible to be opened by a text editor, a browser or any other application that supports *.xml files.
*.tzx	As *.xml files are quite large files, by saving them in *.tzx format, a zipped xml file is actually created.
*.kzx	This file format, is similar to *.tzx files, but this time corresponds to zipped *.xml file associated to Kerkythea program (render engine program, ancestor of Thea Render).
*.kst	These files, are similar to *.ipt files, but this time correspond to scripting texts associated to Kerkythea program.
*.obj	This kind of files, pretty common in 3D world, are three-dimensional objects containing 3D coordinates, texture maps, and other object information and can be opened by many applications.
*.3ds	This kind of format is a 3D image file format used by Autodesk 3D Studio (3dsMax) and contains mesh data, material attributes, bitmap references, smoothing group data, Viewport configurations, camera locations, and lighting information and is used in several 3d applications.

*.sia	By choosing to open a *.sia file, you open a scene previously saved in that format at Silo application.

2.3.3 Merge

Apart from opening a new scene (or other input file) as we just described, we can also merge a new scene to the current one. This feature is useful for merging two separately created scenes, into one. A pop up window (see Figure 2-5), similar to the one for opening a file appears, that helps you to merge a new *.scn.thea, *.pack.thea, *.img.thea, *.xml, *.tzx, *.kzx, *.obj, *.3ds and *.sia file, to the existing scene.

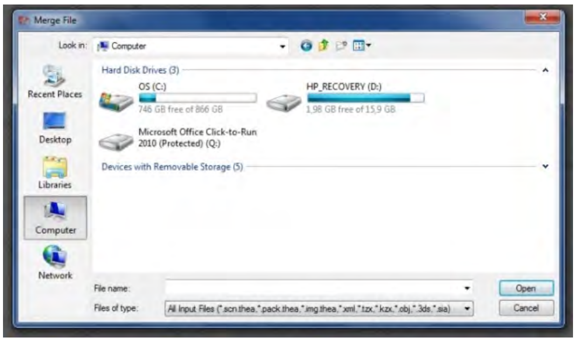


Figure 2-5: Merge File Pop-up window

After selecting the desired file, a new window appears, in order to specify more details of the merging of two files into one scene. As we see also in Figure 2-6, these options refer to Models, Lights, Cameras, Environment, Render Settings, Materials and Surfaces of the imported file. There are several options next to each category that help user to define the way each category will be merged into the scene.

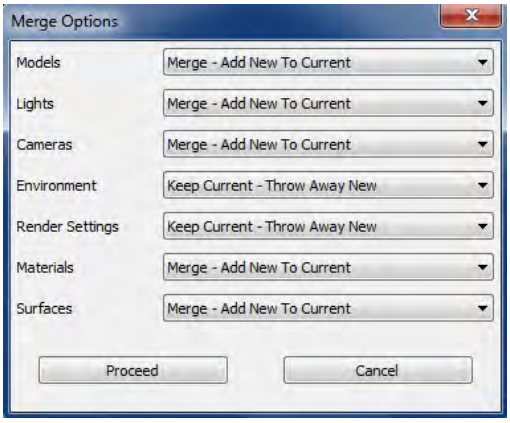


Figure 2-6: Merge Options

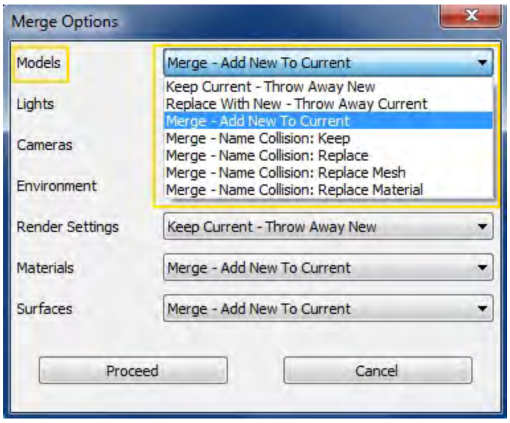


Figure 2-7: Available Merge Options per Category

In Figure 2-7 we see the options for the Models category. With order of appearance in the list, user can perform the next actions:

1. Keep current models in the final scene (and throw away those of the new scene)
2. Replace with new models, meaning throw away the current ones and let the new models.
3. Merge: Add new to current, so that the models of the two files are kept and we have them all available.
4. The next set of options define the actions in case of name collision while merging and are very useful for merging quite same scenes, which have only some modifications. For

example you may have opened a scene in Thea Studio, apply materials, make the camera settings, have added lights etc., but then you had made some changes at the scene at you modeling application. For not editing the scene again from scratch, you can merge the old one (with all its settings) with the new one, where some objects may be somehow different. In that case, there will be a name collision, as models, lights, cameras and materials will be the same to these two scenes. So, for these more specific occasions, you can choose the action you want: keep the existing model, replace it, replace its mesh (geometry is now new, but material applied to previous model remains) or replace its material (geometry stays same as before, but the model material is the new one).

The same list of choices appears for Lights (for name collision, user can replace the position or the emitter of the previous, same light) and for Cameras (for name collision user can replace the camera position or the lens properties). Concerning environment and render settings, user can either keep the current ones or replace them with the new ones. Finally, for the materials and surfaces (surface proxies), user can add the new materials/surfaces to the current ones and for name collision, keep or replace them.

2.3.4 Revert

For cases of merging some files in your scene, or doing some editing that you finally didn't wanted, you can revert the procedure and go back to the last saved scene. After pressing “Revert” button, a pop-up window appears (see it in Figure 2-8) that informs you that by pressing “OK” button, you will go to the last saved scene and any changes made in between will be lost. By choosing “Cancel” button, your scene stays as it was.

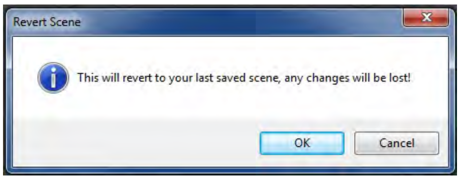


Figure 2-8: Revert Option Pop-up Window

2.3.5 Save

This menu option saves any changes made in your scene either by creating a new file (in a format among *.scn.thea, *.xml, *.tzx, *.pack.thea, *.lib.thea and *.img.thea) at the location that you will specify at the Save File window (see it in Figure 2-9) or by overwriting the previously saved file. A pop-up window appears again to inform you for the file (and its location) that you will overwrite and lets you decide to continue or not (see Figure 2-10).

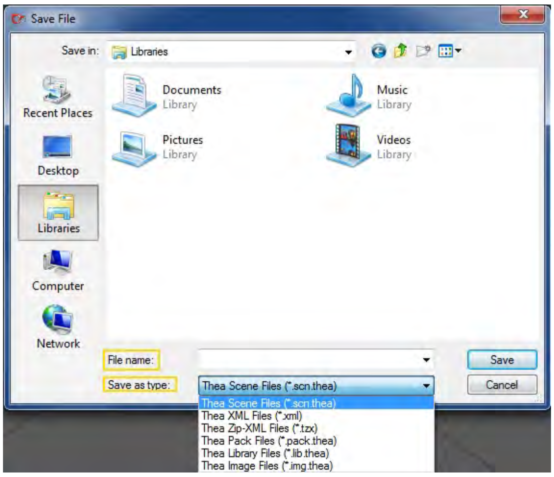


Figure 2-9: Save File window

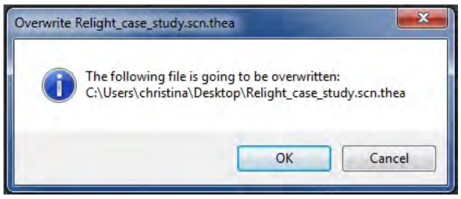


Figure 2-10: Overwrite a File

2.3.6 Save As

Instead of saving the scene upon the existing one and overwrite it you can use the Save As option. A window opens that helps you browse your disk and choose the desired location of the saved file and also its type (as in Figure 2-11).

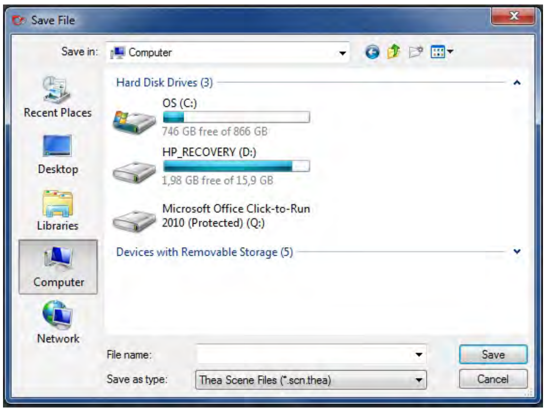


Figure 2-11: Save As Pop-up Window

2.3.7 Scenes

This sub-menu (see Figure 2-12) helps user to open a scene, but instead of choosing it from the Disk (as the Open button does), the selection is taking place among user Favorite scenes, the Example and Simulation scenes (they are pre-installed in Thea Studio) or from the recently opened scenes. Below, we see a table with the available options in more detail.

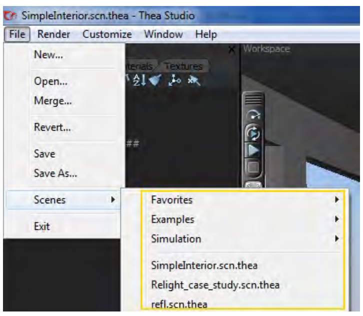


Figure 2-12: Open a Scene from Favorites, Examples, Simulation and Recent scenes

<table>
<tr><th>Scenes</th><th>Details</th></tr>
<tr><td>Favorites: if we choose the Favorites option, a list like the one in Figure 2-13 appears, from where we can:

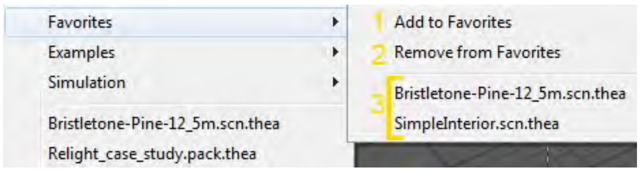
1. Add the current scene at the list of our favorites
2. Remove the current scene from the list of favorites
3. Open one scene from the list of our favorites</td><td>

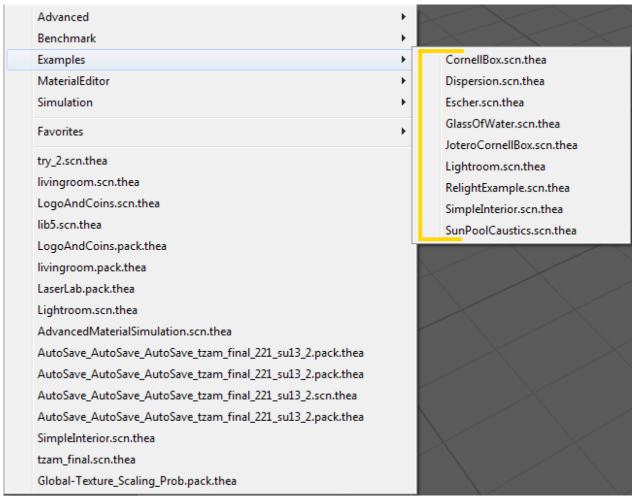
Figure 2-13: Open Scene from Favorites</td></tr>
<tr><td>Examples: by choosing the Examples option, a list with all the existing example scenes that are coming with the Studio appears (see it in Figure 2-14). Each scene has several characteristics and properties to help you study specific settings (relight or caustics for example).</td><td>

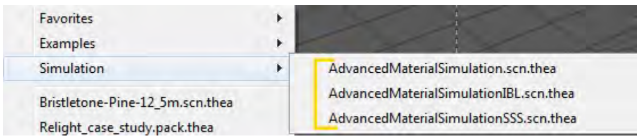
Figure 2-14: Open Example Scenes</td></tr>
<tr><td>Simulation: these scenes are used for a better understanding of the Material System, the Image Based Lighting and the Subsurface Scattering.</td><td>

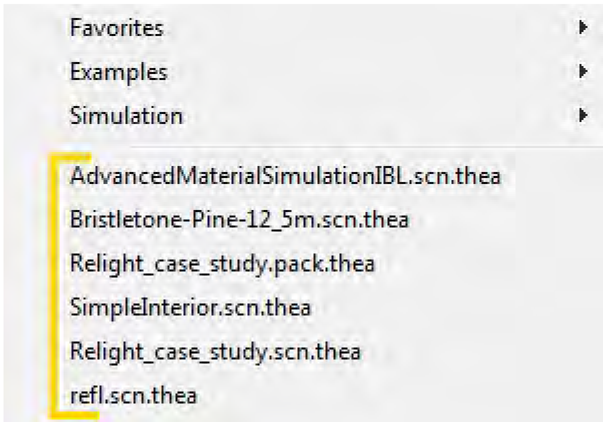
Figure 2-15: Open Simulation Scene</td></tr>
<tr><td>Recent: below the three previous options, we see a list with all (16 max) previously opened scenes (see an example list in Figure 2-16). This helps user to locate easier the desired scene, if it was opened a recent time.</td><td>

Figure 2-16: Open Recent Scene</td></tr>
</table>

2.3.8 Exit

This option is used for quitting the application. Once you press it, a pop-up window (see it in Figure 2-17) will ask you to confirm (and quit Thea Render) or cancel the procedure and let it running.

Figure 2-17: Quit Thea Render Pop-Up Window

Note: the same happens, once we press the x button that exists at the top right of the application window.

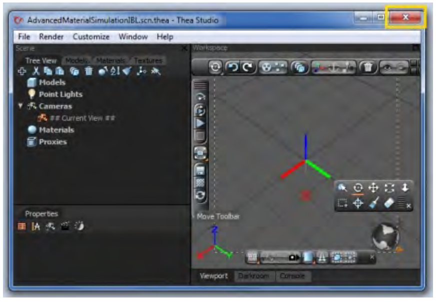


Figure 2-18: Close Button

2.4 Edit Menu

The second option we see at the top menu of the Studio is the Edit menu, which includes all the main options related to scene editing. As we see in Figure 2-19, once the Edit menu is pressed, a drop down list appears that helps user to Undo the last action, Redo it, to Cut, Copy and Paste an object (a model for example), Duplicate or Delete it.

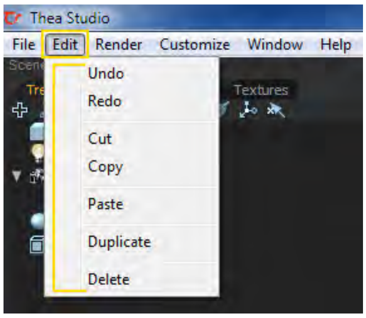


Figure 2-19: Edit Options

2.5 Render Menu

The third option we see at the top menu of the Studio is the Render menu, which includes all the main options related to rendering procedure. As we see in Figure 2-20, once the Render menu is pressed, a drop down list appears that helps user choose the desired preset for rendering, the displays and perform actions like start, resume, pause or stop rendering. We see these options in detail, at the following paragraphs.

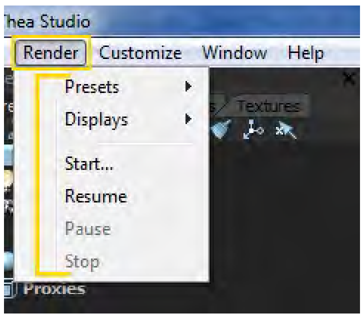


Figure 2-20: Render Options

2.5.1 Presets

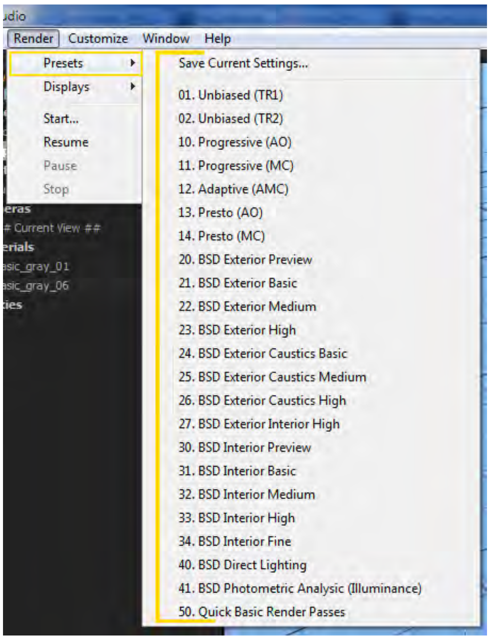


Figure 2-21: Presets List

As we see in Figure 2-21 at the Presets sub-menu, we have at the top the option “Save Current Settings”. As we may have adjusted the render settings and we need to re-use them later on, this option makes it possible to save these settings as a new preset. A pop-up window appears (Figure 2-22), to let us define the name of the new preset. From now on, this new preset will appear at the bottom of the Presets list.

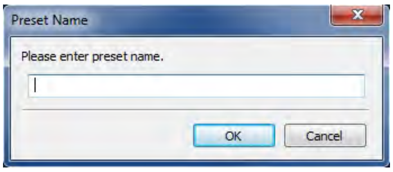


Figure 2-22: Preset Name Pop-up Window

In the list of presets, the first places belong to presets coming already with the Studio. Their names describe the way rendering will be performed (biased or unbiased), the engine that will be used (Presto for example) and the needed quality (Low, Medium, High). Once a preset is selected, the Render Settings are updated to the new preset settings and user can see which values are now used. At the bottom of the list, as we already mentioned, exist the presets already saved by the user at previous times.

2.5.2 Displays

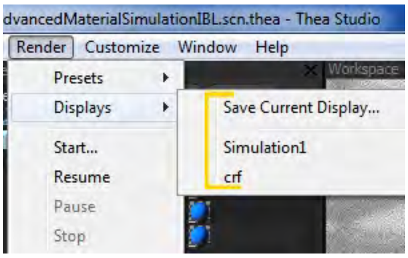


Figure 2-23: Displays Options

Apart from saving the render settings as a preset, user may need to save also the Display adjustments of the Viewport and the Darkroom, for later use. In the list that appears (see it in Figure 2-23), user can either save the current settings of Display or load the pre-saved ones. Note that a pop up window appears where user can specify the name of the Display settings to be saved (see it in Figure 2-24). Once the user selects a specific layout, the Display

settings are updated accordingly (

Figure 2-25).

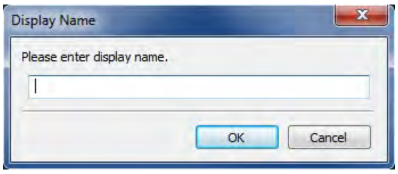


Figure 2-24: Layout Name Pop-up Window

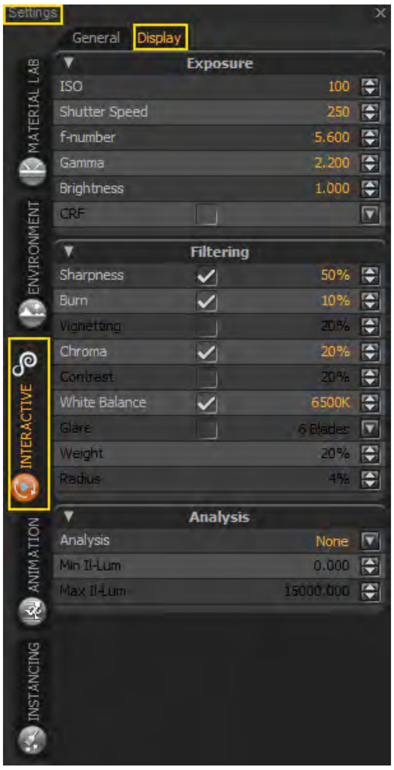


Figure 2-25: Display options of the Viewport

2.5.3 Start

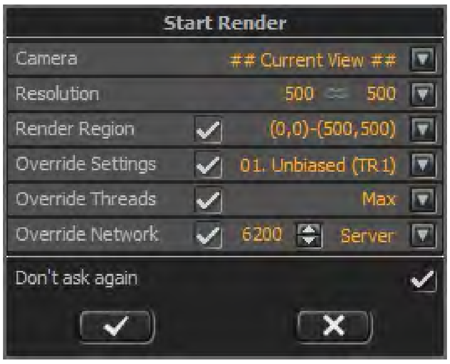


Figure 2-26: Start Render Pop-up Window

By pressing this sub-menu, you can start rendering your scene. It is an equivalent action to the Start button in the Darkroom, at Render Status Bar. Before starting though, you may need to specify some details. This is why a pop-up window (see it in Figure 2-26) appears, where you can select certain preferences.

Here are the preferences options that this window helps you to define the following:

<u>Camera</u>: a list with all the cameras used in the scene and the current view camera appears here, in order to define the one will be used in rendering.
<u>Resolution</u>: a list with all available resolutions to select appears, but user can also click on the resolution value area and enter the exact, desired resolution (text area is editable). As we will see later, we can also change the default resolutions that appear in the list from the Customize>Resolutions option.
<u>Render Region</u>: by selecting this option (you need to tick the box at the left to enable it first), you can define which area of your scene will be rendered.
<u>Override Settings</u>: by enabling this option, you can select from the drop down list, one of the available presets and use these settings instead of the current render settings.
<u>Override Threads</u>: from here, once the option is enabled, you can specify the threads you want to be used for the rendering (and ignore those specified at the Render Settings panel).
<u>Override Network</u>: once this option is enabled, you can ignore the settings made for network render and choose the desired port and the machine mode (server or not).
<u>Don't ask again</u>: by choosing this option, this pop-up window will not appear again when you press the Start Render button from the Darkroom, but will still appear with starting render from this menu.

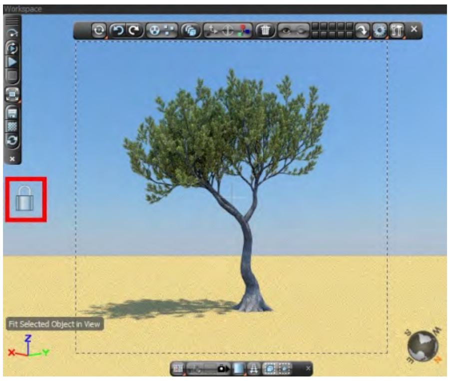


Figure 2-27: Viewport is Locked While Rendering

Note: while being in the Viewport, after choosing to start rendering (click Tick icon), rendering will start in the Darkroom, while you will still be in the Viewport, which is currently locked (see padlock icon in Figure 2-27), until render is finished or you stop it.

2.5.4 Resume

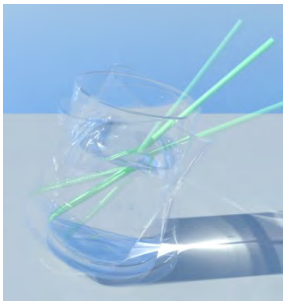


Figure 2-28: Render resumed after changes have applied

This button is very useful for the cases you have stopped a render and you want to continue it from where it was stopped and not start it all over again. As many times you may need to turn-off your computer and stop the render, you can save apart from your scene, the rendered image in *.img.thea format and then reload both of them in the Studio. By pressing Resume button, render will start from where it was stopped and not from the beginning, as it would happen with the Start button.
In cases you have made changes although to your scene, you need to start and not resume render in order to have these changes applied correctly, otherwise, new rendered image will be on top of the previous one. Sometimes though this may create more artistic results (Figure 2-28).

2.5.5 Pause

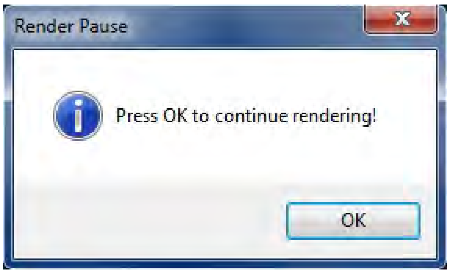


Figure 2-29: Render Pause Pop-up Window

This option (equivalent with the Pause button of the Darkroom Render Status Bar), helps you to pause the render (and release the threads for other processes). A pop-up window appears to inform you that the rendering is paused (see it in Figure 2-29). By clicking "OK" button, you can continue rendering from where you have stopped.

2.5.6 Stop

You can press this sub-menu option to stop the rendering procedure (it is equivalent with Stop Button in the Darkroom Render Status Bar). Once rendering is stopped, you can edit again your scene in the Viewport (it is no longer locked) or press resume later to continue.

2.6 Customize Menu

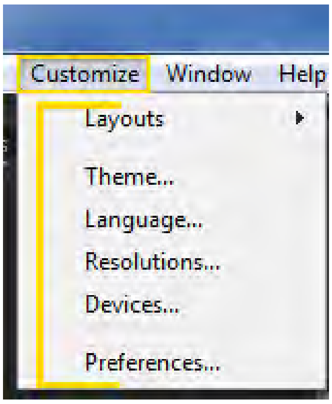


Figure 2-30: Customize Options

Customize options that appear in Figure 2-30, include all the preferences concerning the User Interface environment. From here you can select the Layout of the Studio, the Theme, the Language, the list of Resolutions, the Devices Presto engines will use and adjust any other Preferences. We analyze in detail each parameter at the next tables.

2.6.1 Layouts

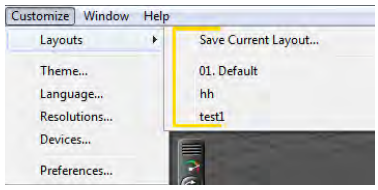


Figure 2-31: Layout Options

As we also see in Figure 2-31, once the user hovers the mouse on top of Layouts options, a drop down list appears, that makes it possible to save the current layout of the Thea Studio or load an existing one. Layout consists of the panels that are open and their position in the application window.
In the next pictures we see two different layouts, the Default one (Figure 2-32) and another one, created and saved as test1 (Figure 2-33).


Figure 2-32: Default Layout

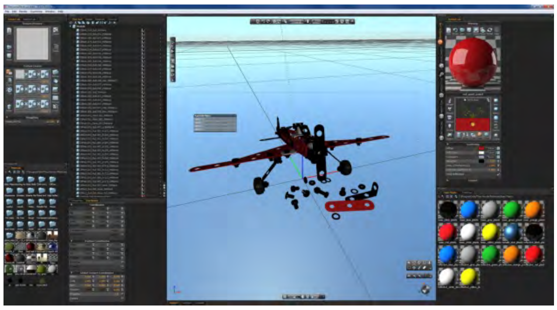


Figure 2-33: Custom Layout – Second Browser and More Settings Panels are also open

2.6.2 Theme

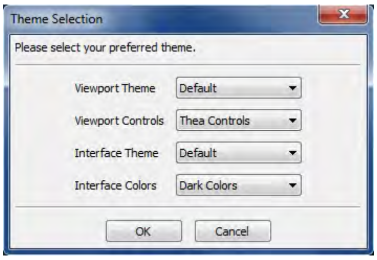


Figure 2-35: Theme Selection

The default theme for Thea Studio is as seen in all the previous figures. Though user can make some other selections with this option, which opens a pop-up window, as seen in Figure 2-35. This window helps user define the Viewport Theme (currently exists only the default one), the Viewport Controls, the Interface Theme and the Interface colors. In the next figure (Figure 2-34) we have used Light Interface Colors.

Note: to see the changes applied, you need to close and restart the program.

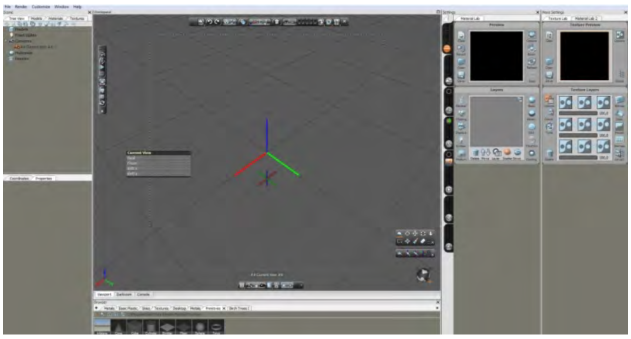


Figure 2-34: Light Interface Colors

2.6.3 Language

The default language for Thea Render is English. Thea Render is currently not supporting official translations of the program in other languages but some translations from users exist in thea.mo file formats in the [Forum](). User can add these files to Thea Data folder, at the Languages folder, inside the sub-folder of the corresponding language. Then from the pop-up window that appears with Language option (see Figure 2-36) the corresponding language can be selected.
Here are some steps you need to follow in order to create and/or use a translation.

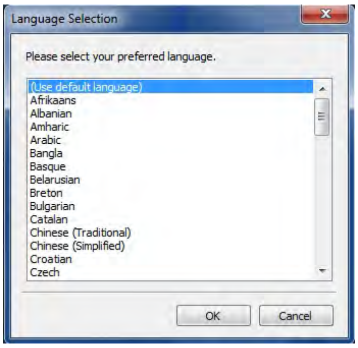


Figure 2-36: Language Selection

First of all, Thea Render makes use of .mo (binary) files that are essentially packed strings. These files can be generated by an ascii analog, a *.po text file. This strategy of *.po/*.mo translation files is quite usual in Linux. There is one particular open source application that can be used to edit easily the *.po files. That's poEdit and can be found [here]() (it's available for all platforms). You can locate the *.thea.po string file in the Language folder of Thea data folder. You can edit this file with poEdit in order to provide translations for the English strings contained there. Working with poEdit will generate another file (binary) called "thea.mo". You will need to place that file in a particular folder under Language (in application data). So, go to Language and create a folder that is the country code of your translation. Place the *.thea.mo file in that folder. Then select the desired language, restart the program and you have a translated version of Thea.
Typical Country Codes: de (German), es (Spanish), fr (French), it (Italian), ja (Japanese), pt (Portuguese), pt_BR (Brazilian Portuguese), ru (Russian), zh_CN (Chinese Simplified), zh_TW (Chinese Traditional).

2.6.4 Resolutions

As we have previously mentioned, when user defines the desired resolution (either from the start render pop-up window or at the camera and current view properties), a list with certain resolutions appear. These default resolutions can be changed from this option. A pop-up window, as seen in Figure 2-37 appears and in this text area, you can edit the pre-defined resolutions. You can either erase or add new ones in that format: $X_{resolution}xY_{resolution}$.

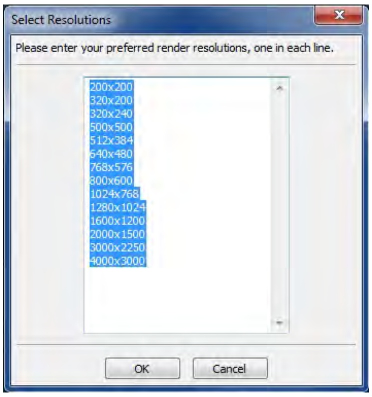


Figure 2-37: Select Resolutions

2.6.5 Devices

By pressing the Select Devices sub-menu a pop-up window appears (as seen in Figure 2-38). Here you can see a list with the GPU and CPU devices of your machine, which can be used by Presto engine. At this window, you can enable/disable a device, by clicking to the corresponding box and increase/decrease its priority. At this window apart from the names of the existing devices, you can also see their cores, their memory and other information.

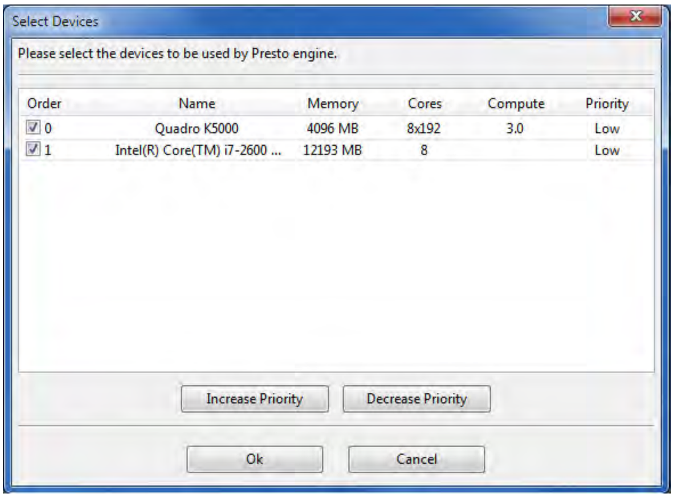


Figure 2-38: Select Devices Window

2.6.6 Preferences

By pressing preferences sub-menu option, a pop-up window appears (Figure 2-39), which contains several settings of the program organized in different tabs. In the tables that follow, we will describe analytically what each option does.

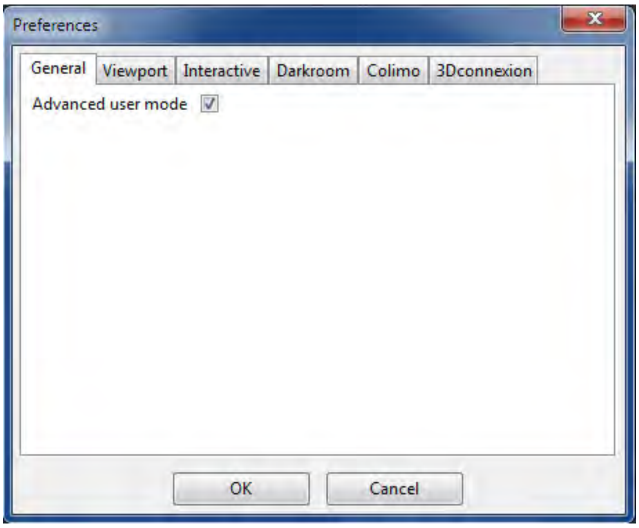


Figure 2-39: Preferences Window

Preferences	Details
General	At this initial tab user can define if Studio will run in Advanced User Mode or not. By enabling this option, some extra options appear at the Settings panel, at Render Engines tabs. These options are suitable for more advanced users (and their values are better not to be changed), so they are hidden by default from the Studio content. At the render engines chapters, we show these options in detail.

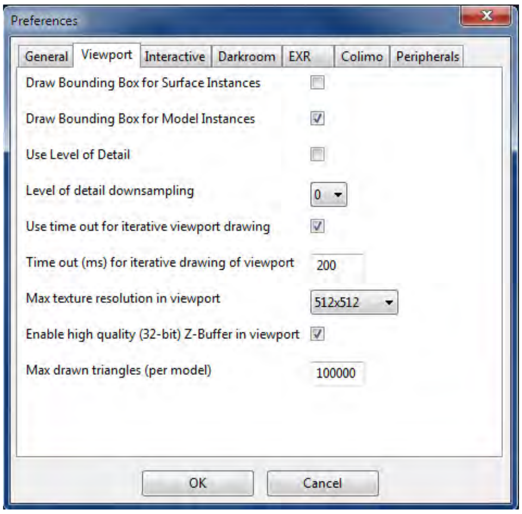
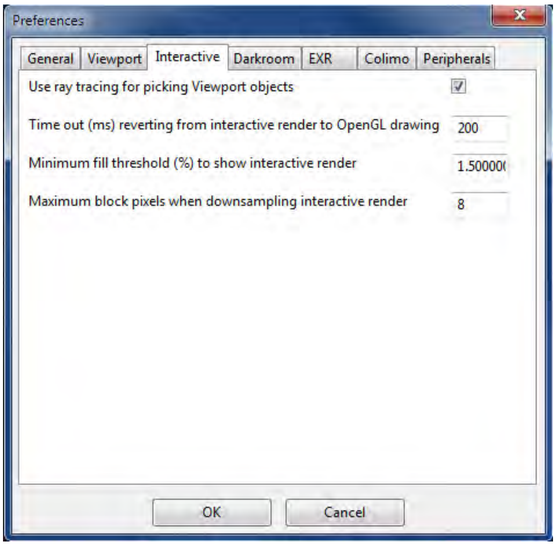
<table>
<tr><td colspan="1">Viewport</td><td colspan="2">

Figure 2-40: Viewport Preferences</td></tr>
<tr><td>Draw Bounding Box for Surface Instances</td><td colspan="2">By enabling this option, surface instances will be represented in the Viewport by a bounding box and will only be visible while rendering. This makes Viewport staging much faster, especially when we have heavy geometry. In Figure 2-41, the trees – surface proxies - are represented as bounding boxes.</td></tr>
<tr><td>Draw Bounding Box for Model Instances</td><td colspan="2">Model Instances (geometry and material), which are produced by instancing tool, are represented by bounding boxes (if this options is enabled). This makes moving around Viewport much faster, for cases we have a large amount of instances. In
Figure 2-41the next figures, grass is created with the use of Instancing tool, and is represented by bounding boxes.</td></tr>
<tr><td></td><td>
Figure 2-41: Surface (Trees) and Model Instances (Grass) are drawn with Bounding Boxes</td><td>
Figure 2-42: Corresponding Rendered Scene</td></tr>
<tr><td>Use Level of Detail</td><td colspan="2">The level of detail corresponds to showing your models in a much coarser form so as to draw them inside the Viewport much faster. An acceleration structure per model has to be built in that case; note that the creation of this structure may not be instant and it takes also some memory resources. This acceleration structure is then used for displaying models (instead of its real mesh geometry) that are distant from the viewer.</td></tr>
<tr><td>Level of detail downsampling</td><td colspan="2">This number corresponds to the resolution of the level of detail structure. Choosing a bigger number will create a coarser acceleration structure but it will be even faster to draw and require less memory. Choosing a lower number will create a higher resolution structure that will resemble the model better.</td></tr>
<tr><td>Use time for iterative</td><td colspan="2">If this option is enabled, a timer will be used when drawing in the OpenGL</td></tr>
</table>

viewport drawing	viewport to avoid freeze of the application, for very heavy scenery. The drawing in this case, will be accomplished iteratively by relaunching it periodically.
Time out (ms) for iterative drawing of Open GL viewport	This is the period used for the time out mechanism, as described above.
Max Texture Resolution	This option gives the possibility to define the maximum resolution in which the used textures in OpenGL Viewport will be displayed. For setting maximum resolution to 512x512 for example, if you add a texture with higher resolution, its resolution (as seen by graphics card) will be scaled down to 512x512 and by this way working in Viewport is faster and uses less memory.
Enable high quality (32-bit) Z-Buffer in viewport	With this option you can enable the higher quality for Z-Buffer in OpenGL Viewport to reduce any z-fighting issues. This option is by default, 32-bit on Windows (higher quality) and 16-bit on Linux/MacOSX (higher performance).
Max Drawn Triangles (per model)	This option is pretty useful for million-triangle models for avoinding any slowdown on Studio viewport, by limiting the drawn triangles (default value: 100K per model).
Interactive	 Figure 2-43: Interactive Render Preferences
Use Ray Tracing for picking Viewport objects	This parameter is related to interactive render (IR) and especially for the case when auto refresh is on. By enabling Ray Tracing use, for picking Viewport objects, while staging the scene (with IR auto), there is no use of the Viewport commands (as it happens when we are at OpenGl mode). For heavy scenes, with much geometry, this makes things run faster.
Time out (ms) for reverting from Interactive render to OpenGL drawing	This parameter too, is related to automatic interactive render and helps you set the maximum time that interactive render will wait to have a rendered result to show you, after making a movement of a model for example, before going back to OpenGL drawing. By increasing this time, IR will wait more before switching to Viewport.

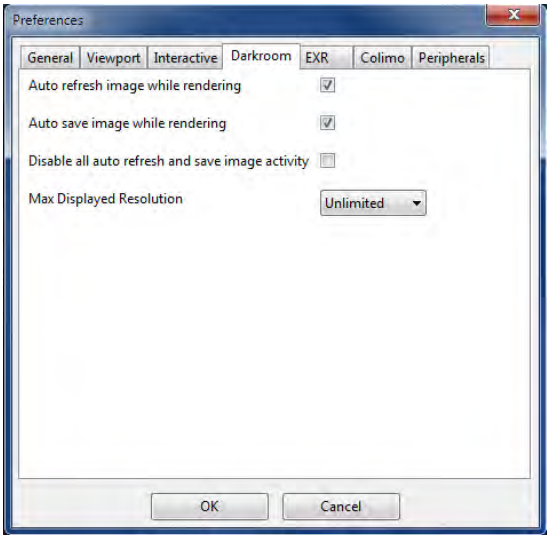
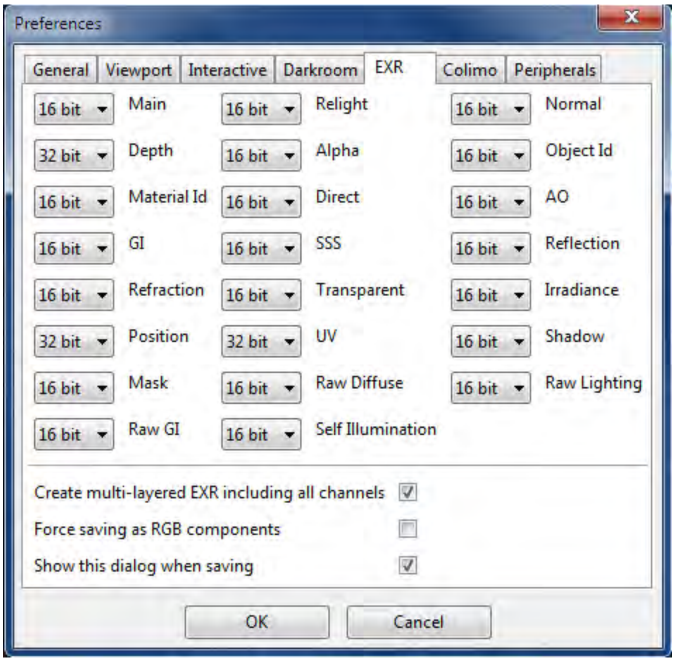
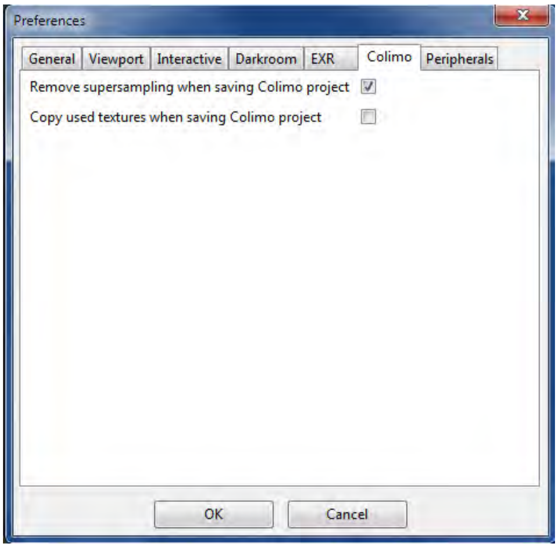
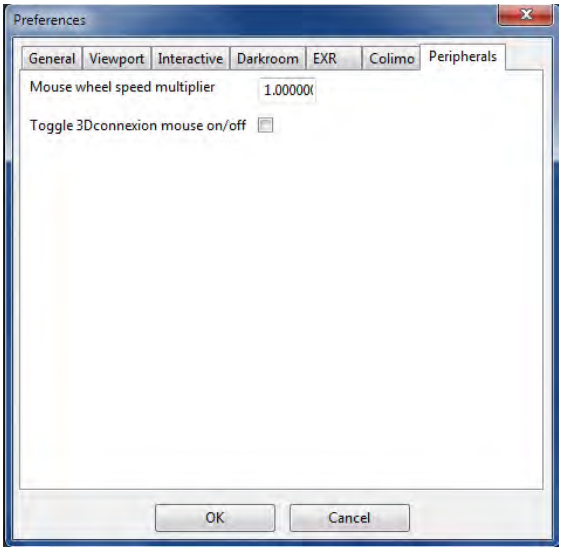
<table>
<tr><td>Minimum fill threshold (%) to show interactive render</td><td colspan="2">Once again, as interactive render is set to auto and we are making changes to the scene, this percentage defines when we will start see the rendered image. By setting it to 1,5%, it means that once the rendered image is ready by this percentage, it will be shown to the user. By increasing it, IR starts showing an image when it is clearer and ready, but this may cause to luck of interactiveness.</td></tr>
<tr><td>Maximum block pixels when downsampling interactive render</td><td colspan="2">Once Interactive Render starts, the initial image consists of small square blocks. By increasing their pixels, these blocks are now bigger and working with IR while editing your scene is faster, but may offer a lower viewing quality.</td></tr>
<tr><td>
Figure 2-44: Maximum Block Pixels set to 8 - Initial IR view</td><td>
Figure 2-45: Maximum Block Pixels set to 40 - Initial IR view</td><td>
Figure 2-46: Same image after some seconds</td></tr>
<tr><td>Darkroom</td><td colspan="2">

Figure 2-47: Darkroom Preferences</td></tr>
<tr><td>Auto refresh Image while rendering</td><td colspan="2">By enabling/disabling this option, the rendered image will be/be not refreshed during rendering in the Darkroom. If it is enabled, you will be able to see how it looks like all the time, while rendering. If you disable it, you will need to press refresh image button to see the progress of rendering.</td></tr>
<tr><td>Auto save image while rendering</td><td colspan="2">Some renders may take much time and certain unexpected events may occur. With this option enabled, as your image is rendered, is automatically saved in a folder named Temp (located in Thea Data Folder). You can find there expect from the .png format, the .img.thea format, that together with your scene file, help you to continue rendering from where it was stopped or interrupted.</td></tr>
<tr><td>Disable all auto refresh and save image activity</td><td colspan="2">The application will be periodically refreshing and saving the render in progress. These procedures can take some (small) resources of your system, particularly if the image being rendered is of very high resolution. By</td></tr>
</table>

	disabling them, all the system resources are focused on rendering.
Max Display Resolution	This is the maximum resolution displayed in the Darkroom. By limiting this resolution, the image refresh becomes faster.
EXR	 Figure 2-48: EXR Preferences
	Using the preference panel (Figure 2-48) we can select the bit depth for each channel. Please be aware that not all channels will need accuracy of 32 bit depth but some, like the position, depth and UV pass will benefit from it.
Create multi-layered EXR including all channels	At this point you are able to adjust the settings for saving all the rendered channels in one multi-layered EXR. By eneabling this option all rendered channels will be saved in one only multi-layered EXR otherwise each one will be saved separately to the selected image format (png, jpg, EXR etc..).
Force saving as RGB	Depending on the image editing software to be used, you can enable this option. This will be necessary for programs like Photoshop or Photoline. If you are planning to use the multi-layered EXR with composition software like After Effects, Nuke or Fusion then you can leave this option disabled (which will also produce smaller EXR file size).
Show this dialog when saving	When saving a render and selecting EXR as file format, the EXR dialog window will pop up, allowing changes to be made in the settings before saving the image. We can disable this behavior by unchecking this option here.

Colimo	 Figure 2-49: Colimo Preferences
Remove supersampling when saving Colimo project	This option has to do with Motiva Colimo Application. When saving a Colimo project, you can save the rendered image with the same resolution but by ignoring the supersampling (if you had used any).
Copy used textures when saving Colimo project	For Colimo application again, when saving a project in Thea Studio as a Colimo file, this option helps you to create a folder with the used textures of your scene, so that once the project is opened to another computer, all needed textures to be available.
Peripherals	 Figure 2-50: 3Dconnexion Preferences
Mouse wheel speed multiplier	Allows to increase the speed of your mouse wheel, allowing faster zoom ins and outs during navigation.
Toggle 3Dconnexion mouse on/off	With this option 3Dconnexion mouse can be used (or turned off) for Viewport navigation.

2.7 Window Menu

As we see in Figure 2-51, when we press the Window menu, a list with the existing panels in the application appears. By enabling/disabling each one, we make it visible/hidden from our layout.

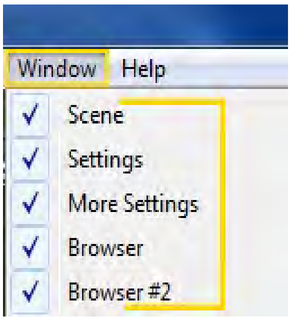


Figure 2-51: Window Options

2.7.1 Scene Panel

As seen at the left side of Figure 2-52, Scene Panel contains the Tree View, Models, Materials, Textures, Coordinates and Properties tabs.
It is analytically presented in Chapter 4.

2.7.2 Settings Panel

This panel contains some very important panels, which help you create materials and choose render methods and its settings. As we also see it in Figure 2-52, we have the following tabs: the Material Lab, Environment (Sky&IBL) tab, Biased Engine and Unbiased Engine tabs, Interactive tab, Animation and Instancing tabs. We will see all these tabs in separate chapters.

2.7.3 More Settings Panel

This panel, as seen at the right side of Figure 2-52 consists of the Texture Lab panel (see Chapter 9) and Material Lab 2.

2.7.4 Browser Panel

It is by default located at the bottom of the Studio and shows the needed folders for staging your scene (folder that include materials, models, skies etc.). See more details for Browser Panel at Chapter 6.

2.7.5 Browser #2 Panel

This panel is similar to the previous panel and offers more efficiency as helps user locate easier materials, models and textures (see Chapter 6).

In the next figure, we show the default position of these panels in the Viewport (if we have enabled all of them). Remember that you can change their position by dragging them from their top side to the desired point in the Studio window (available positions to move a panel are highlighted as you hover the panels around the window).

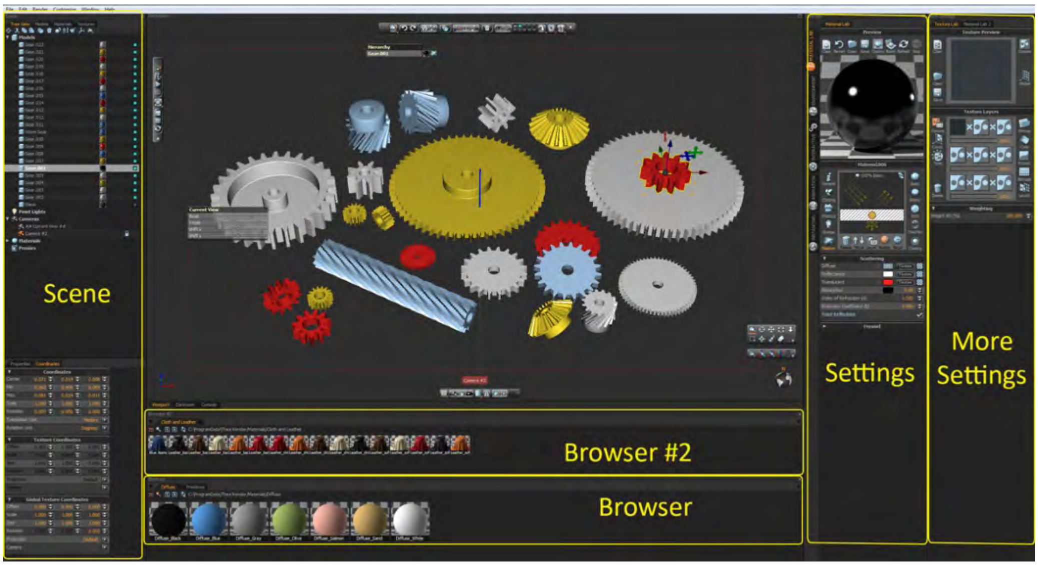


Figure 2-52: All the Available Panels in Thea Studio

2.8 Help Menu

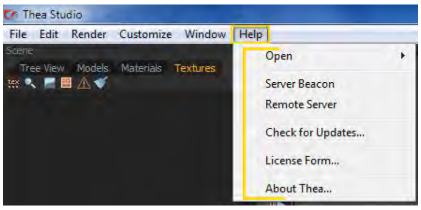


Figure 2-53: Help Options

The last menu that we see at the Top Menu of Thea Studio is the Help, which once pressed, the list shown in Figure 2-53 appears. Some main Help functions appear here, concerning Activation and Licenses of the Studio & Plugins, Network and Remote Rendering, Program Folders etc. At the following tables we see these options in detail.

2.8.1 Open

When selecting the Open sub menu, the following options appear (see also Figure 2-55).

1. Open License Agreement (rtf): with this option the “Thea Render, Plugins and Resources End User License Agreement” text file opens by your default text reader program. At this text file you can find the needed legal information and terms of use.
2. Open Data Folder: this option helps you to open the folder where all Thea data are located (as you have specified during installation).
3. Open Config Folder: this option helps you to open the folder where all Thea configuration files exists (xml files for devices and layouts editing.)

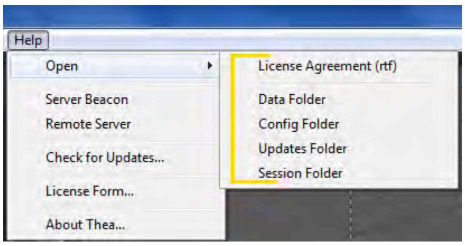


Figure 2-54: Open Options

4. Open Updates folder: this option helps you to open the folder in which the downloaded files (from automatic update menu, as will be explained later) are saved.
5. Open Session Folder: this option helps you to open the folder in which the current Thea session details are saved.

2.8.2 Open

When selecting the Open sub menu, the following options appear (see also Figure 2-55).

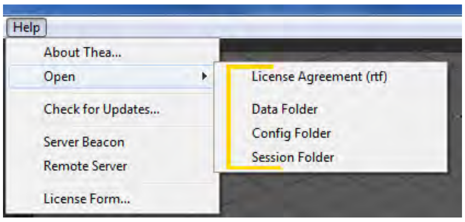


Figure 2-55: Open Options

6. Open License Agreement (rtf): with this option the “Thea Render, Plugins and Resources End User License Agreement” text file opens by your default text reader program. At this text file you can find the needed legal information and terms of use.
7. Open Data Folder: this option helps you to open the folder where all Thea data are located (as you have specified during installation).
8. Open Config Folder: with this option you are able to open the Configuration folder which contains useful xml files that affect your devices and the layout.
9. Open Session Folder: this option helps you to open the folder where all Thea Sessions are saved (folder location was specified at the pop up window the first time you run Thea).

2.8.3 Server Beacon

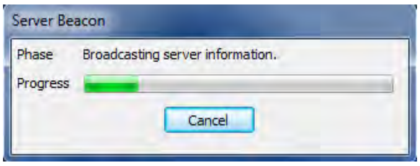


Figure 2-56: Server Beacon Pop-up Window

This option is related to Network rendering and needs to be used for making the Studio act like a server. By pressing this button, a pop-up window appears (see it in Figure 2-56) that indicates that the machine is broadcasting its identity so that the client will be able to locate it and establish the connection.

2.8.4 Remote Server

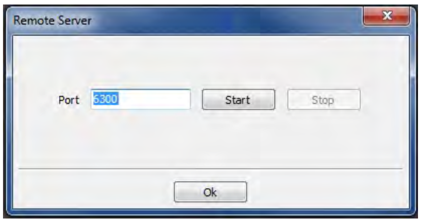


Figure 2-57: Remote Server Window

This pop-up window helps you define the port and start/stop the remote server option in order to allow remote connection.

2.8.5 Check for Updates

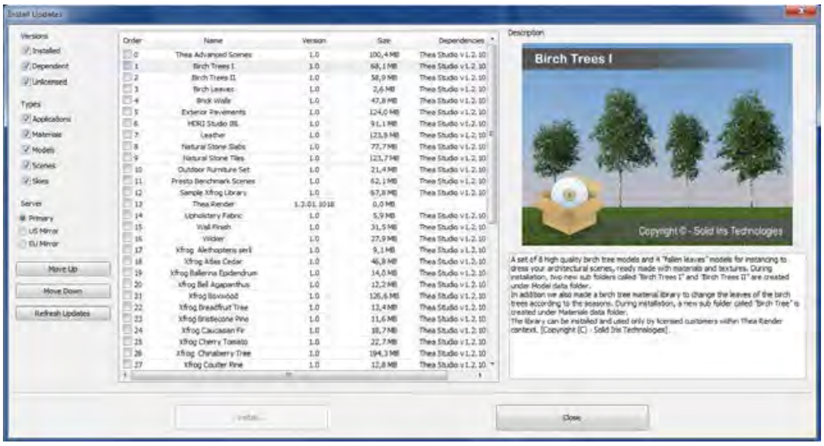


Figure 2-58: Check for Updates Windows

By the "Check for Updates" window you are able to check and install new versions and resources right from inside Thea Studio and stay always up-to-date. At the next table we see more analytically the options that exist at this window and the action they perform.

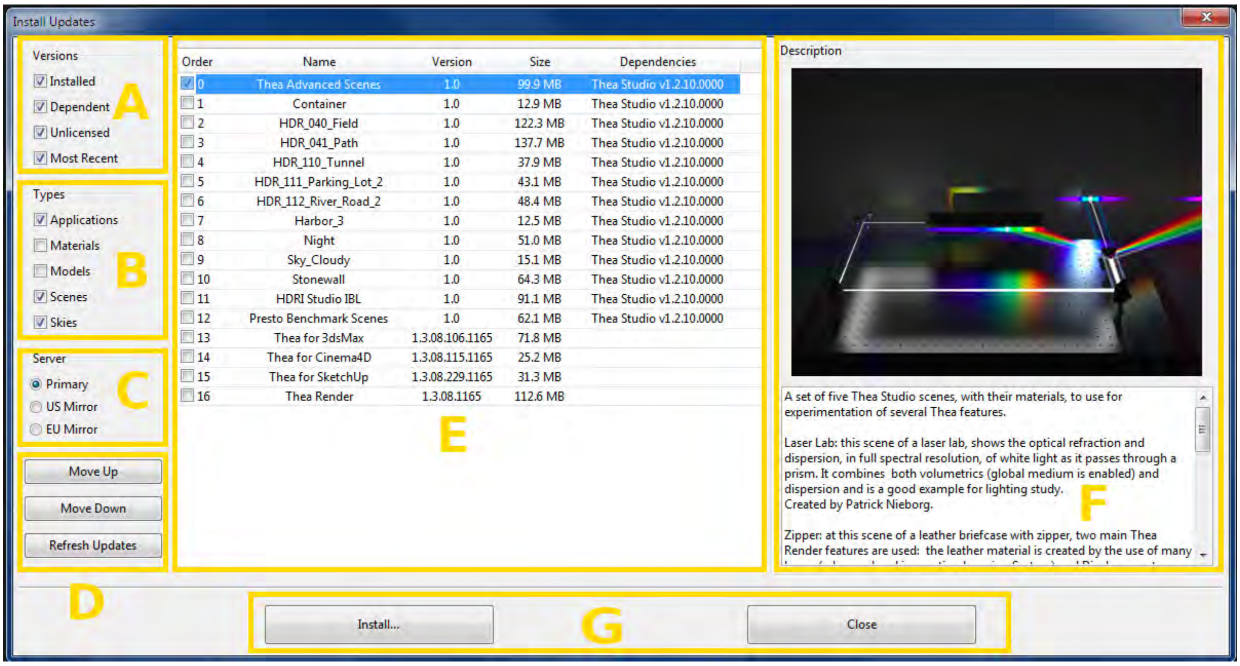
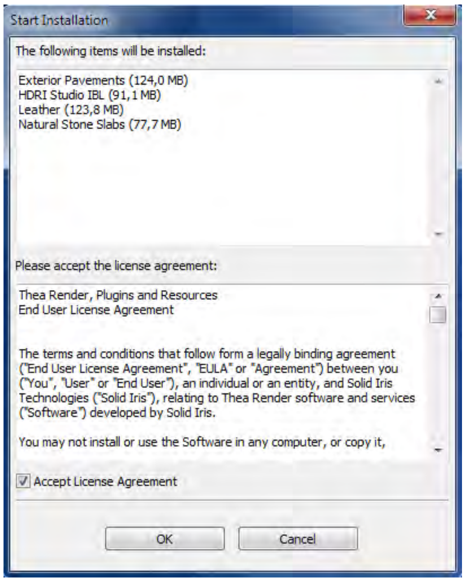


Figure 2-59: Install Updates Window

Area	Name	Description
A	Versions	At the version panel, you can select what type of versions you want to see at the Main (E) area: the Installed ones, the Dependent, the Unlicensed or the Most Recent.
B	Types	At this point you can decide if you want to see the existing applications or content libraries. You can decide for example to check the available material

		libraries and scenes.
C	Server	For faster downloads you can select among the existing servers, according to your location: Primary (USA based), USA mirror or EU mirror. The available files of each server are appearing to the main table (Area E).
D	Move/Refresh	Move Up/Down buttons help you define the ordering of the items as seen in Main area and this, defines also the order in which the downloading/installation of the selected items will be held. With the Refresh Updates button you can retrive the necessary information once again.
E	Main	At the main window, all the existing updates (according to the preferences you specified) appear. You can see some details over the version number, the size of each file and their Dependencies (if for example the file is only available for licensed users or the version number that needs at least to be functional). At the small boxes at the left side you can click to select the files you want to install (one or more)
F	Description	At this part of the Updates window a preview image of the selected library (click on it) appears along with a short description.
G	Install/Close	Once you have selected the updates you need you can press the Install button. This opens a second window (see it in Figure 2-60) where the selected updates are mentioned and after agreeing with the License Agreement terms, you can start the download.  Figure 2-60: Start Installation window

Note: Install Updates Window is a separate process and can be controlled independently of Thea Studio, which is still running and can be used in parallel.
By going to Help > Open > Updates folder you can see the downloaded files.

2.8.6 License Form

With this option the License Form window opens (as seen in Figure 2-61) that helps in program activation.
More details on the activation procedure can be found at Chapter 1 (page 12).

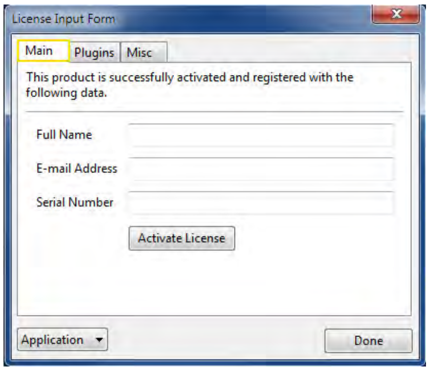


Figure 2-61: License Input Form Pop-up Window – Main

2.8.7 About Thea

This sub-menu option, opens a pop-up window (see it in Figure 2-62) that shows some main information for the program.
On top you can see details of the current edition. Below, there are the names of the team that has created Thea Studio and its Plugins. You can also find here some copyrights and links that will redirect you to Thea Render home page and forum.
By pressing “OK” you can close this window.

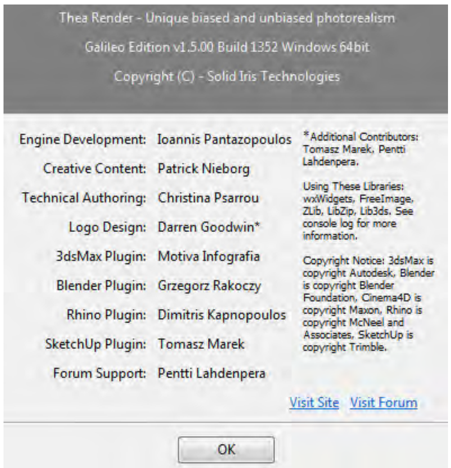


Figure 2-62: About Thea Render

Chapter 3: OpenGL Viewport

Image by Majid Yeganegi

3. OpenGL Viewport

3.1 Introduction

The Viewport (as seen in Figure 3-1) is the real-time viewer in the center of the application. This is the main area where all the action takes place when you want to perform staging tasks, like moving an object, adding a light, creating an animation, starting interactive render etc. Below, there is a detailed analysis of the existing toolbars, along with the corresponding functions.

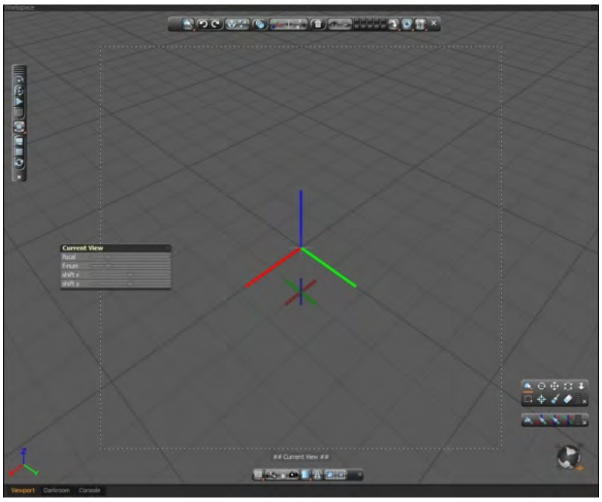


Figure 3-1: Thea Render Viewport

The main toolbars that appear in the Viewport are the Action Toolbar and the Viewer Toolbar. Both include a variety of options which will be analytically described at this chapter.
Additionally, we can see in the Viewport three smaller toolbars: the Current View Properties window, the Hierarchy window and the Select/Unselect toolbar that we will too.

3.2 Viewport Controls

Before start to analyze the Viewport Toolbars and their functionality, we can give a short list of the available Viewport control keys. Note that you can find the corresponding xml file at Thea Render Data Folder, at Themes, at Controls, in case you need to edit them.

Delete Key->"Del"	Left View Key->"3"	Selection Key->"s"
Duplicate Key->"Ins"	Bottom View Key->"4"	Focus Key->"f"
Camera Key->"c"	Back View Key->"5"	Rotation Key->"q"
Gizmo Key->"g"	Right View Key->"6"	Pan Key->"a"
Hide Key->"h"	Reset View Key->"7"	Roll Key->"r"
Mount Key->"u"	Fit View Key->"8"	Dolly Key->"d"
View Mode Key->"v"	Center View Key->"9"	Brush Key->"b"
Unselect Key->" "	4-View Switch Key->"0"	Eraser Key->"e"
Top View Key->"1"	Control Cycle Key->"m"	
Front View Key->"2"	Pivot Mode Key->"p"	

3.3 Action Toolbar

The Action toolbar is located at the top of the Viewport and includes all the tasks related to editing your scene. In Figure 3-2 we see how this toolbar looks like.

1 2 3 4 5 6 7 8 9 10 11 12

Figure 3-2: Action Toolbar

These options, from left to right, are:

1. Object Selection & Viewport Navigation
2. Undo & Redo
3. Group & Ungroup
4. Duplicate Object
5. Object Transform: Translate, Rotate, Scale
6. Delete Object
7. Show all Objects & Hide Selected Object(s)
8. Object Visibility / Render Layers
9. Insert Lights, Cameras, Infinite Plane into the Scene
10. Preference Settings / Viewport Elements Visibility
11. Tools (Transform, Animation, Interactive Render)
12. Hide Toolbar

All these options will be explained in detail at the next tables.

Note 1: the way the Viewport is shown, can be changed from the Current View Properties panel, at the left side of the Viewport, displayed when clicking the small camera button. There, you can change the desired Resolution and Film Height along with the camera Focal Length (change of the zoom).
Note 2: this toolbar, as well as all other toolbars in the Viewport, can be placed to the position that is more convenient to the user. Once you click on it you can drag it wherever you want.

3.3.1 Object Selection & Viewport Navigation

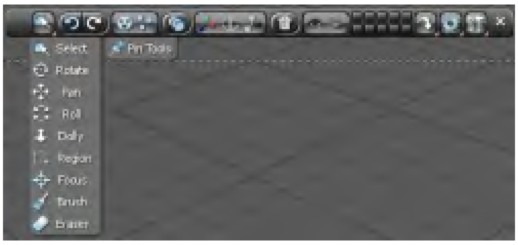
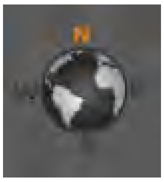
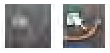
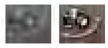
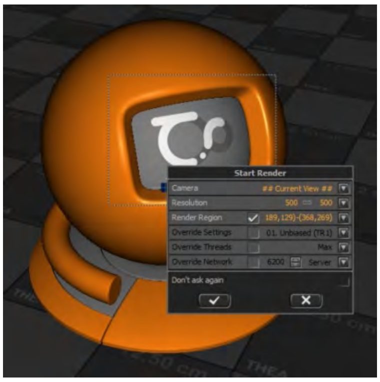


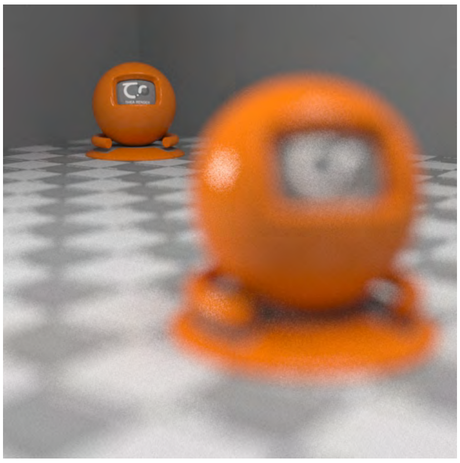
Figure 3-3: Object selection & Viewport Navigation

By clicking on the first button of the Actions Toolbar, you can see a drop down list with 10 in total functions which define the action taken when the user clicks inside the Viewport. At the following table, we can see an analytical description of these tools.

Tools	Description
 Figure 3-4: Pin Tools	Pin Tools button (Figure 3-4) allows the user to place a small panel with all these options visible in the Viewport, in order to have easier access to them. The new toolbar appears at the bottom right of the Viewport, but by clicking on the small horizontal lines at its right side, you can drag it to the position that is more efficient for you.  Figure 3-5: Pinned Tools
 Figure 3-6: Select Tool	This is the main (and default) function of your cursor. It allows you to click on an object in the Viewport and select it. The cursor is transformed to a hand shape. For making selection procedure easier, an extra toolbar for Select/Unselect objects is added at the Viewport. As we see it in Figure 3-7, the options that this toolbar can perform are:  Figure 3-7: Select/Unselect Toolbar 1. Unselect: you can unselect everything that you might have selected. It is equivalent with pressing the Space bar at your keyboard. 2. Select Global Frame: the Global Frame of your scene is selected. 3. Select Cursor Frame: the Cursor Frame is selected. 4. Align Cursor with Selection: with this option you can align the Cursor frame with the selected object.
 Figure 3-8: Rotate tool	By clicking on this button, you can rotate your scene by clicking and dragging to your desired direction. Tip: you can see your geographical orientation, with the help of a compass which is located at the bottom right of the Viewport (Figure 3-9).  Figure 3-9: Viewport Compass Note 1: rotation around a point can be done in two ways: around the **Global Frame** (center of the axes in the middle of the Viewport) and around the point you click on. In order to specify your desired way, you need to see if you are in **Dynamic Mode**. You can find this mode at the Viewport preferences (as will be analyzed later). While being in Dynamic Mode, rotation occurs according to your selected point.

	This may result in a small delay at the beginning of the rotation, for large scenes, but assures more intuitive rotation. By disabling Dynamic Mode, rotation is carried out around the Global Frame again.  Figure 3-10: Disabled and Enabled Dynamic Mode Note 2: the rotation can be made in another mode as well. By default we have the rotation around Global Frame or selected point, as described above. Another way is **Fly Mode**, which can be enabled at Viewport Preferences. Fly Mode makes possible to “look around”, which can be very useful when navigating inside interior scenes.  Figure 3-11: Fly Mode Off & On
 Figure 3-12: Pan Tool	Pan button allows you to translate inside the Viewport. This function is also achieved each time you do a right mouse and drag it around Viewport. By this way, you can go to any direction you want, without changing orientation. Note: Pan movement is also affected by Dynamic Mode. When enabled, Pan is achieved around the specific clicked point of the Viewport. By disabling Dynamic Mode, Pan uses again the Global Frame as reference point.
 Figure 3-13: Roll Tool	By clicking Roll button, you can rotate the scene right and left, around the axis of the visual field.
 Figure 3-14: Dolly Tool	Dolly selection, allows you to zoom at the specific clicked point. It works like the mouse wheel, but this time, zoom center is the point that you click on.
 Figure 3-15: Region Tool	This option allows you to define a specific area in your Viewport and render it. When clicking on Region button, cursor takes a cross shape. By clicking and dragging, you can select the desired area. Once you release the button, the Start Render Window (with main render options) appears. We see in Figure 3-16 and Figure 3-17 that the rendered image corresponds to the region we have specified.
	 Figure 3-16: Region Selection  Figure 3-17: Rendering Selected Region
	By choosing the Focus Tool, your cursor transforms to a double circle shape and

<table>
<tr><td>Figure 3-18: Focus Tool</td><td colspan="2">allows you to choose your desired point of focus. This option is directly related to the current view Focus Distance and affects the depth of field. You can change Focus Distance value at the Current View Properties panel too, but with the Focus Tool, the distance is automatically adjusted according to the selected point in the Viewport. Starting Interactive Render (as we will explain later), is a good way to see how the selection of the focus point affects the rendered image.</td></tr>
<tr><td></td><td>
Figure 3-19: Focus Point at the Front

Focus point is at the front sphere (by clicking on it). Focus Distance has become 0.731 m. (we can see that at the Current View Properties panel). We see that the sphere and the room at the back are out of focus.</td><td>
Figure 3-20: Focus Point at the Back

Focus point is at the back sphere (by clicking on it). Focus distance has become 2.151 m. (we can see that at the Current View Properties panel). We see that the focus area is located on the back sphere, while the front area (lower part of the image) is out of focus.</td></tr>
<tr><td>

Figure 3-21: Brush Tool</td><td colspan="2">The Brush Tool is useful for placing instances on your canvas. This option, like Eraser Tool, is selectable when you use the Instancing Tool, at Settings window, and you have already selected an instance and the canvas. By clicking on Brush Tool, cursor takes a brush shape and by dragging it on the canvas, instances are placed following the instance motion.</td></tr>
<tr><td>

Figure 3-22: Eraser Tool</td><td colspan="2">The Eraser Tool is useful when you have already created some instances in the scene. By selecting it, cursor takes an eraser shape and helps you to delete the instances at the clicked point on the canvas (or at the whole region is case of non-zero Tool Radius, at the Instancing Tool panel).</td></tr>
</table>

3.3.2 Undo & Redo

Figure 3-23: Undo & Redo Options

These two options make it possible to undo or redo a movement of an object, a grouping procedure or a delete of an object.

3.3.3 Group & Ungroup

Figure 3-24: Group & Ungroup Options

When all desired objects are selected (with Control+click you can select multiple objects), you can put them in a new group, by clicking on the Group button. This group is now appearing at the Tree View panel, with the default name "New Group" (you can change it by clicking on it and retyping the name you want). By pressing the Ungroup button, while the selection being a group, you can ungroup the objects and delete the previously created group.

3.3.4 Duplicate Object

Figure 3-25: Duplicate Object Option

This option allows the user to select an object and duplicate it. The new copied object appears right on the previous one and is now selected (appears with yellow color lines), so you can now manipulate it. It is also added to the scene's Tree View.

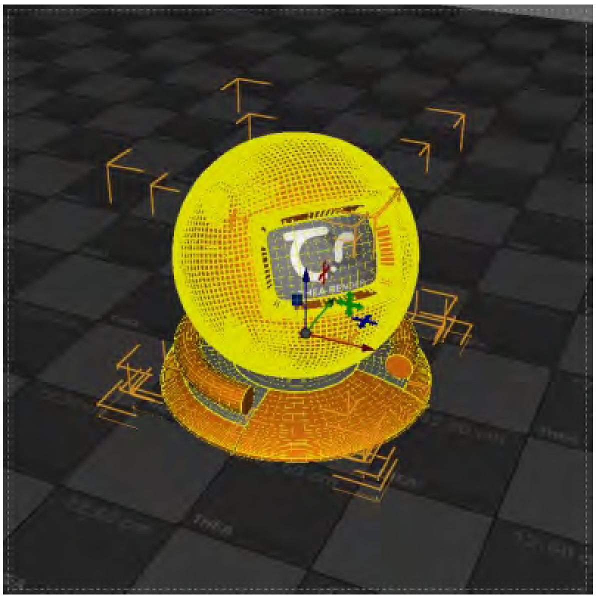


Figure 3-26: Selection of the Original Object

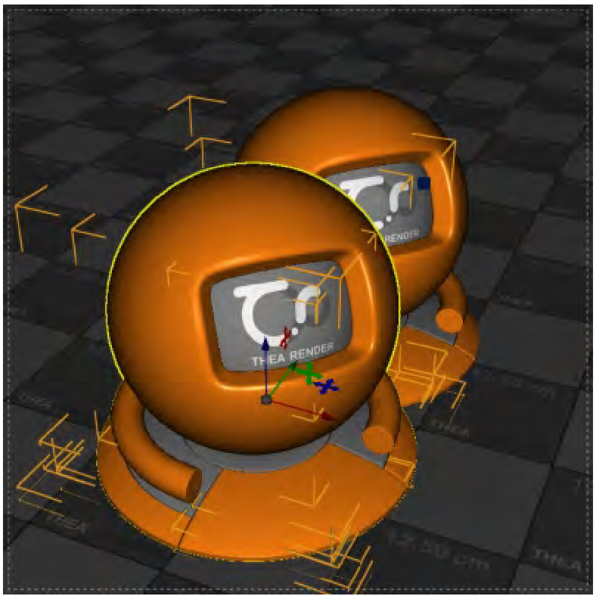


Figure 3-27: Duplicated Objects

3.3.5 Object Transform: Translate, Rotate, Scale

Figure 3-28: Translate, Rotate and Scale Options

With these actions (see Figure 3-28), user can translate (move), rotate or scale the selected object, by choosing the corresponding button. In the next figures we see these actions described in detail.

Figure 3-29: Translation

Translation arrows allow you to click and drag the object to the desired position at the Viewport. You can either select a single axis or achieve a movement along this axis only or, by clicking in the middle of the axis (on little gray sphere) move the object freely. By clicking and dragging the cross arrows, you can translate the object in 2 dimensions. For example, the green cross arrows button, which is between the blue Z-axis and the red X-axis, moves the object on the plane that these 2 axes define (X-Z plane), while its position on the green Y-axis stays fixed.

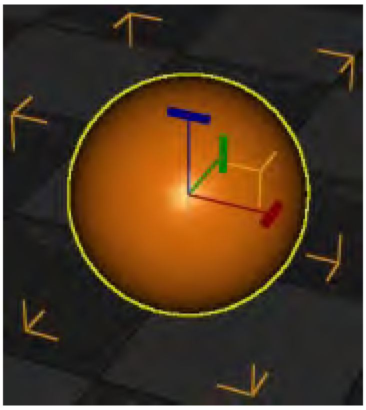


Figure 3-30: Rotation

Rotation arrows are useful for rotating an object around the desired axis. By clicking on the axis arrow that you want, you can rotate the object around it.

Figure 3-31: Scaling

Scale arrows enable you to change an object's size in one or all dimensions. You can either select an axis or drag it out or into to enlarge or shrink correspondingly the object, or by clicking on the middle gray cube, rescale uniformly in all dimensions.

Expect from this way for translating, rotating or scaling an object, you can also insert the desired coordinates values for more accurate results. When you select an object, you can see at the Coordinates tab of the Scene panel the Coordinates, Material Texture Coordinates and Model Texture Coordinates.

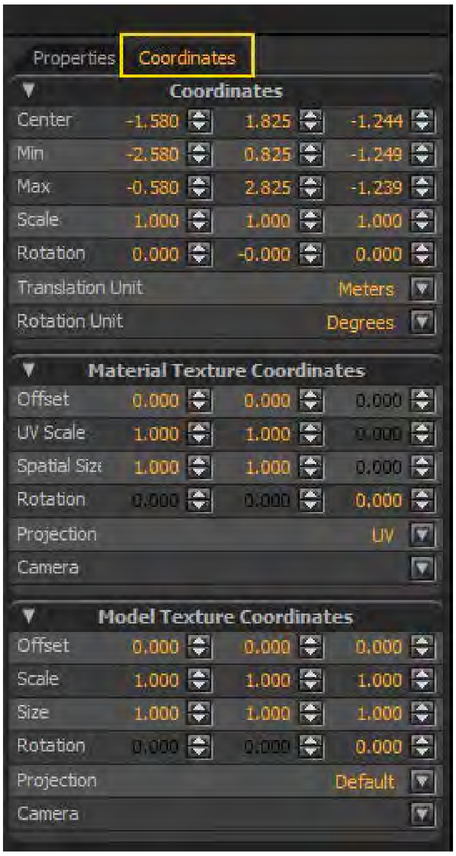


Figure 3-32: Coordinates Tab

At this tab as shown in Figure 3-32, we can see all the position and texture coordinates of the object and its textures as well. As you drag the translation, rotation or scale axes in the way we previously described, you can see the changes applied at the corresponding values (X, Y, Z coordinates) here. Center represents the center of the object. Min and Max show the position, in the Viewport, of the object's bounds in each axis.

All coordinates are displayed with respect to the Global Frame. When you move an object, its Center and Min and Max values change automatically. You can also type the desired values, and the object will be assigned to the new coordinates. There is also the possibility to switch from meters to centimeters, millimeters, inches or feet as the translation unit. Scale values change correspondingly whenever you change your object size. You can specify here the exact dimensions you need. Rotation values change too as you rotate an object. Rotation unit can be degrees or radians.

All these transformations are being achieved with respect to the object **Pivot Point**. Pivot Point is used as a reference point for every object. It is the point where all axes are placed and most important, any rotation will be applied.

By default, most of the times, Pivot Points are at the center of the object, but this can be changed according to user's preference. In order to change an object's Pivot Point, you should enter in Pivot Mode either by pressing “p” key on the keyboard or by clicking on the corresponding icon at the Viewport preferences tab (as we will describe later at page 64). A new icon will appear at top left of your Viewport as a reminder of being in Pivot Mode (see it in Figure 3-34).

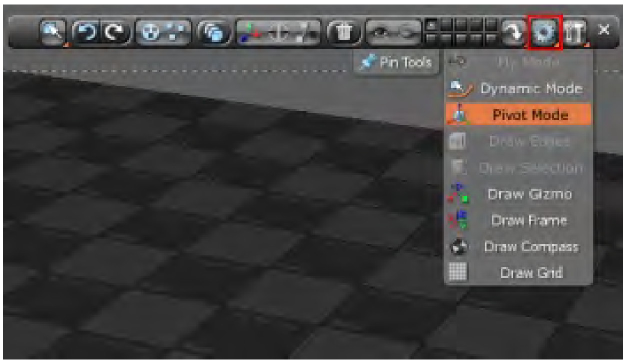


Figure 3-33: Enabling Pivot Mode

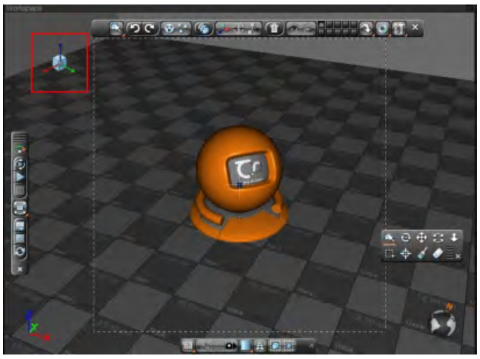


Figure 3-34: Being in Pivot Mode

While being in Pivot Mode, you can translate or rotate the axis of the object, without moving the object at all. When you exit the Pivot Mode and, for example, try to rotate the object, you will notice that the fixed point, around which the rotation now occurs, is the new Pivot Point. Pivot Point can be also outside of the object.

Figure 3-35: Pivot Point of the object is at the center – instances are placed half above the floor canvas.

Figure 3-36: Pivot Point of the object is at the bottom –instances are placed right on top of the floor canvas.

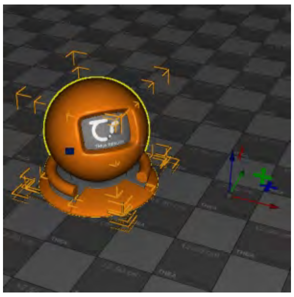


Figure 3-37: Setting Pivot Point, outside of the object.

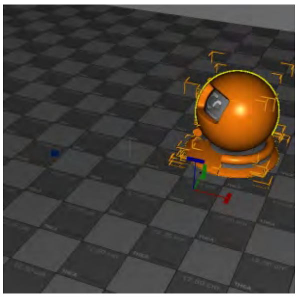


Figure 3-38: Rotation around X-axis at 90 degrees with Pivot Point outside of the object.

3.3.6 Delete Object

Figure 3-39: Delete Object Option

This option allows the user to delete the selected object(s) or group(s). This function can be also achieved by right clicking on the object at Viewport (or at Tree View list), then selecting edit and then Delete.

3.3.7 Show all Objects & Hide Selected Object(s)

Figure 3-40: Show & Hide Options

These two options give to the user the possibility to hide the selected object(s) from the Viewport and show them again. The open eye button makes all the objects, that the user has previously hidden, visible again. The closed eye button hides from the Viewport the selected object. You can also hide an object by right clicking on it (in the Viewport or at the Tree View list) and un-checking the Visible option.

3.3.8 Object Visibility/Render Layers

Figure 3-41: Render Layers

These ten small squares (Figure 3-41) represent the available layers that can be used in your scene. When you start adding objects in the scene, all objects are added, by default, in layer 0. The first square

(Figure 3-42) has now a small blue dot in it to show that it is containing at least one object.

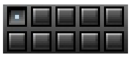


Figure 3-42: Layer is containing objects

Many times though, it is useful to have different layers with certain objects in each, so that you can minimize the visible objects of your scene and work on a specific layer each time. When you have selected an object, you can right click on it and then Assign Layer to it, by choosing the one you want.

Now, the layers that contain at least one object have a color and an indication. If you want to hide a layer (which means hiding all the objects that are assigned to it) you can simply click on the small square of that layer. The selected hidden layers will now appear as shown in Figure 3-43 (with an orange triangle corner). All the objects in it will be now hidden. By clicking on the layer square again, its objects will reappear.

Figure 3-43: Layers 2-6 contain objects – Layers 2 and 3 are hidden

Tip: by hiding specific layers, not only you hide them from the Viewport, for working more efficiently, but you **exclude** them from rendering as well. This means you can select the layers you want and render only them. In the next figures we see some examples.

Figure 3-44: Rendering all Layers – Layer 1 has the room walls and window, Layer 2 has the objects in the room except the bookcase and Layer 3 has the bookcase

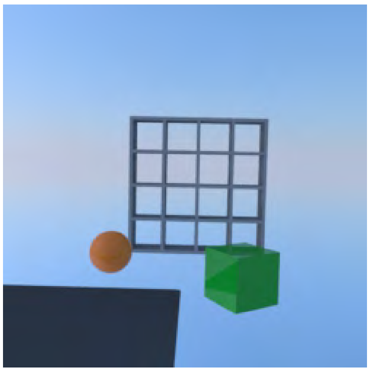


Figure 3-45: Rendering only Layers 2 & 3

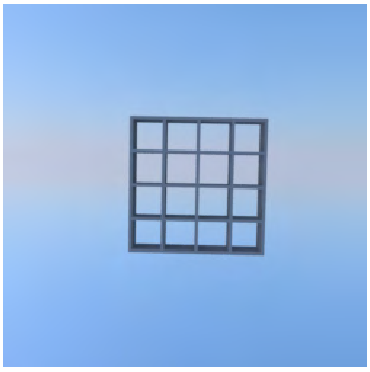


Figure 3-46: Rendering only the Third Layer

3.3.9 Insert Lights, Cameras, Infinite Plane into the Scene

Figure 3-47: Insert Lights, Cameras and Infinite Plane into the Scene

With this button, user can add lights, cameras or an infinite plane and also select the point that the new item will be placed.

3.3.9.1 Insert Omni Light

Figure 3-48: Omni Light

Omni Light is a source that emits light uniformly in all directions, like a bare light bulb. In the next figure we see an inserted point light (at a room without other light sources) and how it appears in the Viewport. We can also edit its specifications at the Selection Properties tab (first button in the Properties panel) as seen in Figure 3-50.

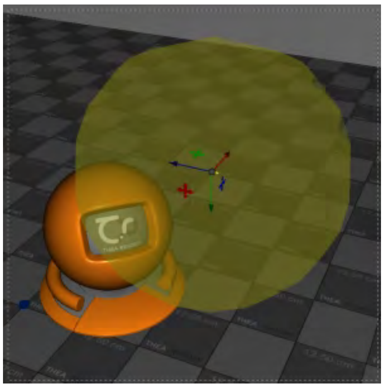


Figure 3-49: Omni Light in the Viewport

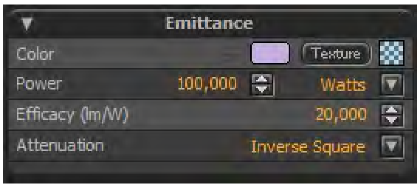


Figure 3-50: Emittance Properties for Omni Light

At emittance panel you can specify the color, the power, the efficacy and the attenuation of your light source.

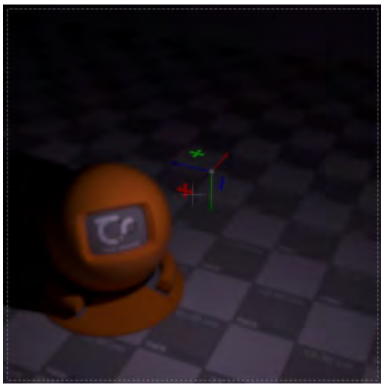


Figure 3-51: Rendering with an Omni Light

3.3.9.2 Insert Spot Light

Figure 3-52: Spot Light

Spot lights, opposite to Omni lights, can be controlled to aim light at specific targets. A Spot light limits lighting within a specific cone only. In the next figures we see a spot light in the previous scene (without other light sources) and the specific area that illuminates. Apart from its position, its light beam can also been controlled.

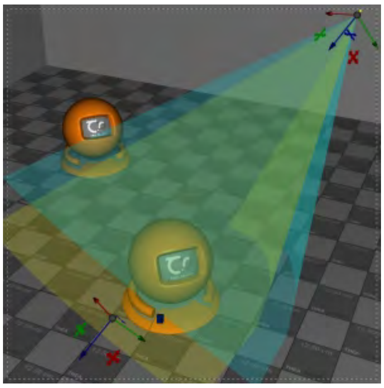


Figure 3-53: Spot Light in the Viewport

Figure 3-54: Emittance Properties for Spot Light

At Spot lights we can also edit the Fall Off and Hot Spot angles (in degrees). Hot Spot represents the angle in which the light beam has a constant power (orange inner cone), while Fall Off defines the maximum angle, after which, lighting is not emitted at all (green-blue outer cone). Between the Hot Spot and the Fall Off the power is gradually attenuated reaching zero at Fall Off angle.

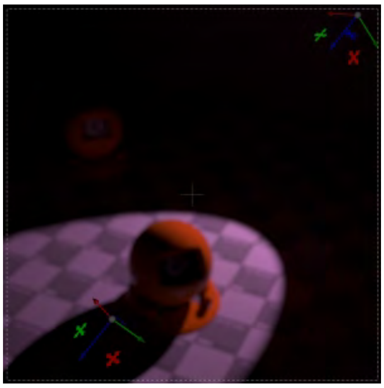


Figure 3-55: Rendering with a Spot Light (areas outside the beam do not receive any direct light).

3.3.9.3 Insert IES Light

Figure 3-56: IES Light

IES stands for Illuminating Engineering Society. IES file format was created for the electronic transfer of photometric data and is basically the measurement of distribution of light intensity stored in ASCII format. After selecting this button and inserting a light, you can import these data at the Properties panel in order to create specific lighting distributions. There are also some default IES files shipped with Thea Render. You can load them from Thea Render Data Folder. There is also the ability to preview these lights' beam cones. You can press the plus (+) sign at the Browser panel (below Viewport) and select the IES folder. You can now see the existing IES files.

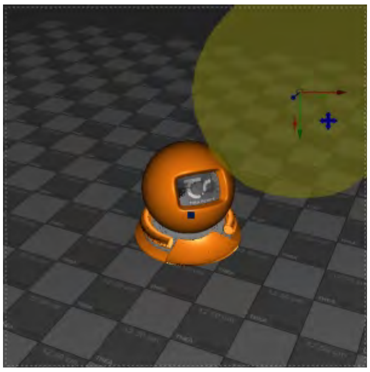


Figure 3-57: IES Light in the Viewport

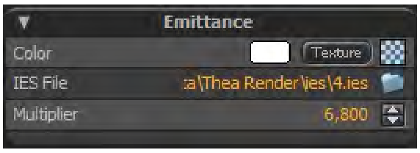


Figure 3-58: Emittance Properties for IES Light

At the Emittance panel, we can select the IES file we want to load and specify its multiplier. By this way we can create the light distribution we want.

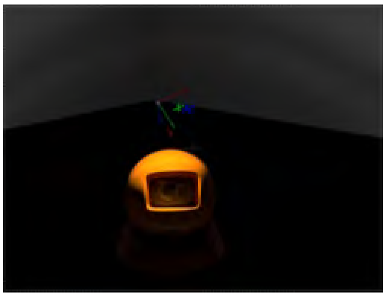


Figure 3-59: Inserting IES – 4 Light

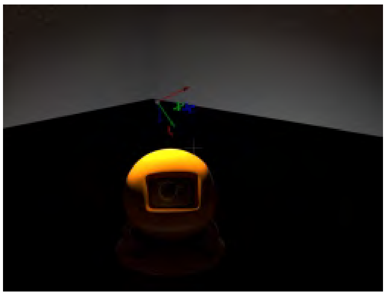


Figure 3-60: Inserting IES – Sample Light

3.3.9.4 Insert Projector

Figure 3-61: Projector Light

By inserting a projector, you can specify a rectangular area that you want to light and, by this way, create a kind of illuminating screen. It is similar to spot light, but with a rectangular beam.

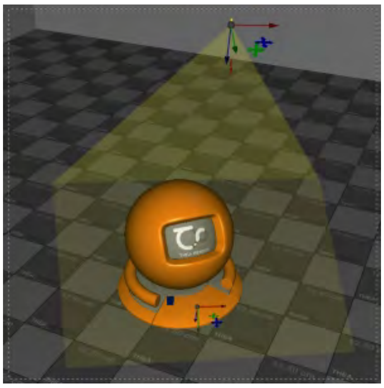


Figure 3-62: Projector in the Viewport

Figure 3-63: Emittance Properties for a Projector Light

At Projector's properties, you can select the color or texture of the projection, the size of the rectangular area, the efficacy and the attenuation.

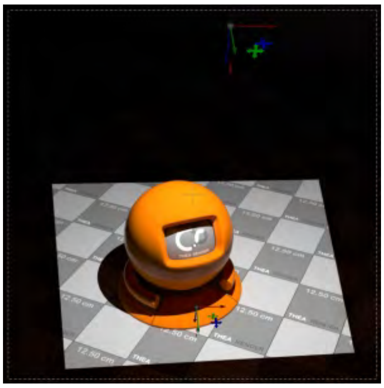


Figure 3-64: Rendering a Scene with a Projector

Figure 3-65: A cool effect using a Projector light with user-defined bitmap and a Global Medium (0.1 scatter and absorption density in this case) to reproduce a cinema-like movie projector.

3.3.9.5 Insert Camera

Figure 3-66: Insert Camera

From the same drop-down menu you can also insert the cameras in the scene. After inserting the camera, you can always move it to the appropriate location and also adjust the area that will capture.

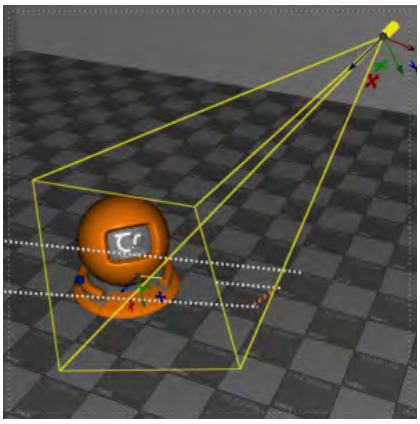


Figure 3-67: Camera in the Viewport

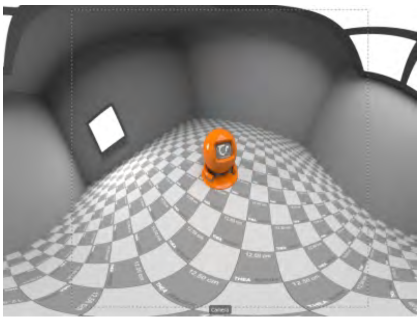


Figure 3-68: Spherical Projection

Figure 3-69: Camera Properties Window

At camera properties window (Figure 3-69) we can see many different options for the camera adjustment. The user can define the Resolution, the Film Height (size of the yellow square) and the Focal Length at first. At lens properties, the user can select among the existing projections (perspective, cylindrical, spherical, parallel), define the shutter speed, the X and Y Shifts and the Diaphragm. At the next panel, the user can change the f-number of the camera, the

Focus Distance and the Depth of field (in percentage). These last options are useful for creating and adjusting the depth of field. At the last panel user can enable Z-Clipping for the selected camera, by defining the near and far distance to which the camera will create a vertical section. In the next image we have enabled near and far clipping, for a room that had by default no openings. The rendered image is taking under consideration the clipping parts but not the outside environment.

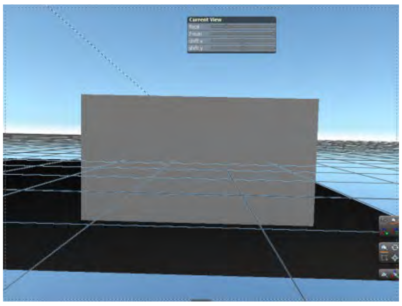


Figure 3-70: View of the room with Z-Clipping option disabled.

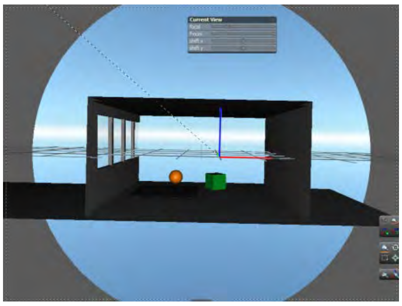


Figure 3-71: Z-Clipping is enabled for near and far distance.

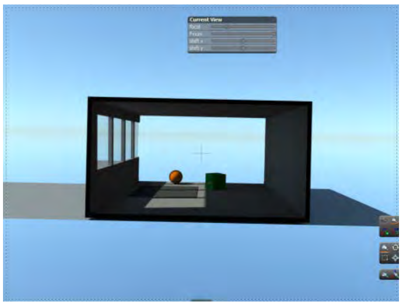


Figure 3-72: Rendered image.

3.3.9.6 Insert IPlane

Figure 3-73: Insert Infinite Plane

IPlane stands for Infinite Plane which is added to the scene on the X-Y axes. Once it is inserted, it is represented by a rectangular surface while, when it is rendered, it is infinite.

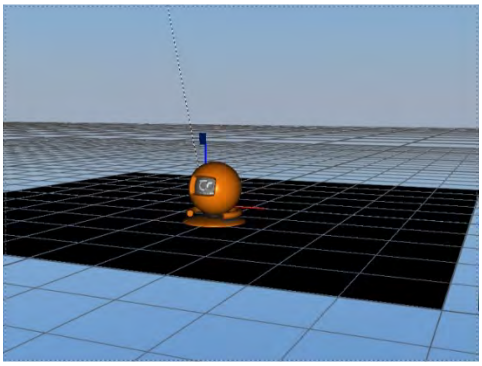


Figure 3-74: Infinite Plane in the Viewport

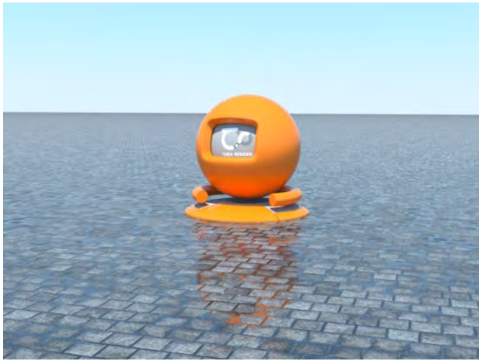


Figure 3-75: Infinite Plane Rendered

There are three different options that use a key point for inserting items in the Viewport. Specifying these points, makes it easier in large scenes to insert and locate the new items.

Figure 3-76: At Viewer Frame

Inserted objects are positioned at the origin of the viewer frame as you see in Figure 3-77 for an inserted Omni light.

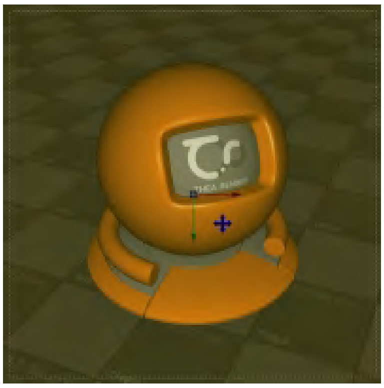


Figure 3-77: Inserting a Light at Viewer's Frame

Figure 3-78: At Global Frame

The new objects are all placed at the start of the axes (Global Frame) that is located in the middle of the grid. You can see it also in Figure 3-79.

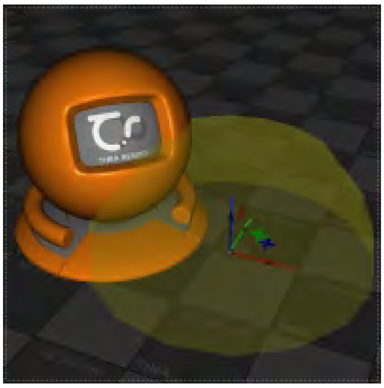


Figure 3-79: Inserting a Light at Global Frame

Figure 3-80: At Cursor Frame

There exists also in your scene, a small red cross-shape object that can be moved like all other objects, and all new inserted ones will be placed where this cursor is. (Figure 3-81)

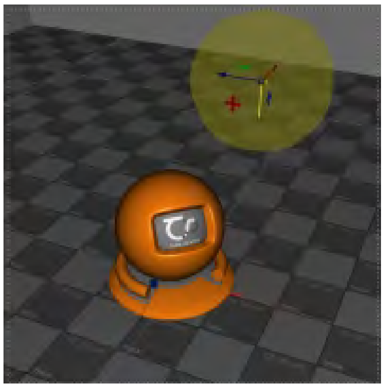


Figure 3-81: Inserting a Light at Cursor Frame

3.3.10 Preference Settings/Viewport Elements Visibility

Figure 3-82: Preference Settings/Viewport Elements Visibility

With this drop-down menu (Figure 3-82), user can select the desired modes to be in, in order to achieve specific operations, like changing the pivot point, and hide Viewport elements. All these options are analyzed here in detail.

Tip: you can also **pin** this toolbar at the Viewport, for quick selection of the desired preferences. By clicking on the Pin Tools button, a new window will be placed at the right bottom of the Viewport (see it in Figure 3-83). By clicking on the small horizontal lines at its right side, you can drag it wherever you want.

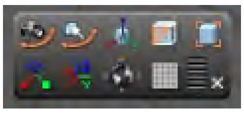
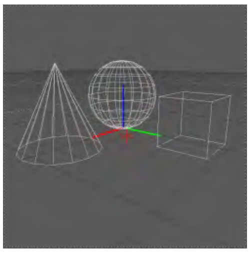
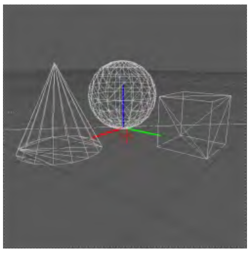
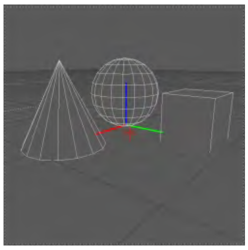
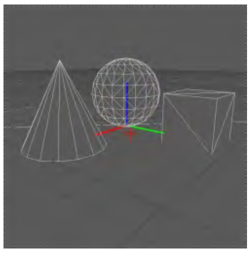


Figure 3-83: Pinned Preference Tools

<table>
<tr><th>Modes</th><th colspan="3">Description</th></tr>
<tr><td>
Figure 3-84: Fly Mode</td><td colspan="3">Fly Mode, is used to create a “View Around” effect, just like someone is standing at viewer frame and looks the space all around. The effect of Fly Mode is applicable while using the Rotate Tool, as we have previously explained. While in default mode, rotation takes place around clicked point or Global Frame, in Fly Mode, rotation takes place around viewer frame itself.</td></tr>
<tr><td>
Figure 3-85: Dynamic Mode</td><td colspan="3">While being in Dynamic Mode, rotation, pan and dolly movements occur according to your selected point. This means that the whole movement of the view (in order to rotate for example or zoom in) is taking place according to the specific point that you click on and not around the global axis. This may result in a small delay at the beginning of the rotation-pan-dolly movement, for large scenes, but usually it is more intuitive. By disabling Dynamic Mode, all these movements are being carried out around the global frame instead.</td></tr>
<tr><td>
Figure 3-86: Pivot Mode</td><td colspan="3">While being in Pivot Mode, the user can translate or rotate the axes of a selected object in Viewport, without moving object itself. Only the placement of axes is changing and from now on, they are being used as the reference point from which the movement of the object will be performed. More details can be seen in previous figures (at page 55).</td></tr>
<tr><td>
Figure 3-87: Draw Edges</td><td colspan="3">As will be analyzed later, there are four ways of seeing the objects in the Viewport: Pointcloud, Wireframe, Solid and Hiddenline mode. When being in wireframe mode (where we see only the meshing of the objects), we can choose to see the full meshing (all edges) of the object, by enabling the Draw Edges option. The same effect is also achieved while being in Hiddenline mode (where only the front visible lines are seen for each object and not the geometry inside or behind them).</td></tr>
<tr><td>
Figure 3-88: Scene in Wireframe Mode with Draw Edges Disabled</td><td>
Figure 3-89: Scene in Wireframe Mode with Draw Edges Enabled</td><td>
Figure 3-90: Scene in Hiddenline Mode with Draw Edges Disabled</td><td>
Figure 3-91: Scene in Hiddenline Mode with Draw Edges Enabled</td></tr>
<tr><td>
Figure 3-92: Draw Selection</td><td colspan="3">This button can be very useful in large scenes with many objects since it helps user to view only the selected object.
Note: even if the user sees only the selected object, the whole scene is rendered though. In case you only need only this item to be rendered, you can put it in a new layer and then render this layer only.</td></tr>
</table>

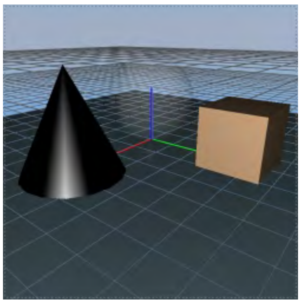
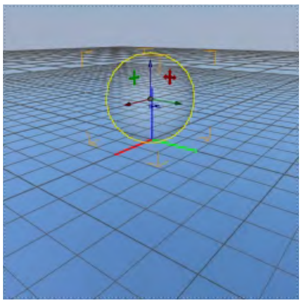
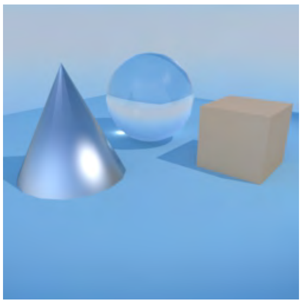
<table>
<tr><td></td><td>
Figure 3-93: Initial Scene at the Viewport</td><td>
Figure 3-94: Viewing Selection Only</td><td>
Figure 3-95: Whole Scene is Rendered</td></tr>
<tr><td>

Figure 3-96: Draw Gizmo</td><td colspan="3">This option enables the user to see or not the Gizmo (the axes icon) when an item is selected. When we need though to translate, rotate or scale an object, Draw Gizmo must be enabled. This option exists as a safety switch, to avoid moving an object by accident (which for example, could cause the restart of the Interactive Render).</td></tr>
<tr><td>

Figure 3-97: Draw Frame</td><td colspan="3">Draw Frame button shows or hides the axes icon at the left bottom side of the Viewport. This is a replica of the Global Frame, fixed at the corner of the Viewport, which helps user to visualize the current orientation. Note, that in Thea Render, Z-axis is considered to be pointing upwards (see Figure 3-98).

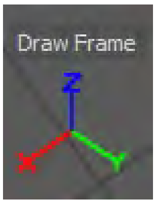


Figure 3-98: Axes Frame in Viewport</td></tr>
<tr><td>

Figure 3-99: Draw Compass</td><td colspan="3">Compass can be found at the right bottom of the Viewport and shows the geographical orientation of the user. Compass icon can be enabled or not by this button.


Figure 3-100: Compass seen in the Viewport</td></tr>
<tr><td>

Figure 3-101: Draw Grid</td><td colspan="3">This button allows the user to turn on or off the Grid (squares at the ground) placed on X-Y plane. Grid helps the user to get a quick qualitive impression of the size and placement. Note: each square is equal to 1x1 square meters.</td></tr>
</table>

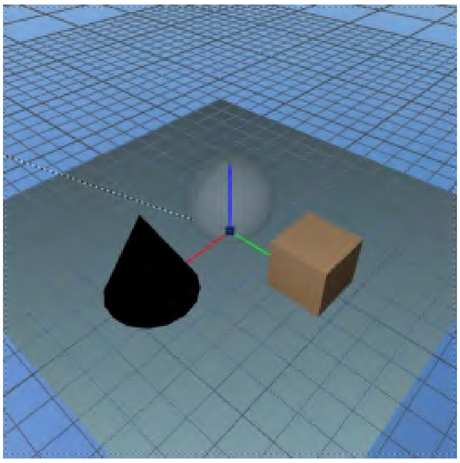


Figure 3-102: Grid is Visible

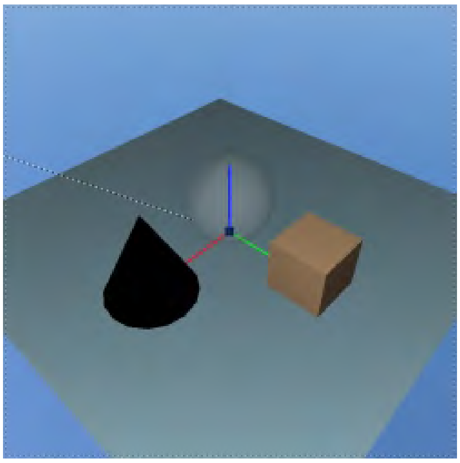


Figure 3-103: Grid is Invisible

3.3.11 Tools (Transform, Animation, Interactive Render)

Figure 3-104: Transform, Animation, Interactive Render Tools

In this drop-down menu we see three very useful options: the Transform window, the Animation Tool and the Interactive Render option which will be explained in detail below.

Tools	Description
 Figure 3-105: Transform	By clicking on this button, a new window appears at the top right side of the Viewport. In the next figures we see the available options in this window.
 Figure 3-106: Coordinates Properties	At the top of this bar, there are four main buttons. The first one is the transform button, which shows the coordinates of the selected object, exactly as we see them at the Properties panel (at the left side of the Viewport). You can click at each cell and enter the values you want for your object position, scale and rotation.

Figure 3-107: Alignment Options

From these three buttons, the two first are useful for aligning two or more objects with each other. The first button helps the user to align the selected objects, so they are all at the same vertical line (X & Y coordinates of the second object change). The second button, allows the user to stack the selected objects, so that one object comes over the other, without changing their X & Y coordinates though. The third button can be used for one or more objects bringing everything selected on the ground. In the next images we can see these options visually.

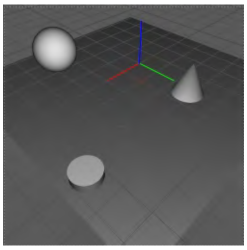


Figure 3-108: Initial Position of Objects

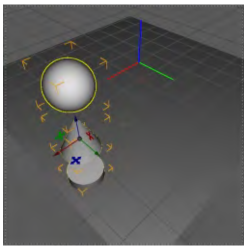


Figure 3-110: Aligning the Objects

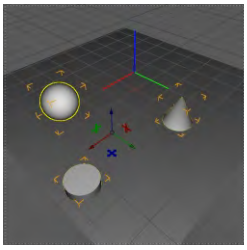


Figure 3-112: Stacking the Objects

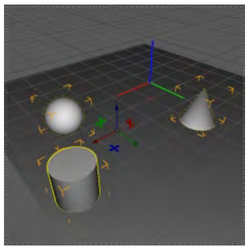


Figure 3-114: Moving Objects to the Ground

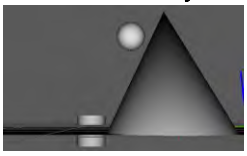


Figure 3-109: Right View –Initial-

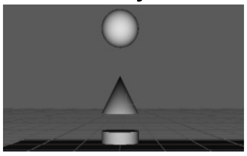


Figure 3-111: Right View -Align-

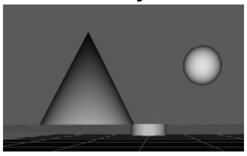


Figure 3-113: Right View –Stack-

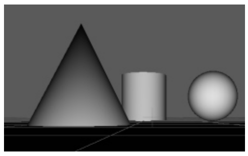


Figure 3-115: Right View -Ground-

Figure 3-116: Bitmap Properties Window

The fourth option in this window, with the name Bitmap, allows the user to select a texture and edit its coordinates (click and write) and its projection on the object. These coordinates (position, scale, rotation) can be also found at the Properties (at the left side of the Viewport), at the Texture Coordinates panel. From there the user can choose also the desired projection. In this window, the main four projections are only available: UV, Cube (Cubic), Sphere (Spherical) and Tube (Cylindrical).

Figure 3-117: Animation Tool

Animation button opens the Animation Toolbar Figure 3-119, which enables the user to edit object motion, by setting appropriately the key frames. Animation toolbar works together with the Animation tab, which can be found at the Settings panel (Figure 3-118) and is analytically described at a later chapter.

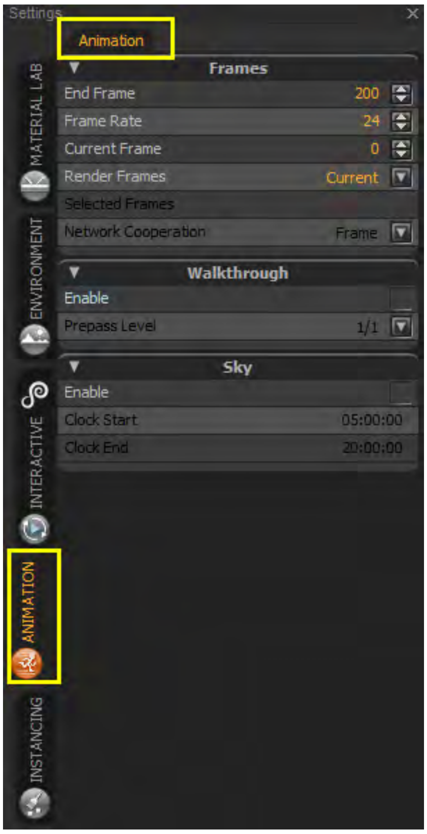


Figure 3-118: Animation Tab

At first, user must define the total frames for the animation (20 for example), the frame rate, the current frame (which also changes in the Viewport animation toolbar), which frames will be rendered and the day light animation of the sun – sky in the scene. These options are set at the Animation panel as seen in Figure 3-118.

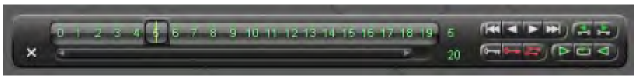


Figure 3-119: Setting Key Frames

At this toolbar (Figure 3-119), user can set the desired key frames when defining the object motion. There are also buttons for deleting key frames and playback the animation. The white key is used for adding/saving and adjusting the object animation. You can choose another key frame, perform the necessary object movements and save the key frame again. By choosing another key frame, after doing the necessary movements of the object, we can save the key frame again. By repeating this procedure you can create an animation. You will need to render all the key frames that take part in the animation in order to have the full movement rendered.

Here, we describe the function of the buttons of the Animation Toolbar, from left to right, as we see in Figure 3-120.

A: these buttons are used for going to the first, previous, next and last frame correspondingly.

B: with these buttons the user can go to the first and last key frame.

C: these buttons are used for setting a key frame, deleting it and deleting all the key frames.

D: with these buttons, the user can perform a playback, a playback in loop and a reverse playback.

Figure 3-120: Animation Toolbar in Detail

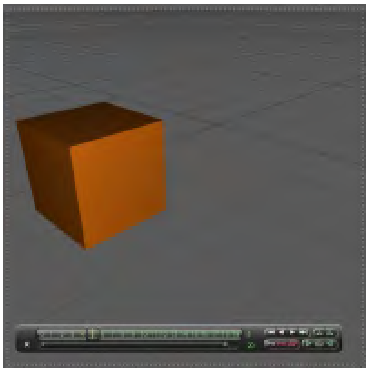


Figure 3-121: Initial Position

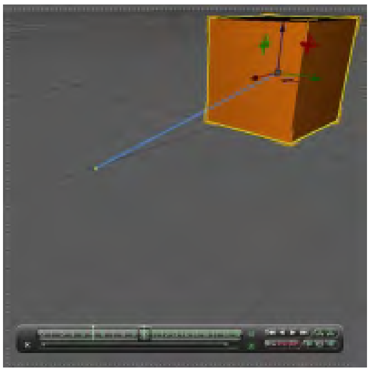


Figure 3-122: Creating Animation Path

 Figure 3-123: Interactive Render (IR)  Figure 3-124: Interactive Render Toolbar	Interactive Render is a very useful tool that makes it possible for the user to create a rendered preview of the scene inside the Viewport and get continuous render feedback during staging operations. This toolbar appears at the left of the Viewport, and works together with the Interactive Render Properties panel at the left side of the Viewport (see it in Figure 3-124). Apart from the horizontal lines at the top, which help us move the window to the desired position in the Viewport, and the close button at the bottom, we have eight buttons, in total, which are analyzed in the next table.
 Figure 3-125: Synchronous Display	Synchronous Display: this option helps you (when enabled) to see the rendered image all the time while you move around the Viewport (auto refresh must be on too) without typical OpenGL mesh visualization during transition. This is the case when Synchronous Display is disabled; in this during the render restart, there exists an initial delay, where instead of waiting for the frame to be available, the typical OpenGL mesh visualization is performed. In very heavy scenes though, you can find that Synchronous Display results in a smoother navigation.
 Figure 3-126: Auto Refresh	Auto Refresh: most of the times, you will need to see the rendered image being refreshed during the scene staging. The Auto Refresh button (re)starts rendering continuously while you are making changes.
 Figure 3-127: Start IR	Start Interactive Render: this is the button that allows you to start interactive render whenever you want to see how your scene looks from the current view. As soon as you make any change to the scene, the interactive render stops.
 Figure 3-128: Stop IR	Stop Interactive Render: once you are satisfied with your rendered image, you can stop interactive render. If you have enabled the Auto Refresh though, rendering will start again when you make a change.
 Figure 3-129: IR	Render Resolution: there are five different resolutions that you can choose for the interactive render. After pressing the render resolution button a list appears with

Resolutions

the available choices. Remember that the resolution you have chosen will be the same to the image that you may want to save (save button is below resolution button and is explained later on).

Tip: in case you shrink or enlarge the Viewport size, interactive render will start again. This happens to all resolutions **except the Camera frame.**

320x240

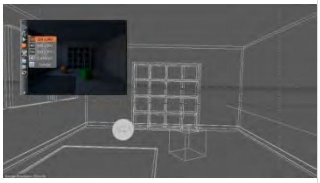


Figure 3-130: IR Resolution at 320x240

400x300

Figure 3-131: IR Resolution at 400x300

500x375

Figure 3-132: IR Resolution at 500x375

The first three available resolutions are these of 320x240, 400x300 and 500x375. They all open a new window next to the Interactive Render Toolbar, as we see in Figure 3-130, Figure 3-131 and in Figure 3-132. These resolutions give you the possibility to work in parallel in the Viewport, move, edit, apply materials, etc., and see at the same time these changes appearing (automatically if auto refresh is on or by hitting start button).

Camera Frame

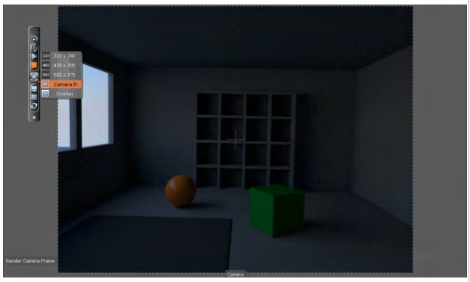


Figure 3-133: IR Resolution at Camera Frame

At camera frame, the resolution of the rendered area is the same as the resolution of the current view (see Figure 3-133). We can change this resolution at the Current View Properties panel, where you can specify the resolution you need. You will see, that the rest Viewport is invisible (covered with gray color) but you still can move around. Another very useful element of rendering at camera frame is the fact that Viewport changes in size **do not affect** the rendering window and therefore Interactive Render is not restarted.

Overlay

Figure 3-134: IR Resolution Overlay

With overlay resolution, the rendering resolution is the same as the resolution of the Viewport. Assuming the application is maximized, this resolution directly relates to the monitor resolution itself, minus the space the rest panels occupy (see Figure 3-134).

Figure 3-135: Save Image

Save Image: this button allows you to save the rendered image that has been created using the Interactive Render tool.

Figure 3-136: Toggle Display Mode

Toggle Display Mode: with this option, you can switch between the rendered view, the OpenGL Viewport and an in-between image. This function works for Overlay or camera resolutions only and the blended image works only for wireframe model display (which we will analyze later).

Figure 3-137: Rendering View

Figure 3-138: Rendering and Wireframe Blended View

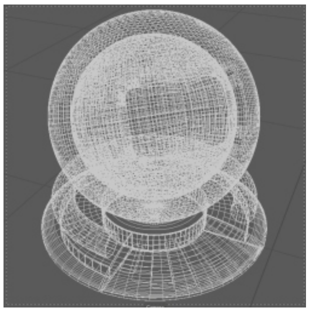


Figure 3-139: Wireframe View (Rendering continues in the Background)

Figure 3-140: Refresh Render Display

Refresh Render Display: this button helps you to refresh your image, after changing some of the display options that can be found at the left side of the Viewport (see Figure 3-141 and Figure 3-143), as for example the ISO or the f-number, without the need to start interactive rendering again. Since Interactive Render is refreshed periodically its main use is to refresh it when rendering has been stopped. In the next figures we have changed some settings twice to show how the rendered image looks after hitting refresh.

Figure 3-141: Exposure Settings 1

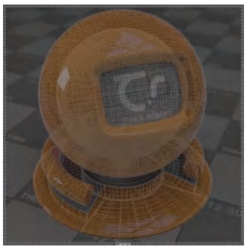


Figure 3-142: Updated Image 1

Figure 3-143: Exposure Settings 2

Figure 3-144: Updated Image 2

Note: these display controls are equivalent to the **Darkroom controls**; as soon as you make a change to one panel, the other panel is updated with the same value.

As we have mentioned, the parameters of the Interactive Render itself (such as the engine core, the super-sampling, etc.), can be found at the Interactive tab of the Settings panel (see Figure 3-145).As we can see, the user can select at first the desired engine core for the Interactive Render tool. The available options are: Progressive (MC), Progressive (AO) and Adaptive (AMC) for the CPU option and the Presto (AO) or Presto MC) for the Presto engine. These engines are described in detail at later chapters.

Figure 3-145: IR Properties Panel

3.3.12 Hide Toolbar


Figure 3-146: Hiding Toolbar

This option helps the user to hide the Action Toolbar completely. In practice, this works like a minimize window function. Instead of the whole toolbar, a small button appears now at the left top of the Viewport, which brings up the toolbar again (Figure 3-147).

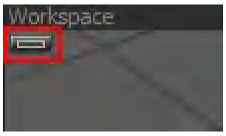


Figure 3-147: Toolbar Minimized

3.4 Viewer Toolbar

Viewer toolbar is located at the bottom of the Viewport and includes all the options related to the way the scene is drawn in the Viewport (Figure 3-148).

Figure 3-148: Viewer Toolbar

The available selections are:
1. View Selection
2. Next Camera View
3. Lock/Unlock Camera
4. Go to Selected Camera View
5. Model Display
6. Switch to Parallel View
7. Fit Selected Object in View
8. Center Selected Object in View
9. Hide Toolbar

All these options will now be explained in detail.

3.4.1 View Selection

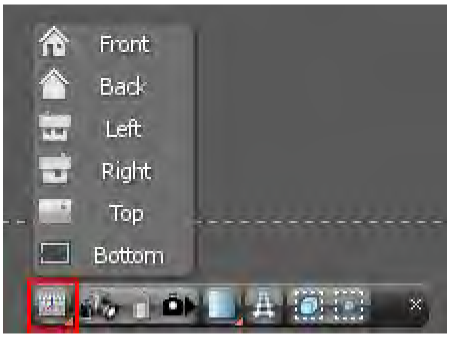


Figure 3-149: View Selection Options

These menu options help the user to quickly switch between predefined views of the scene. So, the whole scene can be viewed from the Front and Back side, Left and Right, Top and Bottom. In the next images we have these six different views of a car scene.

Figure 3-150: Car Front View (Behind of Y-axis)

Figure 3-151: Car Back View (In Front of Y-axis)

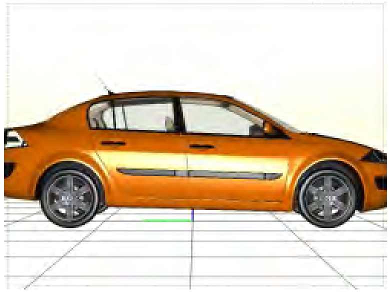


Figure 3-152: Car Left View (Behind of X-axis)

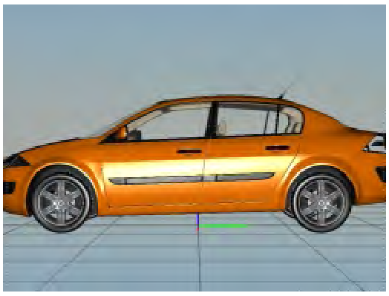


Figure 3-153: Car Right View (In Front of X-axis)

Figure 3-154: Car Top View (In Front of Z-axis)

Figure 3-155: Car Bottom View (Behind Z-axis)

3.4.2 Next Camera View

Figure 3-156: Next Camera View tool

Most of the times, there are more than one camera in the scene, each one covering a different view. This button, allows the user to move to the next camera view. The cameras are all listed at the Tree View with names Camera #n (n= 1, 2, 3, ..) or custom user names (all names are editable). Once you press the Next Camera View button, the view changes to the next camera in the list. By pressing it again, you go to the next one, until you return to the beginning. This procedure can be repeated as long as is needed.

Figure 3-157: Camera #1 View

Figure 3-158: Camera #2 View

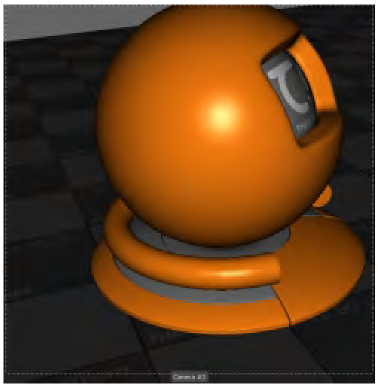


Figure 3-159: Camera #3 View

3.4.3 Lock/Unlock Camera


Figure 3-160: Lock/Unlock Camera

This option makes it possible to lock or unlock the view of a camera. Once a camera is selected (it is highlighted in orange color in the Tree View list) and it is not locked, as we move around the viewport, the camera view is changing accordingly (the dotted line help us to see the camera view). If the camera though is locked, no changes are made from the initial view and its view stays "fixed" to the point it was locked.

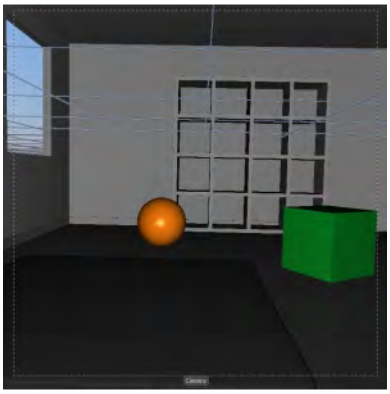


Figure 3-161: Initial Camera Position (is unlocked).

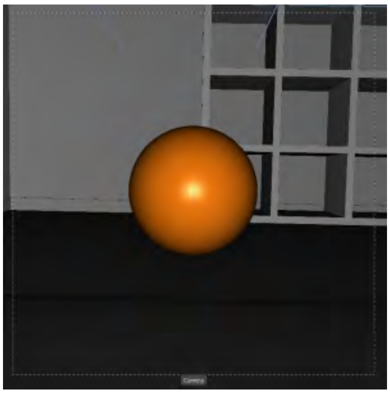


Figure 3-162: By zooming to the orange sphere, camera view is adjusted.

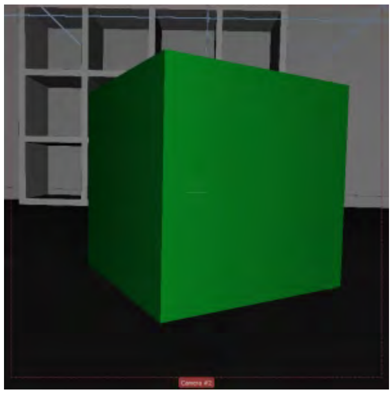


Figure 3-163: Camera is locked (note the red frame) and moving around viewport does not affect it.

3.4.4 Go to Selected Camera View

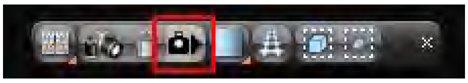


Figure 3-164: Go to selected Camera View tool

This button helps you to go to the view of the camera you have selected. You may have changed view, but once you press the Go to Selected Camera button, you see you scene as it is seen from the selected camera. If you select another camera from the Tree View list and press this button, you go also to its view.

3.4.5 Model Display

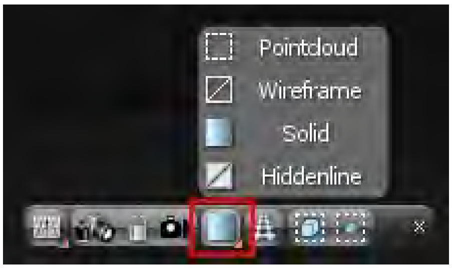


Figure 3-165: Model Display Options

There are four ways to see the objects in the Viewport and so we have four Model Display options: Pointcloud, Wireframe, Solid and Hiddenline.

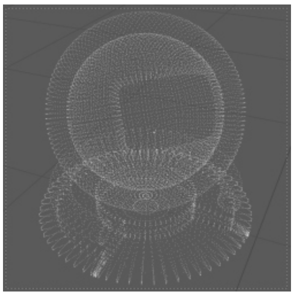


Figure 3-166: Pointcloud Display

As we see in Figure 3-166, at Pointcloud view, the object vertices are only drawn (represented with dots). A cube for example, has one dot at each corner. Note that the Pointcloud display is the fastest one.

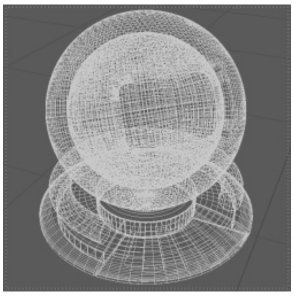


Figure 3-167: Wireframe Display

In Wireframe mode, the edges of the objects are drawn. A cube is drawn with one line for each edge and we can see even the back edges.

Figure 3-168: Solid Display

In Solid display mode, the objects are fully drawn, using a material representation and basic lighting (one light exactly on viewer, acting like a flash light. Note that only the active texture bitmap is being displayed (this is set for each material separately in the material lab).

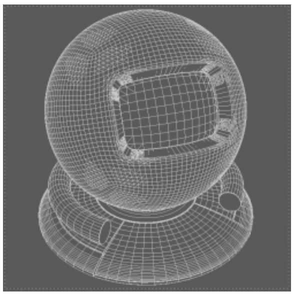


Figure 3-169: Hiddenline Display

The Hiddenline view is like the Wireframe, with the difference that only the front faces of the meshes are visible. Note that the Hiddenline view is slightly slower than the Wireframe mode.

3.4.6 Switch to Parallel View

Figure 3-170: Switch to Parallel View Tool

Parallel View corresponds to orthogonal projection of the scene. It means that the phenomenal size of the objects does not change with the distance from the viewer. We can see the way that Parallel View looks like in the next figures. You can go back to perspective view, by clicking again this button (Switch to Perspective View).

Note: Parallel View helps **aligning** objects. Since, their projected position is not affected by the distance, we can visually align objects by making their edges coincident.

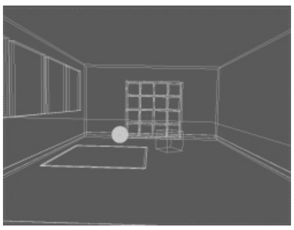


Figure 3-171: Perspective - Wireframe Mode

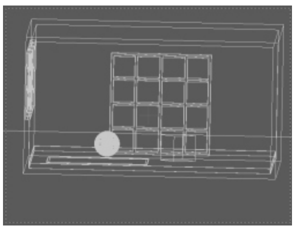


Figure 3-172: Parallel - Wireframe Mode

Figure 3-173: Perspective - Solid Mode

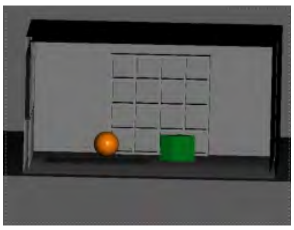


Figure 3-174: Parallel - Solid Mode

3.4.7 Fit Selected Object in View

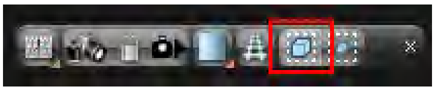


Figure 3-175: Fit Selected Object in View Tool

This option allows the user to select an object and move in front of it so that it occupies almost all the Viewport area. This means that a zoom in or out is taking place.

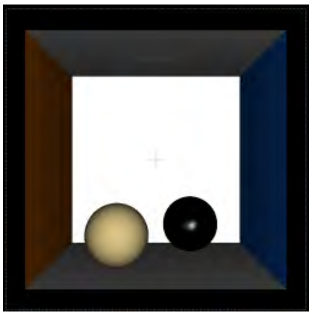


Figure 3-176: Initial Object View

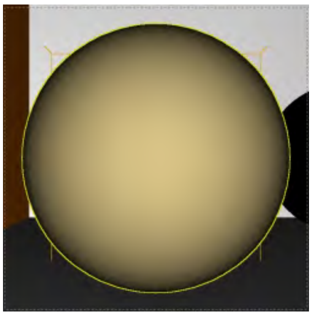


Figure 3-177: Selected Object Fits in View

3.4.8 Center Selected Object in View

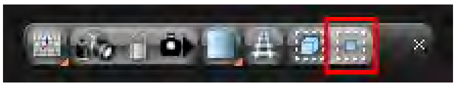


Figure 3-178: Center Selected Object in View Tool

This option helps the user to have the selected object centered in the view. This time, there is no zoom in or out, only a horizontal or vertical translation of the current view that shows the object in the center of the Viewport.

Figure 3-179: Initial View of the Scene

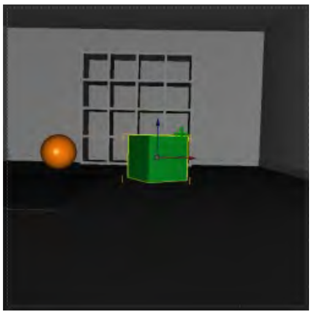


Figure 3-180: Selected Object in Center

e Toolbar

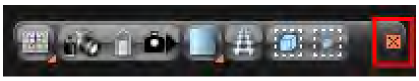


Figure 3-181: Hiding Toolbar

allows the user to hide the Viewer Toolbar completely. It actually works as a minimize window function. Instead
le toolbar, a small button appears now at the left bottom of the Viewport (Figure 3-182), which brings up the

ain once is pressed.

Figure 3-182: Toolbar Minimized

er Toolbar (in contrast to Action Toolbar) changes the view in the corresponding window only. There is a hidden ivated when the user presses “0” (zero) on the keyboard that splits the Viewport in four smaller ones. View be different in each one of them as it is shown in Figure 3-183.

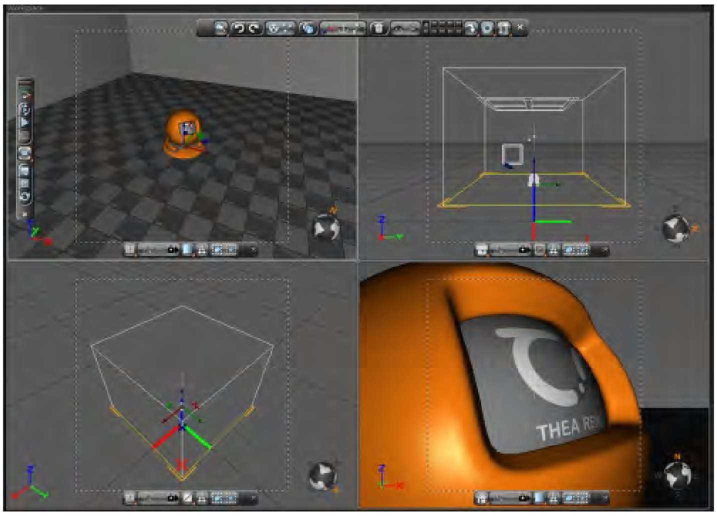


Figure 3-183: Viewport Split in Four

3.5 Current View Window

Apart from the two main Viewport toolbars, Current View window is another toolbar, which helps us to change easily the current view properties (we see it in Figure 3-184).

This window consists of the following options to edit: focal length, f-number and the X-Y coordinates of the current view.

Current View Window, is easy to be dragged and placed in any convenient position in the Viewport and also been closed by the “x” button on its top right corner.

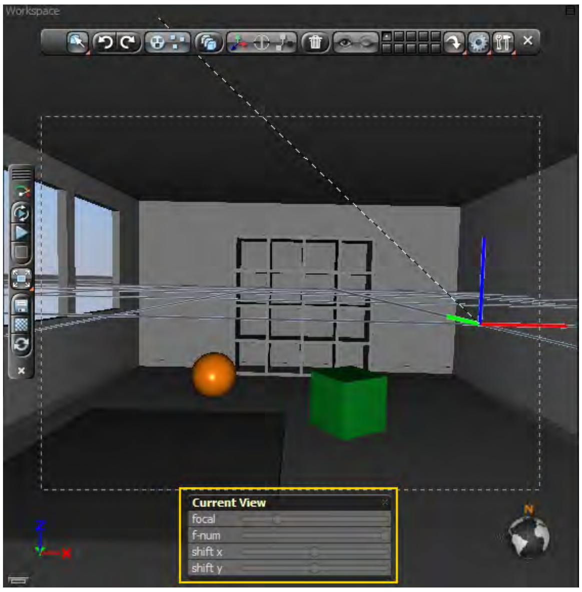


Figure 3-184: Current View Window

Tip: once this window is closed, a small identification icon appears at the top right corner of the Viewport (see it in Figure 3-185). By pressing it, the Current View window opens again.

Figure 3-185: Re-opening Current View Window

Note that these options, work simultaneously with the Current View Properties tab, located at the Scene panel (see it in Figure 3-186).
When a change is made to either the Properties panel or the Current view window, the corresponding values are changing to the other accordingly.

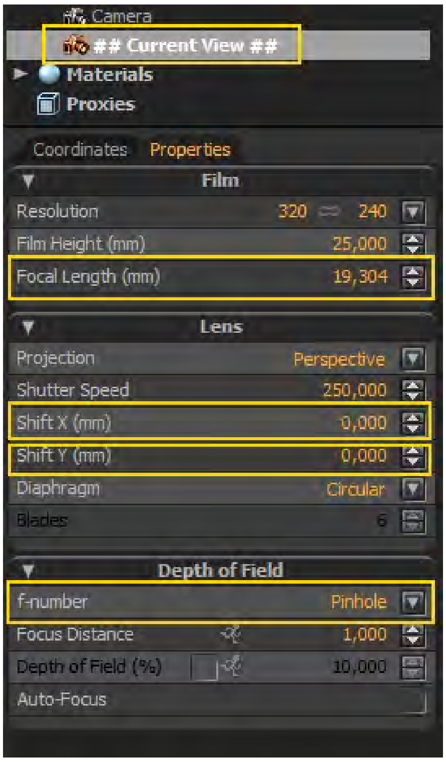


Figure 3-186: Properties Tab

3.5.1 Focal

Focal Length option helps user to change the distance from the lens to the film (increase it by dragging the bar rightwards and decrease it by dragging it leftwards). In the next figures we see the way the current view changes by increasing/decreasing the focal length.

Figure 3-187: Small Focal Length (at 11 mm) creates a "zoom out" effect, though for too small values this can lead to unrealistic results.

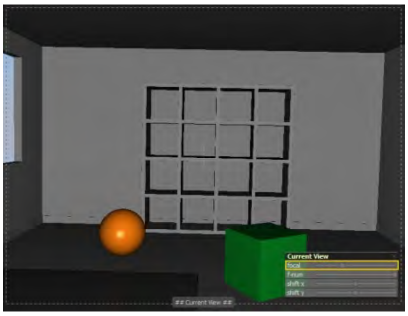


Figure 3-188: By increasing the Focal Length (at 35 mm) image distance is decreasing.

Figure 3-189: For even larger values of Focal Length (80 mm) we are "zooming in" our image.

3.5.2 f-num

F-number is the second value that we can change with the use of the Current View window bars. By dragging the bar leftwards, f-number is decreased, while by dragging it rightwards, we increase it. F-number, affects the Depth of Field of the rendered scene. For seeing the way the f-number changes the Depth of Field, we need to render the image or enable the Interactive Render. In the next figure, we see how f-number affects the Depth of Field.

Figure 3-190: By dragging the bar at the rightest side, the f-number is set to Pinhole. This means that there is no Depth of Field at all.

Figure 3-191: A value around the middle (5.6 for example at this image) creates an intermediate Depth of Field effect.

Figure 3-192: By decreasing the f-number we see that only a very small area is in focus, while rest areas (front and back) are out of focus.

3.5.3 Shift X

This option helps us change the horizontal direction of the current view. The direction changes accordingly to the side we drag the bar; leftwards shifts the camera at left and rightwards shifts the camera right.

Figure 3-193: By dragging the bar leftwards, camera is shifted leftwards in X direction by -20 mm (at our example image)

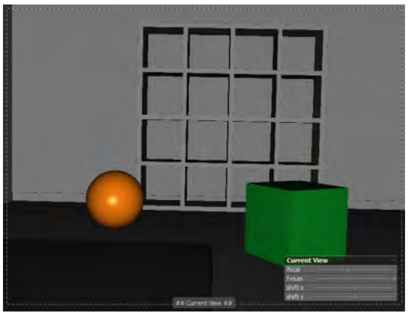


Figure 3-194: X is set to 0, meaning the camera view is at its initial position (no shifted).

Figure 3-195: By dragging the bar rightwards, camera is shifted rights in X direction by +20 mm (at our example image)

3.5.4 Shift Y

This option changes the vertical direction of the current view. The direction changes accordingly to the side we drag the bar; leftwards moves camera up and rightward bar sifting moves camera down.

Figure 3-196: By dragging the bar left, camera is shifted upwards in Y direction by -15 mm (at our example image)

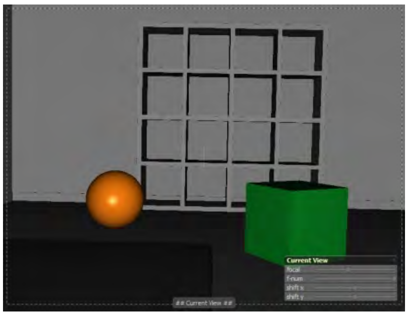


Figure 3-197: Y is set to 0, meaning the camera view is at its initial position (no shifted).

Figure 3-198: By dragging the bar rightwards, camera is shifted down, in Y direction, by +20 mm (at our example image)

3.6 Hierarchy Window

When selecting an item in the Viewport is many times useful to see the “hierarchy path” of this object (meaning the groups that it belongs to). Especially for big scenes, this window -that appears after selecting an object in the Viewport- helps user see the exact hierarchy of it, without the need to search it in the Tree View list.

At the example scene we see in Figure 3-199, we have a simple room interior. We have also two groups: one group with all the objects located in the room with the name Stuffs Group (Bookcase, Ball, Cube and Carpet). There is also a sub-group within it, with name Primitives, which contains the Cube and the Ball.
By selecting the Ball at the Viewport we see that Hierarchy is like we see it in Figure 3-200.

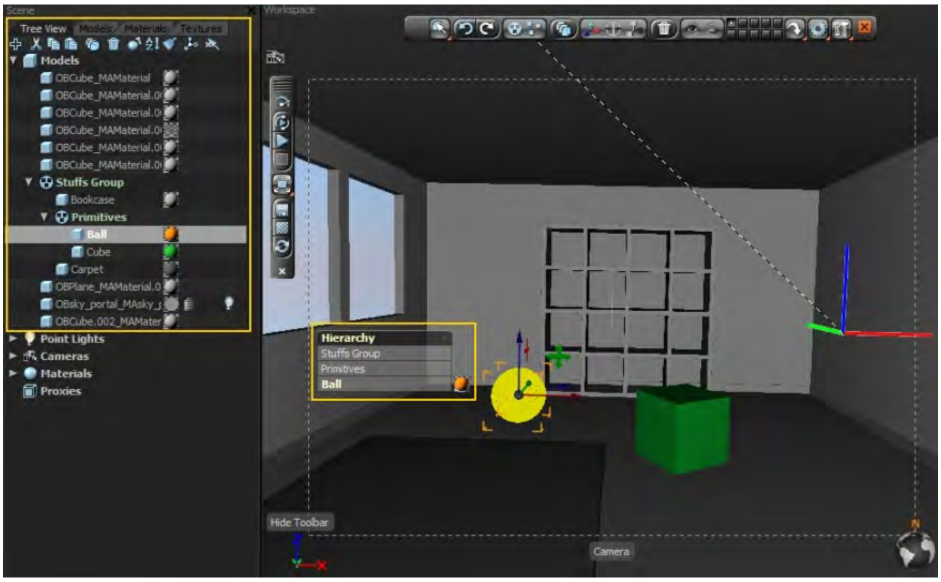


Figure 3-199: Hierarchy Toolbar in the Viewport

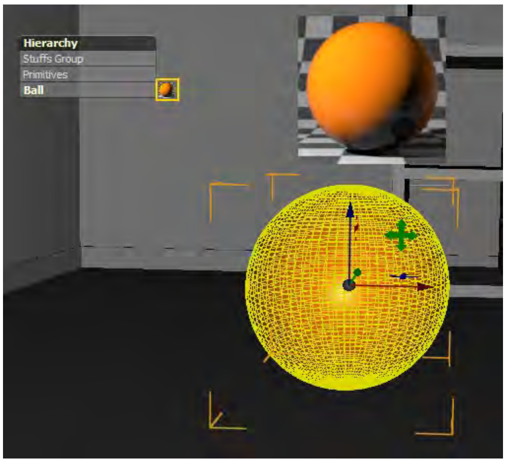


Figure 3-200: Ball Preview at Hierarchy

By hovering the mouse on top of the small object preview, we see rightwards a bigger preview of the selected object material (this preview is specified by the Room options of the Material Lab). As we also see at the Hierarchy window, above the Ball, there is the Stuffs Group and below the Primitives Group, as this object belongs to both these groups.

Stuffs Group
 Primitives
  Ball

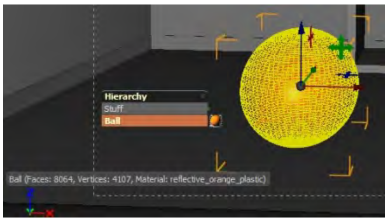


Figure 3-201: Short Description of selected object

Another piece of information that appears here is visible at the left bottom side of the Viewport, where for each selected object of the Hierarchy window we see its number of faces and vertices and the name of the applied material.

Hierarchy Window, is not only a visual reminder of the groups that exist in the scene, is also a clickable area.
By clicking on the Stuffs Group for example, a second window opens at the right, which shows the objects that exist inside this group. We can do an extra step and click again on the next group (Primitives) and see the containing items (see Figure 3-202). Each time we select something from these windows, the corresponding objects in the Viewport are also selected - highlighted.
Note that, as we have also said for the Ball there is a small preview of the material of all objects at their right side (along with their main property flags), which becomes larger by hovering the mouse on it.

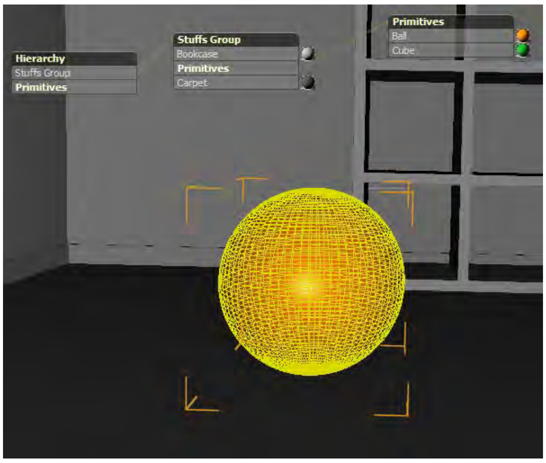


Figure 3-202: Selecting Stuff Group and then Primitives Group

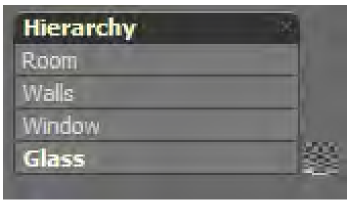
As we see at the Hierarchy Window of Figure 3-202, in case the appearing name corresponds to an object, we see its preview, while if it is a group (Primitives for example), a small green dot appears at the right side to indicate us that it is a group and contains other objects.

Note: sometimes a group may contain another group which contains another group and so on. These group levels may be large in number and so, for avoiding the opening of many linked windows, the amount of lever showing is limited to three. This means that we will always see the chosen group along with its container group and the containing sub groups.
We can give an example to show in a visual way how the hierarchy window each times appears. We suppose we have the following groups (with nested groups) of Figure 3-203.

Figure 3-203: Groups List example

By selecting the Glass object in the Viewport, the Hierarchy Window will be as in Figure 3-204. We see that the Glass object is part of the Window group, which is part of the Walls Group that belongs to the Room group.

We can now click on the Room Group and a new extra window appears rightwards, as seen in Figure 3-205. We see that the Room Group contains the Walls Group and the lights object.



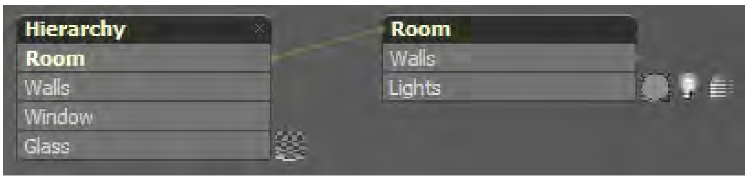


Figure 3-205: Room Group contents

Figure 3-204: Hierarchy of Groups

By clicking on the Walls Group, a third window appears. The first window (Hierarchy) has changed and shows the previous group level of the Walls group (the Room group). The selected group is in bold letters (Walls here).

By clicking now on the Window group, no fourth window appears, but the Hierarchy windows are as in Figure 3-207. We see that apart from the current group (Window) the previous one is seen (Walls) and their order is visible at the first Hierarchy window.

Figure 3-206: Window Group

Figure 3-207: Window Group

You can close the Hierarchy window by the "x" button on top right of the first window. A new icon appears now in the Viewport (top left), which reveals again the Hierarchy window once pressed.

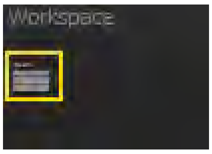


Figure 3-208: Hierarchy Minimized Button

Tip: while being in the Viewport and a scene is open, you can do a right click on a model and list as in Figure 3-209 appears. These options for an object are analytically described at the Tree View list right click options (at the next chapter). If no object is selected, a list as in Figure 3-210 appears. From here you can create a New Model Group, Light Group Camera or Material. You can also Transform the scene by moving it to Origin or Ground, Swapping X-Y or scaling it. You can also Sort or Clean Up All Objects. The options are analytically described at the next chapter.

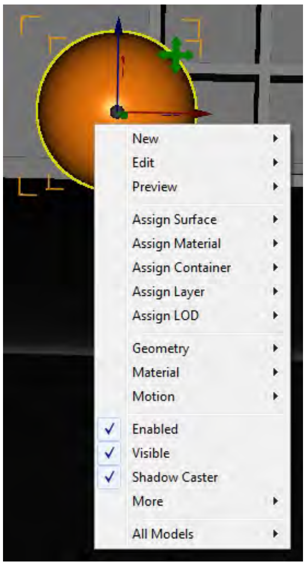


Figure 3-209: Right click in the Viewport while an object is selected

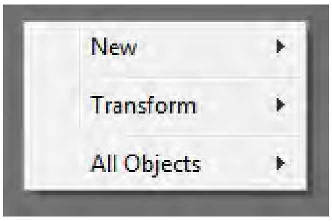


Figure 3-210: Right click in the Viewport while nothing is selected

THEA RENDER

phyisically-based unbiased, biased & gpu render engine

Chapter 4: Scene Panel

Image by Beppe Barone

4. Scene Panel

4.1 Introduction

A very important panel in Thea Studio is the Scene Panel (see Figure 4-1). It consists of six main tabs:

1. Tree View
2. Models
3. Materials
4. Textures
5. Coordinates
6. Properties

(Note that if we wish we can change their position by swapping the tabs.)

We could separate these tabs in two categories: At the first one, we could have tabs 1-4, as these tabs show all the existing models, materials and textures of our scene. The second group could consist of the Coordinates and Properties tabs, in which we find information and options concerning only the object that is currently selected.

At this chapter we analyze each of these tabs; their existing options and the list of options that appears by right clicking on them.

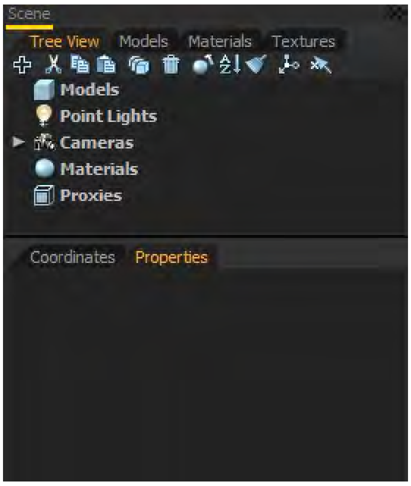


Figure 4-1: Scene and its tabs

Note: you can close the Scene panel, as all other panels, from the x button on the top right. For viewing the panel again, you can enable it from the Top Menu, at Window>Scene.

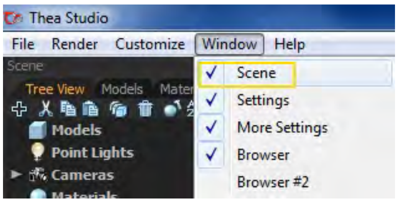


Figure 4-2: View/Hide the Scene Panel

4.2 Tree View Tab

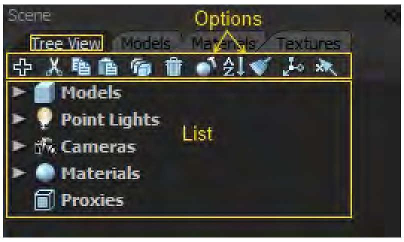


Figure 4-3: Tree View

Tree View, is the main tab that presents a list with all the available objects that exist in your scene (see it in Figure 4-3). It consists of two areas: the Options bar that helps you edit the existing list and the actual List area, where all the available Models, Point Lights, Cameras, Materials and Proxies that exist in the scene are displayed (more options appear by right clicking on an item of this area).

Tip 1: at the left side of each category that exists in the Tree View tab we see a **small triangle** that helps us see or hide the list within the category (see them in Figure 4-4). Models and Materials lists, for example, are now hidden, while Point Lights and Cameras lists are extended.

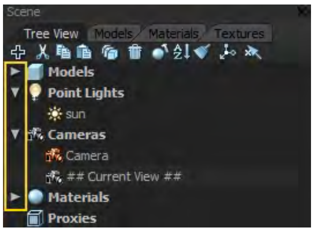


Figure 4-4: Triangle Icons

Tip 2: very often you may have long lists of models, materials etc. to your scene. For finding a specific object, you can scroll down the list (with your mouse wheel or with the scroll bar at the right side of the panel) or use one of the available **bookmark** options. These bookmarks that are appearing at the bottom right of the Tree View (when the list is bigger that the tab length) help you see directly the selected category. So, if you click at the Cameras Bookmark, the list will automatically show you the available Cameras (as seen in the following images).

Figure 4-5: Available Bookmarks

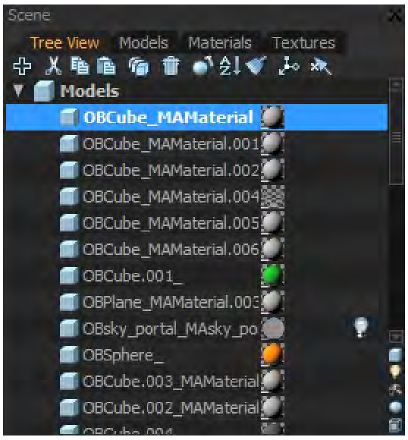


Figure 4-6: Initial list, starting with the Models of the scene.

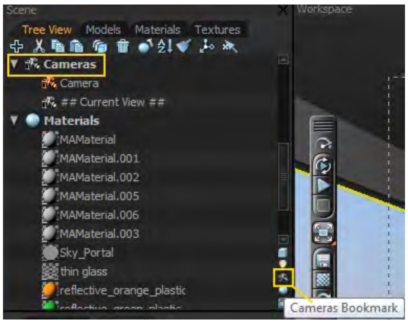


Figure 4-7: By clicking on the Cameras Bookmark, we see now the available cameras.

4.2.1 Tree View Options Bar

The available options that will be analyzed are (see Figure 4-8):

1. New Group/Camera/Material
2. Cut
3. Copy
4. Paste
5. Duplicate
6. Delete
7. Build All Material Previews
8. Sort Scene
9. Clean Up Scene
10. Transform Scene
11. Unselect

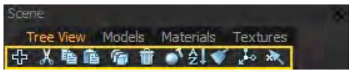


Figure 4-8: Tree View Options Bar

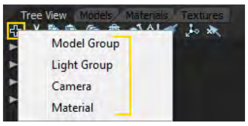


Figure 4-9: New Model/Light/Camera/Material

1. New Model Group, Light Group, Camera, Material: when pressing the New button, a list with four options appears, in order to select the new object that you want to create. You can create a new model group and an icon like in Figure 4-10 will appear at the Models list. A gizmo will be also added in the Viewport to show the position of the new model group. You can also create a new Light group. An image like shown in Figure 4-11 will appear at the list of Point Lights and a gizmo in the Viewport which will show the position of the new group. By choosing New Camera option, you can add a camera in your scene and its name will appear in the cameras list (see Figure 4-12, where the new camera takes the number #n (n= 1, 2, 3, ...) depending on the amount of cameras already used. The new material button adds a new material icon at the list of the Materials (see it in Figure 4-13). This new material is by default empty, but you can create or assign to it the material you want.

Note: whenever an item -or items- is selected in the Tree View list (it is **highlighted** with gray color), then this item is also selected in the Viewport and, in the case of a model or material, the material preview can be seen in the material lab as well . You can quickly **rename** an item by clicking on it for a second time (after it has been selected).

Figure 4-10: New Model Group

Figure 4-11: New Light Group

Figure 4-12: New Camera

Figure 4-13: New Material

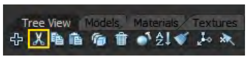


Figure 4-14: Cut Option

2. Cut: this tool can delete and remove from the Viewport a selected model or light. You may have selected it from the Viewport or from the Tree View List and in both cases it will be highlighted in the list of the models (gray highlight color). Once you click on the Cut, object will be cut.

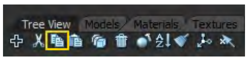


Figure 4-15: Copy Option

3. Copy: this button is creating a copy of the selected item. It may be a model, a texture, a material, a camera or a light. It can work in cooperation with the Paste button.

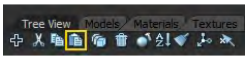


Figure 4-16: Paste Option

4. Paste: paste button uses the already copied item/s and creates new ones to the corresponding list: if the selected item is a model, the copied and pasted model appears now at the Models list and on the same position with the initial model in the Viewport, if it is a material, it is added at the Material list and so on.

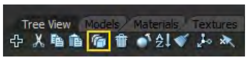


Figure 4-17: Duplicate Option

5. Duplicate: this button creates an exact copy of the selected item and puts them in the same list (if it is a model, at the Model list and also at the same place with the original one in the Viewport).

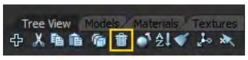


Figure 4-18: Delete Option

6. Delete: this button is used to completely delete a selected item from the lists we have it (and from our scene).

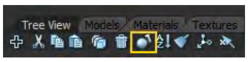


Figure 4-19: Build All Material Previews

7. Build All Material Previews: this button is used to create the preview of all the materials you have. Once a material has no preview, this button helps you to create one. If some materials have already one, they will be skipped by the process. The built previews are created according to the settings specified by the user at the Material Lab Preview tab of the Settings panel (see Figure 4-41). In that panel, you can select the auto refresh option, which creates a preview automatically for a selected material (see it at Figure 4-20).

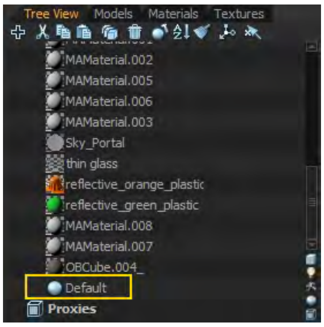


Figure 4-20: A new Material is created and currently has no Preview.

Figure 4-21: Material Lab Preview Options at Settings panel.

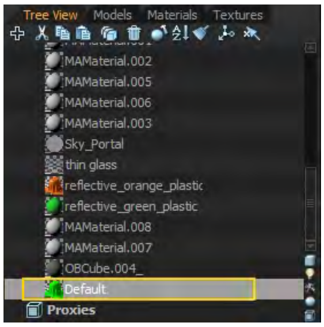


Figure 4-22: The Build All Materials Previews option creates the material preview according to the specified options.

As the terms **Clear**, **Build** and **Rebuild** will be seen many times later, we will give some more details here.
When we create a new material, it comes with no preview. We can then edit it, add layers etc. and we may need a new preview of it. With the Build option, a material that has no preview gets a new one. If it has already a preview, we need to use the Rebuild option, which deletes the previous preview and creates a new one. For deleting a preview we can use the Clear Preview option.

Apart from the preview options concerning one material, there are also the terms **Clear All**, **Build All** and **Rebuild All** which refer to all the existing materials. Clear All button, deletes all the current previews. Build All, builds previews for the materials that have no preview at the moment (for large scenes, this option saves time, as it doesn't affect the existing previews). Rebuild All option deletes and rebuilds all the previews of all the materials that exist.

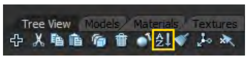


Figure 4-23: Sort Scene

8. Sort Scene: the items of the lists are placed one below the other by the order they are created/added in the scene. This button, recreates the existing list but this time, items are listed alphabetically (from A to Z -in English language- with numbers coming first). In the next figures we see the way an example list is now sorted.

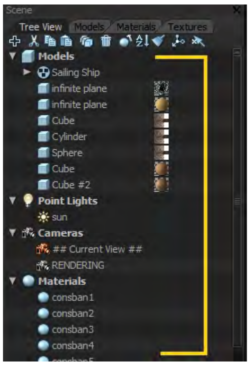


Figure 4-24: Initial List

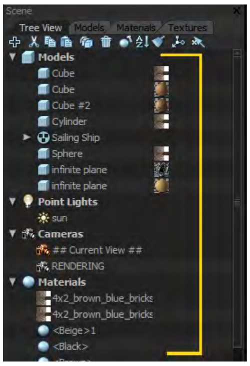


Figure 4-25: List in Alphabetical Order

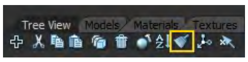


Figure 4-26: Clean

9. Clean Up: this button, removes from the Tree View all those groups that are empty (they include no models or lights) and textures or materials that are not

Up Scene — assigned to any model in the scene.

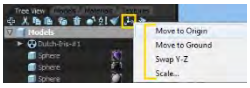


Figure 4-27: Transform Scene

10. Transform Scene: when this button is pressed, a drop down list appears with four options to help you transform the whole scene:

1. Move to Origin: the whole scene is aligned with regards to the Grid in the Viewport. The middle of the scene (from the highest to the lowest point) is at the same level with the Grid.
2. Move to Ground: the whole scene is shifted to the ground so that the lowest part of the scene to be placed at the surface of the Grid.
3. Swap Y-Z: as many applications use for vertical axis the Y-axis instead of the Z-axis that Thea uses, some imported scenes may be inserted incorrectly. With this button all objects change position as their Y-Z axes are swapped (see Figure 4-29).
4. Scale: this button opens a dialog box (see in Figure 4-30), where you can insert the desired scale of the scene. Values larger that one, make your scene larger, while smaller values shrink it, as we can see also in Figure 4-31.

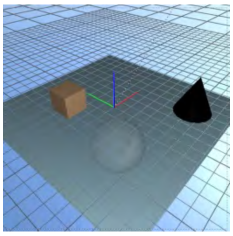


Figure 4-28: Initial Position of the Scene

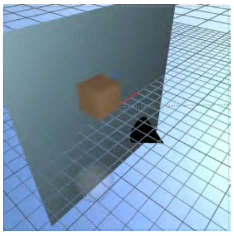


Figure 4-29: Scene after Swapping Y-Z

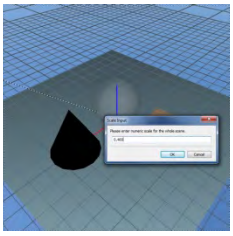


Figure 4-30: Scale Dialog Box

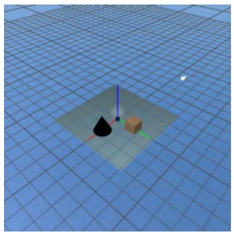


Figure 4-31: Scene Scaled to 0.4

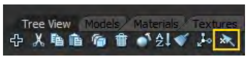


Figure 4-32: Unselect Option

11. Unselect: we may have selected one or more objects in the Viewport or at the Tree View List. With this button all the selected objects are unselected. They are no longer highlighted in the Tree View list or selected in the Viewport. We can perform the same action by pressing “0” at our keyboard or by the use of Select/Unselect toolbar of the Viewport.

4.2.2 Tree View List – Models Property Flags and Right Click Options

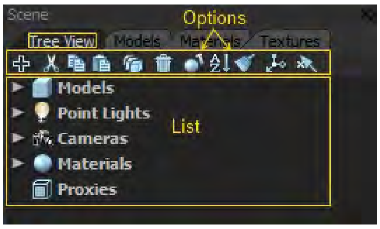


Figure 4-33: Tree View List

As we have already mentioned, all the existing models, point lights, cameras, materials and proxies of the scene are listed in the Tree View List, as we see in Figure 4-33. This list is now in a compact form, as only the main titles are seen. If you press at the small triangle icons at the left side of each category, the included items will be seen in an extended list, like this of Figure 4-34.

As we see, the models of our scene, which include also the packages of the instances that we may have created, are listed at the Models category. All lights, light groups and the sun (if enabled) are listed at the Point Lights category. Below, the existing cameras are displayed (Current View camera is also listed). At the Materials category, all the materials are presented. Note that in this list, you can find even the materials of models that you have deleted. This feature assures that even if you erase a material accidentally, by this way you can track it here and keep it for

Figure 4-34: Tree View List extended

later use as well. You will need to use "Clean Up" option to remove it completely.
Next to the name of the scene items we can see some **property flags** that are appearing based on the item status. For example, in the case of models, one can easily see whether a model is hidden or is animated. For materials, you can easily check out whether a geometric modifier is applied to a material or the material corresponds to an area emitter. At the next table we will see how these property flags look like and what they mean. Apart from the visual display of the existing items and their properties, at the Tree View list we can perform several actions by doing a **right click** on an item. A menu list appears (which we will analyze later) with basic commands.

Tip: by doing a **right click on the name of each Category** area, a list like in Figure 4-35 appears. You can create a New group/camera/material, transform the models sort them or clean them up. These options are equivalent to the options we have previously described at the Options bar of this panel.

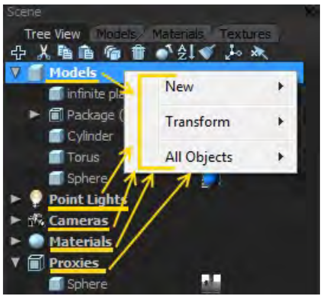


Figure 4-35: Right Click on Categories

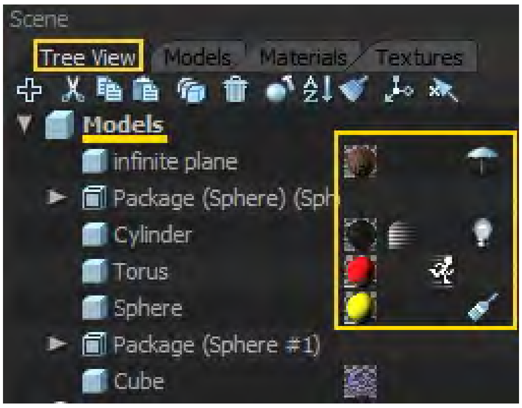


Figure 4-36: Models Property Flags

As we see in Figure 4-36, next to each model, several flag icons can appear according to model properties.
The umbrella icon next to infinite plane shows that the selected model has a material that is a shadow catcher. This property can be assigned at the Material Lab or by the options that appear at right clicking. This flag is also displayed to the Materials category flags.
The square icon next to Cylinder shows that the model is either not enabled or not visible.
There is also a lamp icon next to it, revealing the selected model has an emitter material.
The running man icon next to the Torus shows that this model is used in an animation.
Brush icon next to the Sphere, shows that the model material is repaintable (will be used with Motiva Colimo application).

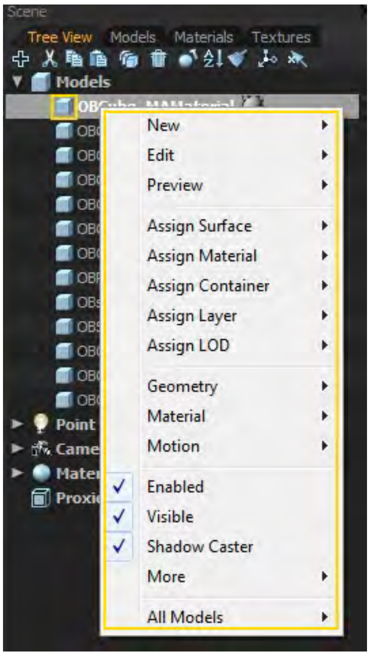


Figure 4-37: Models Right Click Options

In Figure 4-37, we have done a right click on a model of the list and we see the new drop down list that appears. User can perform several tasks with these options, which are analyzed at the next table.

New: create a new Model Group.

Edit: this option helps user to group/ungroup a model, cut, copy it, paste or paste it into, duplicate or delete it.

Preview: at this list the following options appear: Clear, Build, Rebuild, Clear All, Build All and Rebuild All. As at this list the models are just listed and the preview next to them refers to their material (we do not see the models geometry), the model previews can be seen at the Models tab which is the second tab of the Scene panel (see Figure 4-39). Clear is used to remove a current preview, Build to create a preview if there is none and Rebuild to create a new one instead of the existing. These functions can be applied to all models too. Note that Build All option, builds the previews of models which had no preview. In the next figures we see some examples of these options.

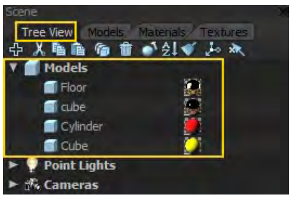


Figure 4-38: We have clicked on Clear All Previews - Models are seen in the Tree View list with a preview of their Materials

Figure 4-39: By switching to Models Tab, we see that the Clear All Previews has created Models with No Preview (they have a green icon instead)

Figure 4-40: By selecting Build All Previews from the Models right click options, we see their Previews at the Models Tab

Assign Surface: with this option, you can create a surface proxy for the selected model or, if you have already created one, instantiate the model mesh and assign another surface proxy. As you see in Figure 4-41, we can give a name for the new proxy and from now on the icon that represents the selected model at the Tree View is changing in a triangle, as seen in Figure 4-42. Surface proxies are used for memory saving purposes, since a (heavy) triangulation mesh can be shared between multiple models.

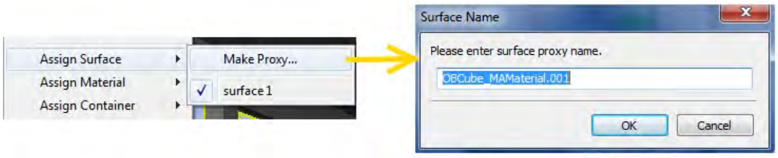


Figure 4-41: Assign Surface and Surface Name window

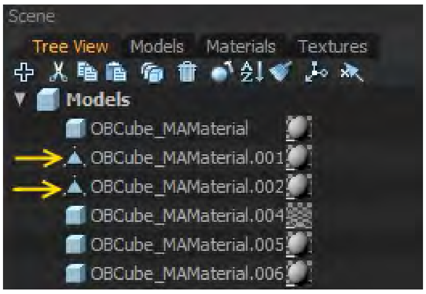


Figure 4-42: Models assigned to a Surface

Assign Material: a list of all the materials that exist in the scene appears and you can select among them the one you want for assign it to the selected model.

Assign Container: the default container for all the models is the Global medium, but here user can define another material (container is a secondary material describing the "backside" of the object). This may be needed when for example an item is within water so its container is not air (global medium) but water material.

Assign Layer: by this option, you can assign a layer to the selected model. A list with all the layers appears (there is a tick icon next to the current layer) and you can select the layer you want to contain this model from now on.

Assign LOD: The downsampling level of detail can be assigned per model; this way we can have coarser resolution for some models and finer for others. For models that are using proxies, this number corresponds to how sparse the instances will be drawn in the Viewport. Please note that this option is used only when Level of Detail is enabled.

Geometry: from this drop down list, you can smooth the selected model (choose desired degrees), subdivided it by two methods (Planar or Charles-loop), weld vertices, flip normal (useful for cases you want to change the normals direction, at emitters for example), center the pivot point or commit position of the model. Commit position is moving the model coordinate frame to the global frame position and actually no difference is created in the scene; this option is introduced mainly for testing purposes.

Figure 4-43: Initial Emitter Light

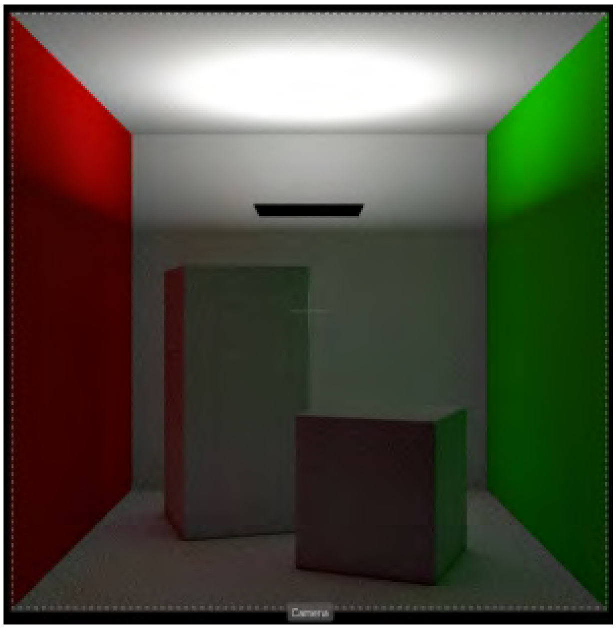


Figure 4-44: Emitted light after flipping its normals

Material: these options concern the material of the selected model and include tasks like copy, paste, paste from material, make unique (use it for example when you have duplicated a model but you need to assign different material only to this one), select models, reload bitmaps and also specify if the material will be two-sided, repaintable and shadow catcher or not.

Motion: this menu is useful when there is an animation created. From here user can define if the motion will be smooth, closed and periodic or not. There are options to set the duration in total key frames, select the active track, copy/paste/delete the motion and load or save motion presets. At the Add Special, you can also add a circular motion for an object. A pop-up window appears (see Figure 4-45) that let user define the Start and End Key Frames, the Rounds and Lock or not the target. The Lock Target parameter is used only for cameras. Note that the circular motion cannot be combined with any other motion track.

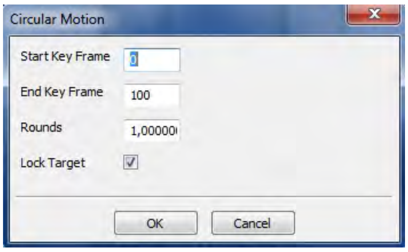


Figure 4-45: Circular Motion pop-up window

Enabled: user can define if the selected model will be enabled or disabled.

Visible: a model can be enabled but be invisible in the scene. This means it will not be rendered but it will affect the scene (with its reflections for example). You can see an example in Figure 4-47.

Shadow Caster: an item by default drops shadow according to the lights position. By disabling this option, the item has no shadows as the items in Figure 4-48.

Figure 4-46: Initial Scene – Orange Sphere and Green Cube are Enabled, Visible and Shadow Casters

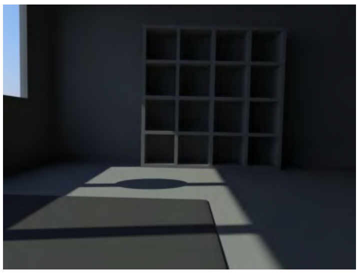


Figure 4-47: Objects are Enabled (they Drop Shadow) but not Visible

Figure 4-48: Objects are Enabled, Visible but Drop no Shadow

More: here user can enable/disable the following properties for the selected model: Shadow tight, Shadow receiver, Caustics transmitter – receiver, Swapped Y-Z (change model axes).

-Shadow Tight, which is by default selected for all models, is used to offer solution to a problem known as the "terminator artifact" (artifact seen at the limit of lighting models that have low-poly subdivision). This solution produces smooth renders even for very low-poly models. Sometimes though, user can select to disable this “fix”, in cases of not well defined meshes, where smooth render may not be desired to be applied.

-Shadow Receiver gives to the models the property to get shadows that other models may throw on them. By disabling it, the model will throw shadows to the rest scene, but will receive no other shadow (it is used with Adaptive (BSD) engine).

-Caustics are the total of light rays that have been reflected or transmitted via at least one specular surface (like water or glass) before hitting a diffuse surface. User, can define here if the selected material will let caustics to pass it through and if they will accept or not caustics on them. In the next figures, we see at first caustics created by the water and the glass and being seen on the floor (Figure 4-49), while at the next figure (Figure 4-50), floor is selected not to accept caustics (Caustics Receiver Disabled). These options are used again with the Adaptive (BSD) engine.

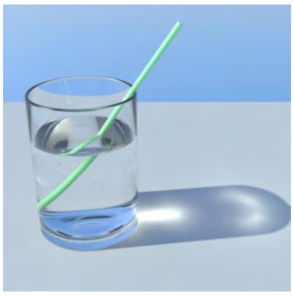


Figure 4-49: Caustics are transmitted through the glass and are seen on the floor

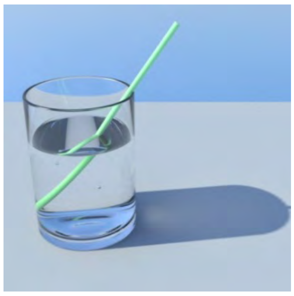


Figure 4-50: By disabling floor from being a Caustics Receiver, caustics are no longer visible on it

All Models: from here user can make a Selection of all models, Sort them or Clean them up (by the way we have explained at the options bar).

4.2.3 Tree View List – Point Light Property Flags and Right Click Options

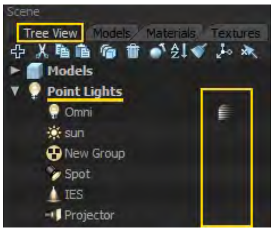


Figure 4-51: Point Light Property Flags

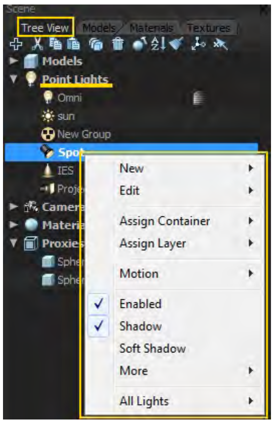


Figure 4-52: Right Click Options for Point Lights

In the same way we have analyzed flags and right click options for the Models category, we will see them here, this time for Point Lights category.

In Figure 4-51 we see the flag properties for the lights. The square icon next to Omni light shows that the selected light is not enabled.

In Figure 4-52 we see the options list that appears once we right click on a light and they are analyzed at the next table.

New: you can insert a new Light Group by this option.

Edit: here you can find options to edit the selected light, such like group/ungroup, copy, paste, paste into, duplicate and delete.

Assign Container: in the same way that models are assigned to a certain container, lights also can be assigned to Global medium (default choice) or to another material.

Assign Layer: from this list of all the layers you can define the layer that will contain the selected light.

Motion: lights as well as models can be moved too (create an animation). Here the user can define if the motion will be smooth, closed and periodic or not. There are options to set the duration in total key frames, select the active track, copy – paste – delete the motion and load or save motion presets. From Add Special option, Circular motion can be also enabled.

Enabled: if the light is enabled a tick icon will be next to it, otherwise, by clicking again at the option, light will be disabled (a property flag will appear as well).

Shadow: user can define if the selected light will create or not shadows to the objects that emits light on. In Figure 4-54 the spot light emits light to the scene but the objects have no shadow that corresponds to this specific light (Adaptive BSD engine only for point lights).

Soft Shadow: user can select if the light will create soft shadow to the objects that illuminates or not. Together with simple shadow, they create a result like this in Figure 4-55, where objects have a thick and a soft shadow.

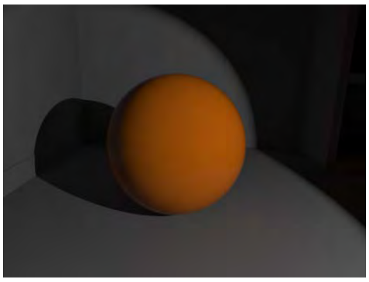


Figure 4-53: Spot Light is Enabled and Drops Shadow – We see a thick shadow behind the ball

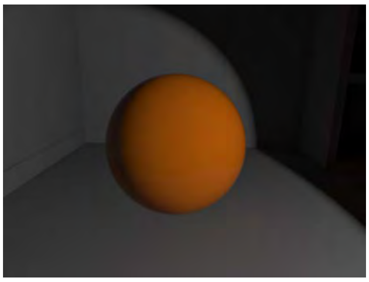


Figure 4-54: Spot Light Emits Light but Creates No Shadows – There is no shadow from the ball to the floor.

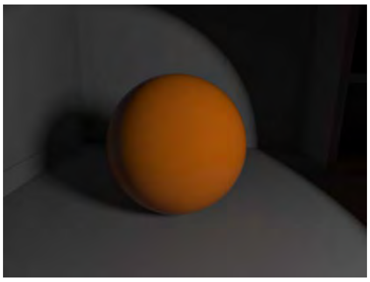


Figure 4-55: Soft Shadow is Enabled – We see a thick shadow in the middle and a soft one around it.

More: global photons and caustic photons parameters indicate whether the light will be used in the computation of global and caustic photon map. Note that these parameters are only used with Adaptive BSD engine.

All Lights: this option can select or sort all available lights that exist in the list.

4.2.4 Tree View List – Camera Property Flags and Right Click Options

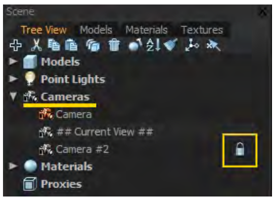


Figure 4-56: List of Available Cameras

Accordingly to the way we have analyzed flags and right click options for the Models and Point Light categories, we show here the options that are available for cameras.

In Figure 4-56 we see the list of all available cameras in the scene displayed in the Tree View. Camera with orange color is the one which view is currently displayed in the Viewport and the padlock icon at the right side shows that this camera is locked.

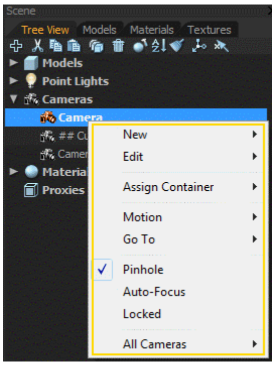


Figure 4-57: Right Click Options at a Camera

In Figure 4-57 we see the list that appears once we right click on a camera. At the next table we see an explanation of these options.

New: this button inserts a new camera into the scene and it appears in the list of cameras as well.

Edit: from this menu, user can copy a camera, paste it, duplicate or delete it.

Assign Container: as other objects, a camera can be contained in global medium or to another material and user can define this from this list.

Motion: during an animation, most times a camera follows the animated model so details for its motion need to be specified. At this menu, as in the other motion menus we described before, user can define if the motion will be smooth, closed and periodic or not. There are options to set the duration in total key frames, select the active track, copy – paste – delete the motion and load or save motion presets. Apart from these options though, for a camera, we have the Target option too. User can copy, paste or delete a camera target from here and define a free rolling or lock it to one direction (for example the motion to follow only the Z-axis as the animation is taking place). Circular motion can be also enabled.

Go To: user can place the selected camera to the Current Position (the position the Current View camera is placed) either to the Current View (change the camera settings accordingly to the Current View camera).

Pinhole: by enabling the Pinhole option, the f-number of the camera (that affects the Depth of Field) is set to pinhole (theoretically equals to zero and creates no Depth of Field at all).

Auto Focus: user can enable auto focus for a camera or disable it. Focus value can be otherwise specified at the camera properties panel.

Locked: we can enable this option to lock or unlock the selected camera so that its view to stay constant.

All Cameras: this option can help the user to select all cameras and sort them too.

4.2.5 Tree View List – Materials Property Flags and Right Click Options

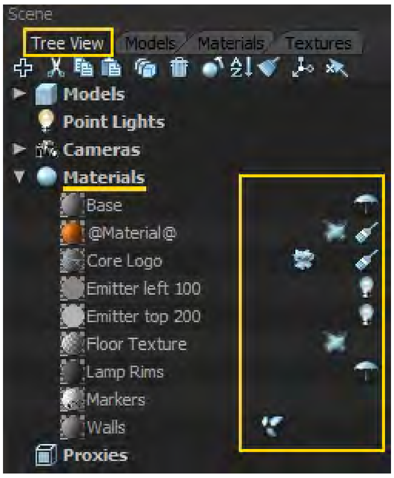


Figure 4-58: Flag Properties for Materials

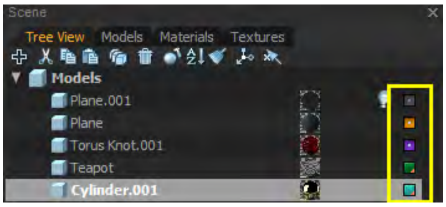


Figure 4-59: Layers icons

In Figure 4-58 we see the flags that appear next to the materials to define whether a geometric modifier is applied to the material or the material corresponds to an area emitter etc. More analytically:

-The umbrella icon, next to the first material ("Base") in this figure, shows that the material is a shadow catcher and the same flag is visible to the model that has the same material at the Models list.

-Next to the orange material, we see a "fog" icon that reminds us that the certain material has a medium applied to it or an SSS material.

-The brush icon that exists next to it shows that this material is repaintable (works with Motiva Colimo application).

-At the right side of the "Core Logo" material, we see an icon with a kind of rock scheme which indicates that for the selected material we have used displacement.

-The lamp icon, as we saw it at the Models flag properties, shows that the material corresponds to an emitter.

-Finally, at the last material, "Walls", we see a leaf icon which shows us that Clipping has been applied to this material.

The square icon at the right side of the models, indicates the layer to which they belong. Apart from layer identification, with the orange triangle upon the layer square icon we can easily see which of these layers (and their objects) are hidden (see)Figure 4-59.

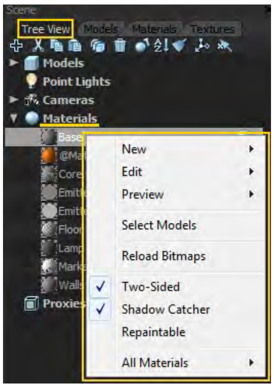


Figure 4-60: Right Click Options for Materials

As we see in Figure 4-60, by doing a right click on a material, a list with options appears and their functions are explained at the next table.

<u>New</u>: a new material can be created by this option. This new material with the name Default will be placed at the bottom of the Materials list. It can be later edited and applied to a model as the other materials.

<u>Edit</u>: user can edit the selected material and perform actions like copy it, paste it, duplicate or delete it.

<u>Preview</u>: at the left side of the materials list we see a small preview of each material. These previews can be cleared, built or rebuilt for this material or for all, by the use of the options. As we have already mentioned, Build option is only applied to materials with no current preview while Rebuild option recreates the preview by replacing the existing one. The same Options can be applied to all materials as well. Build All option will create previews only for those they have none.

Remember that you can also switch to the Materials tab, in order to see these previews in a larger scale. In the next figures we give some examples of the effects these options have to the materials previews.

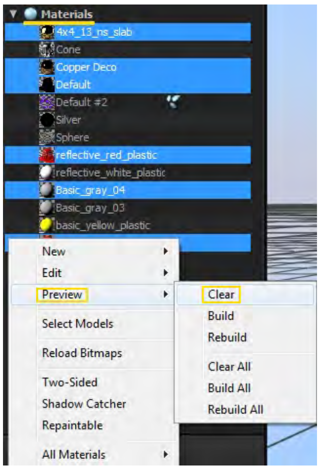


Figure 4-61: We have selected certain materials and we will Clean their Previews

Figure 4-62: Selected Materials at the Tree View have no Previews

Figure 4-64: By choosing Build option for selected materials New Previews according to Material Lab specifications are created at the Tree View

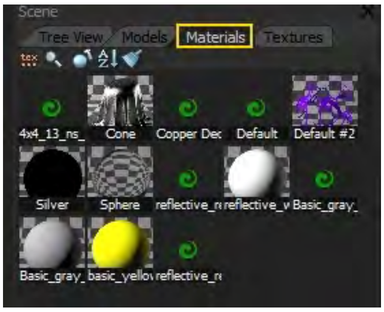


Figure 4-63: Materials have no Preview at the Materials Tab

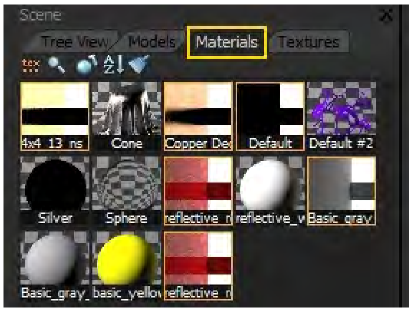


Figure 4-65: New Previews are also seen at the Materials tab

Select Models: this option helps the user to select all the models in the scene that have the specific material on them. These models are highlighted in the Models list and also in the Viewport.

Reload Bitmaps: a bitmap image, that may be used for a material as a texture can be reloaded with this option as it may have been modified meanwhile from another program.

Two-Sided: With this option you can tell the renderer not to take into account any intersections with the back surface of the assigned objects. Thus, only the only the front surface will be rendered. This option is useful also for defining sun/sky portals. In the next figures for example, the material that is applied to the floor has Two-Sided option disabled.
Note that even if it is not visible from the other side, the material properties are still enabled at the side we do not see. So reflections for example of the floor still exist (see Figure 4-67).

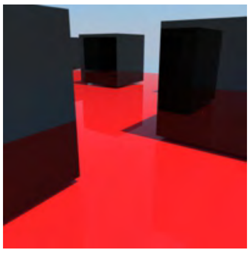


Figure 4-66: Floor material with Two-Sided Disabled as seen from above

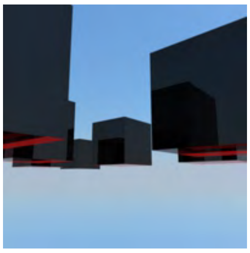


Figure 4-67: Floor material with Two-Sided Disabled as seen from below – it is Invisible though still Enabled

Shadow Catcher: this option can enable a material to be a shadow catcher or not. This feature is used to integrate a model into a scene with a background image as with the Shadow Catcher, we introduce realistic shadows produced by IBL, sun and Thea point lights. In addition to these enhancements the shadow catcher can produce real reflections on ground plane. To enable real reflections, we add a glossy material to our ground plane and add a reflectance color.

Figure 4-68: We insert at the bottom of our scene a plane with Shadow Catcher Enabled and no material

Figure 4-69: Shadow Cathcer settings for Reflectance

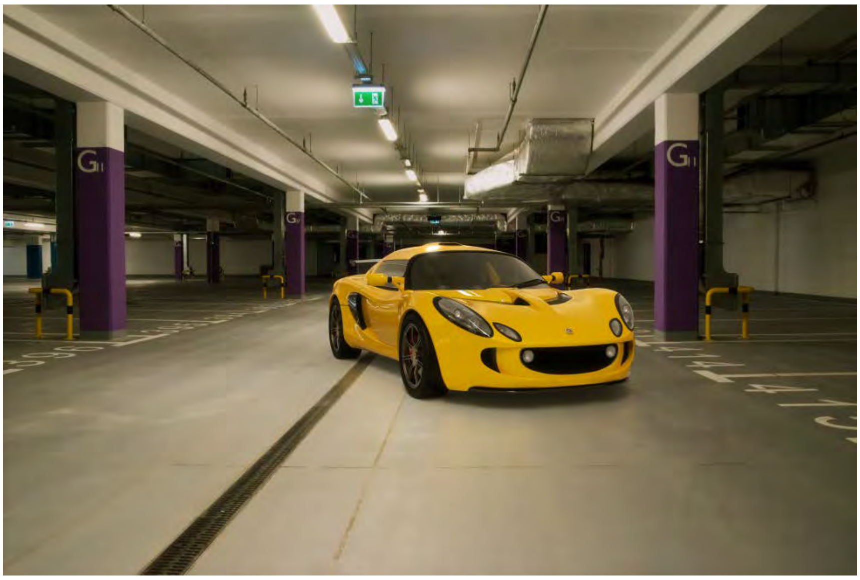


Figure 4-70: This render shows the shadow catcher in action. The illumination is provided by a HDRI and we can see the shadows produced on the back plate image under the car. A bit of blurry reflection has been added to the ground plane shadow catcher, integrating the car with the environment.

Repaintable: this option enables the material to be used for repainting at Colimo application, after it is rendered.

All Materials: with this option you can select all the existing materials, sort them or clean them up (remove unused materials).

4.2.6 Tree View List - Proxies Property Flags and Right Click Options

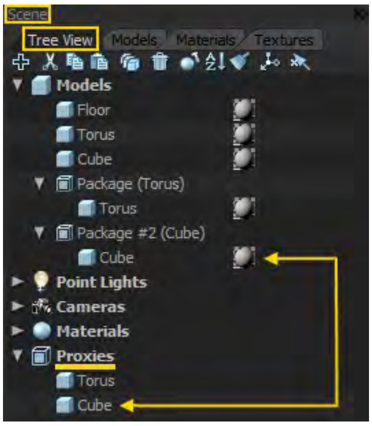


Figure 4-71: Proxies List

As we see in Figure 4-71, the last category that appears in the Tree View List is the Proxies. In case we have already created instances in our scene, with the use of Instancing Tool (Settings panel), the models that have been used as instances (initial object), are called Proxies and they are seen here (Model Proxies). The created instances compose a Package which appears in the Models List as a Package with the Proxy name.

In Figure 4-72 we see the available options that exist if you right click on one proxy of the list. We see that the existing options are almost the same as the ones that appear for the Models. The only options missing are the New, Edit, Preview, Assign Layer and the Motion.

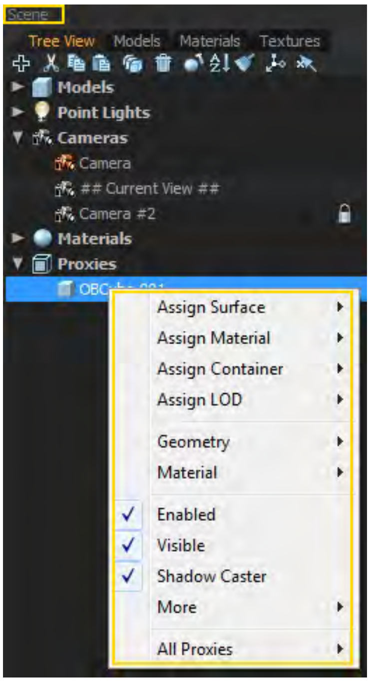


Figure 4-72: Available Options for Proxies with Right Click

The rest options are the same as we have analyzed in the Models right click options and we give a description at the next table.

Assign Surface: with this option we can create for the selected proxy a surface proxy or assign to the whole package another one.

Assign Material: a list of all the materials that exist in the scene and in material category list appears and you can select the one you want for the proxy. The package that has been created will automatically get the same material.

Assign Container: as we have previously said, the default container for all the models is the Global medium, but here user can define another material for the selected Proxy (container is a secondary material describing the "backside" of the object). This may be needed when for example an item is within water so its container is not air (global medium) but water material. Corresponding Package will get this container too.

Assign LOD: The downsampling level of detail can be assigned per model; this way we can have coarser resolution for some models and finer for others. Please note that this option is used only when Level of Detail is enabled.

Geometry: from this drop down list, exactly as it happens for the models, you can smooth the selected Proxy (choose desired degrees), subdivided it by two methods (Planar or Charles-loop), weld vertices, flip normals, center the pivot point or commit position of the Proxy. All models of the packages will be automatically updated with these properties.

Material: these options concern the material of the selected Proxy and its Package correspondingly and include tasks like copy, paste, paste from material, make unique (use it when you have duplicated a model but you need to assign different material only to this one), select models, reload bitmaps and also specify if the material will be two-sided, repaintable and shadow catcher or not.

Enabled: user can define if the selected Proxy and the corresponding Package will be enabled or disabled.

Visible: a Proxy as a model can be enabled but not visible in the scene. This means that the selected Proxy (and the created package) will not be rendered but will affect the scene (with their reflections for example).

Shadow Caster: an item by default drops shadow according to the lights position. By disabling this option, the packages with instances created from the selected Proxy will throw no shadows.

More: here user can enable/disable the following properties for the selected Proxy: Shadow tight, Shadow receiver, Caustics transmitter/receiver, Swapped Y-Z (change model axes).
These options have been explained in the Models right click options and are applied to Proxies in the same way as to Models.

All Proxies: user can select here all proxies, Sort them and Clean them Up.

4.3 Models Tab

Figure 4-73: Models Tab with available Options and Appearing List

The second tab of the Scene panel is the Models Tab, as we see it in Figure 4-73. As the Tree View tab, this tab also consists of the Options bar at the top and a list with the models below it, where by doing a right click new options appear.

In the next tables we analyze these two areas of the Models Tab.

Tip: you can drag and drop a model from this list to a browser folder and in this way save it for future use.

4.3.1 Models Options Bar

Figure 4-74: Options for Models Tab

As we see in Figure 4-74, we have 5 options for this tab, which are presented at the next table.

1. Toggle Names: at the list of the models which exist below these options, at the bottom of each model we see a text with its name (Toggle Names icon is orange as in Figure 4-75). Once we press Toggle Names button, the names below the previews of the Models disappear (Figure 4-76).

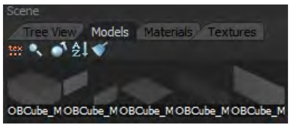


Figure 4-75: Toggle Names Enabled

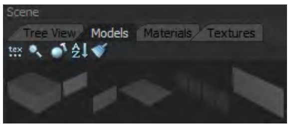


Figure 4-76: Toggle Names Disabled

2. Toggle Icon Size: there are two sizes for the previews of the listed models, a smaller one which is the default one (icon is in blue color as in Figure 4-77) and a larger one as in Figure 4-78 (icon in orange color).

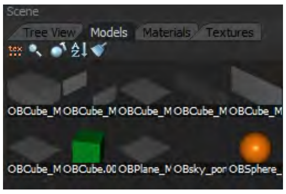


Figure 4-77: Previews in Smaller Size


Figure 4-78: Previews in Larger Size

3. Build All Previews: as we have also analyzed before, this option helps the user to build the previews of the models which currently do not have one.


Figure 4-79: Some Models have No Preview


Figure 4-80: Built All Previews, creates Previews for the

(we see a green icon instead) Models that had None before

4. Sort: this option sorts the list of the models in Alphabetical Order, according to their given name (A to Z with numbers coming first).

5. Clean Up: as some models may be deleted from the Viewport or some Model Groups are empty, this button helps you to remove them from the list.

4.3.2 Models List – Right Click Options

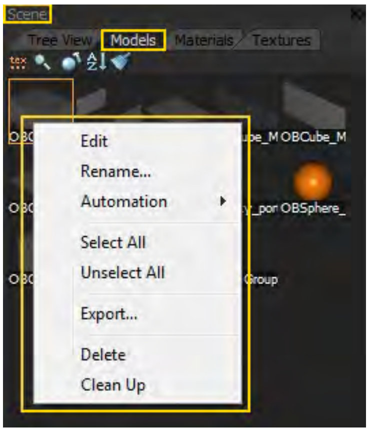


Figure 4-81: List of Available Options by doing a Right Click on a Model

Below the options bar, we see the list of all the existing models in the scene. We can do a right click on a model and the list of Figure 4-81 appears.

At the next table we analyze the way these options work.

<u>Edit</u>: by clicking this button, the selected model (where we did the right click) is now selected in the Viewport. It is also highlighted at the Models Tab list and at the Tree View list with models. You can also select the model in the Viewport by double-clicking on its preview at the list.

Rename: this option brings up a dialog box (see it in Figure 4-82) where you can change the name of the selected model. Remember that you can also change the names of the models and materials from the Tree View Tab, by clicking on them twice.

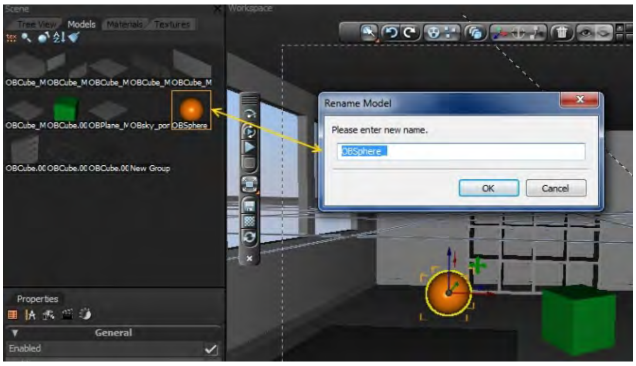


Figure 4-82: Rename Dialog Box

Automation: this option can Build the Preview of the selected model (we have already described this procedure).

Select All: by clicking this button, all the models of the list are selected.
Note: you can choose some of them with using Control+Click on the desired models.

Unselect All: once you have selected one or more or all models, you can hit Unselect All button unselect everything.

Export: by exporting a model, a pop-up window appears that makes it possible to save this model as a *.mod.pack type at the desired location (see Figure 4-83).

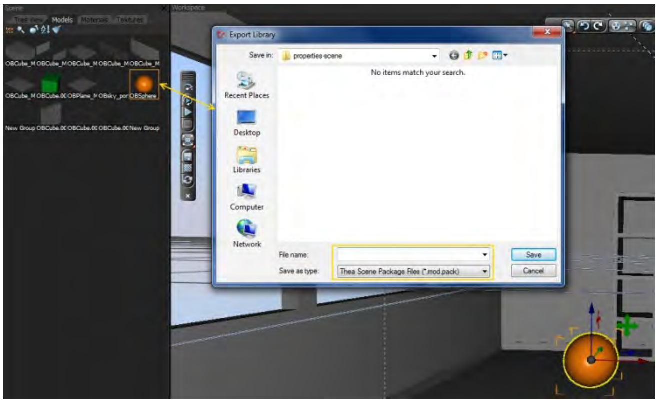


Figure 4-83: Pop-up Window to define the Location of the Exported Model

Delete: you can press Delete button to delete a model from the Scene. Once you do it, you will see it disappearing from the Viewport.

Clean Up: this button is equivalent with the Clean Up at the Options bar; it removes the unused models from the list.

4.4 Materials Tab

Figure 4-84: Materials Tab

The next tab of the Scene panel is the Materials Tab (see it in Figure 4-84). As the previous tabs, this tab also consists of the Options bar at the top and of a list with the existing materials below it, where by doing a right click new options appear.

4.4.1 Materials Options Bar

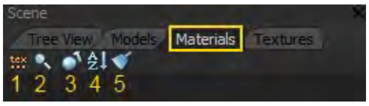


Figure 4-85: Materials Tab Available Options

As we see in Figure 4-85, we have 5 options for this tab, which are presented to the next table.

1. Toggle Names: at the list of the materials which exists below these options, at the bottom of each material preview we see a text with its name (Toggle Names icon is orange as in Figure 4-86). Once we press it, the names below the previews of the materials disappear (Figure 4-87).

Figure 4-86: Toggle Names Enabled

Figure 4-87: Toggle Names Disabled

2. Toggle Icon Size: as in the Models Tab list, here too, we can have two sizes for the preview of the listed materials, a smaller one which is the default (icon in blue color as in Figure 4-88) and a larger one as in Figure 4-89 (icon in orange color).

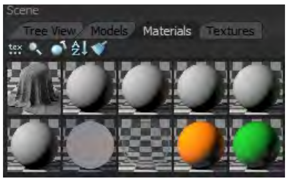


Figure 4-88: Smaller Preview Size

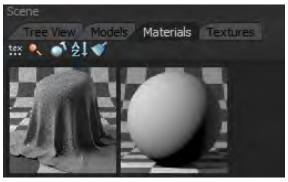


Figure 4-89: Larger Preview Size

3. Build All Previews: as we have also analyzed before, this option helps the user to build the previews of the materials that currently do not have one.

Figure 4-90: Some materials have No Preview

Figure 4-91: By Built All Previews option, the materials that had No Preview, now get one.

4. Sort: this option sorts the list of the materials in Alphabetical Order, according to their given name (A to Z with, numbers coming first).

5. Clean Up: as some models may have been deleted from the Viewport (and their materials are no longer in use) this button helps you to remove them from the list.

4.4.2 Materials List – Right Click Options

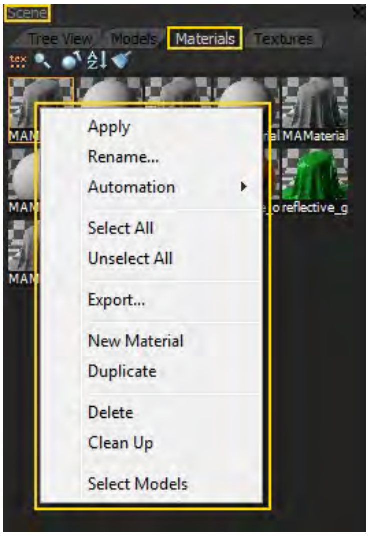


Figure 4-92: List of Available Options by Right Clicking on a Material

Below the options bar, we see the list of all the existing materials that are used in the scene. In the same way to the previous cases, we can do a right click on a material and the list of Figure 4-92 appears. At the next table we analyze the way these options work.

Apply: once a model is selected (in the Viewport) and we hit apply button (from the list that comes with right click on the material), the corresponding material is applied to the selected model.

Rename: this option brings up a dialog box (see Figure 4-93) where you can change the name of the selected material. Remember that you can change the names of models and materials from the Tree View Tab also, by clicking on them twice.

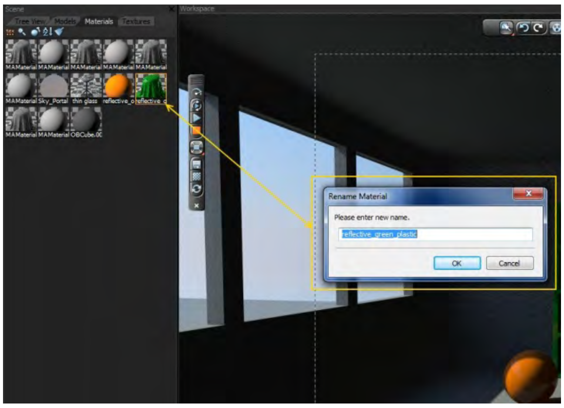


Figure 4-93: Rename Dialog Box

Automation: the first option we find at this drop-down list (Figure 4-94) is the Build Preview, which creates a Preview for the selected material in case it didn't have one.

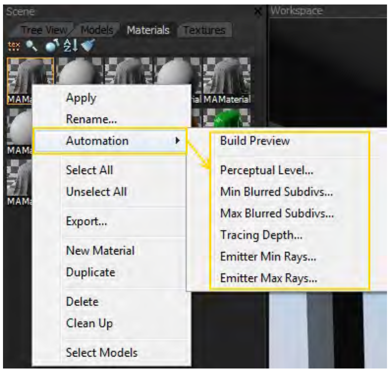


Figure 4-94: Automation Available Options

Below it we see some other automation commands, seven in total, where the user can specify certain material values at the appearing dialog box windows:

1. Perceptual Level: this option is used by the biased engine (Adaptive (BSD)) in order to accelerate direct light evaluation for the specific material. By default, it is set to 100% (full accuracy) but for various materials that make use of high-detailed textures, this parameter can be decreased to accelerate rendering. The idea behind this parameter is that many textures can mask noise due to their high frequencies and errors in the direct and indirect light evaluation are not easily perceived by the human eye. Thus, the user in these cases can set this parameter to a low value (even reaching values as low as 5-10%) to speed up rendering for the particular material.

2. & 3. Min/Max Blurred Subdivs: by default, minimum and maximum blurry reflection and refraction subdivisions are setup by the render settings. The render settings define the subdivisions globally for all materials. Here, the parameters can be used to change the subdivision on per-material basis. Thus, whenever we want improved accuracy for a specific material, we can tune it using these parameters rather than increasing accuracy settings globally for the whole scene. These settings are related to Adaptive (BSD) engine only.

4. Tracing Depth: with this option, user can set the value for the Tracing depth (used for Adaptive (BSD) engine) for the selected material.

Note: these values, that affect the Adaptive (BSD) engine, can be also found at the Material Lab panel at General Properties of the material (see Figure 4-95).

Figure 4-95: Material General Properties at Material Lab panel

5. Define the minimum emitter rays for selected material(s).

6. Define the maximum emitter rays for selected material(s).
These two values can be set also at the Material Lab, at Emitter properties panel as we see at the next figure.

Figure 4-96: Emittance Properties at Material Lab panel

Select All: by clicking this button, all the materials-files of the list are selected. You can also choose some of them with Control+Click on the desired ones.

Unselect All: once you have selected one, more or all the materials, you can hit Unselect All button to deselect them.

Export: by exporting a material, a pop-up window appears that makes it possible to save this material as a *.mat.pack type at the desired location (see Figure 4-97).

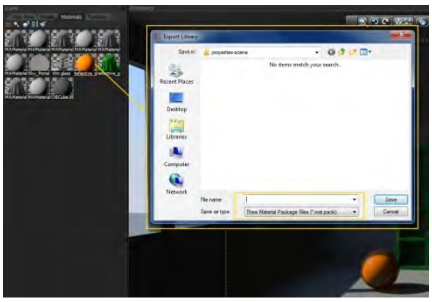


Figure 4-97: Pop-up Window to define the Location of the Exported Material

New Material: creates a new material (default one) with no preview yet available, in the materials list.

Duplicate: this option duplicates an existing material (it gets the name extension #2). You can then edit the new material without affecting the original one.

Delete: you can press Delete button to remove a material from the list and from now on the model that was using this material stays with no material.

Clean Up: this button is equivalent with the Clean Up at the Options bar; it removes the unused materials from the list.

Select Models: this option is used to select the models that on them the chosen material is applied.

4.5 Textures Tab

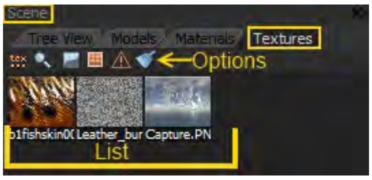


Figure 4-98: Textures Tab with available Options and Appearing List

The next tab of the Scene panel is the Textures Tab, as we see it in Figure 4-98. As the other tabs, this tab also consists of the Options bar at the top and of a list with the used textures in the scene below it, where by right click new options appear.
These textures may be applied to materials or used for Image Based Lighting.

4.5.1 Textures Options Bar

Figure 4-99: Available Options at Textures Tab

As we see in Figure 4-99, we have 5 options for this tab, which are presented in the next table:

1. Toggle Names: accordingly to previous tabs, at the list of the textures, at the bottom of each one, we see its name (Toggle Names icon is orange). Once we press it, the names below the texture disappear.

2. Toggle Icon Size: there are two sizes for the preview of the listed textures, as for models and materials. A smaller one which is the default one (icon in blue color) and a larger one (icon in orange color).

3. Show Procedurals &
4. Show Bitmaps: these two buttons can be switched in use in order to show at the list either the procedurals or the used bitmaps. In Figure 4-100, Show Procedurals icon is in orange, meaning it is active and we see the total list of procedurals that are coming with the program. In Figure 4-101, where Show Procedurals icon is in blue color (meaning it is inactive) we see the used bitmaps. Show Bitmaps icon is in orange and it is active.
Tip: procedurals are a separate category of textures. These pre-installed textures are not applied to your models as the bitmaps, but instead, they are applied according to an internal function they follow, in a specific way.

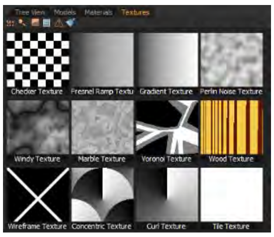


Figure 4-100: In the Textures List we see the Procedurals

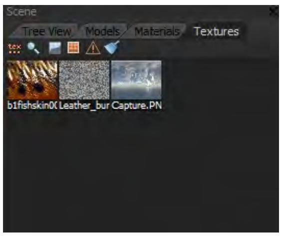


Figure 4-101: In the Textures List we see the used Bitmaps

5. Missing Bitmaps: sometimes, we may have applied a texture to a material, save the scene

(*.scn.thea files save links for the used bitmaps) and then change image location on the disk or delete it. Once we reopen the scene an error will exist at the right bottom of the application (as the link will no longer work). At this tab, a warning icon as shown in Figure 4-102 is present instead of the missing texture. By pressing the Missing Bitmaps button, you can get more details on the missing bitmaps. For finding the missing texture, you can use the Relocate option, which we will see later.

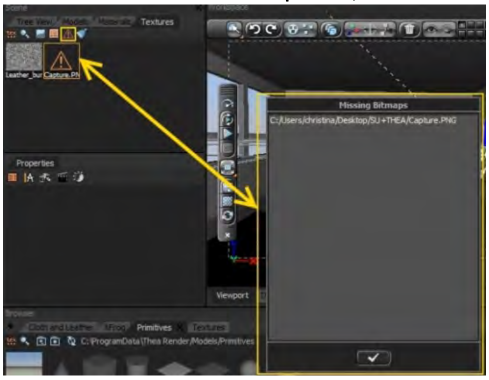


Figure 4-102: Missing Bitmaps Details Pop-up Window

6. Clean Up: as some models may be deleted from the Viewport and so some textures are not in use, this button cleans the list from unused textures.

4.5.1.1 Textures List – Right Click Options

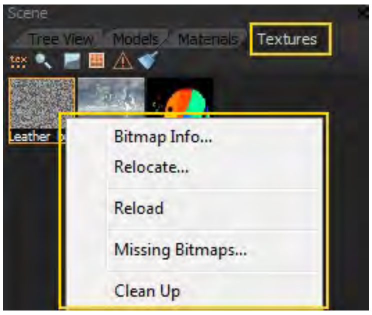


Figure 4-103: List of Available Options by Right Clicking on a Texture

Below the options bar, we see the list of all the existing textures - bitmaps in the scene. We can do a right click on one of them and the list of Figure 4-103 appears. At the next table we analyze the way these options work.

Bitmap Info: when pressing this button a window appears, as in Figure 4-104, which informs user for the location of the selected images in the disk and its resolution.

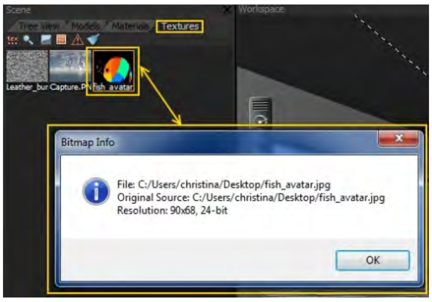


Figure 4-104: Bitmap Info Pop-up Window

Relocate: in case of missing bitmaps or updated images or if you need to switch this one with another one, you can use this button. A window appears (Figure 4-105) that helps you browse your disk and locate the new image and replace the previous one.

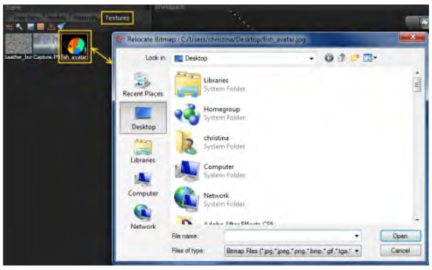


Figure 4-105: Relocate Bitmap Pop-up Window

Reload: as some bitmaps may have been edited from an exterior program, after the first time you used them, reload option checks if the image is updated and shows the last saved version of it.

Missing Bitmaps: this button is equivalent to the button at the options bar which we have already analyzed.

Clean Up: as we have explained at the options bar, some models may have been deleted from the Viewport and so some textures are not in use. This button cleans the list from unused textures.

4.6 Coordinates tab

At Coordinates tab (Figure 4-107) we can see all the coordinates of the object we have selected and these of its texture, if any is applied to it. The three columns represent the X-axis, Y-axis and Z-axis correspondingly.

Coordinates: here we see the coordinates of the model, camera or light that we have selected, by showing their relevant position to the global frame axes. Center represents the center of the object (x_0, y_0, z_0). Min and max values show the positions of the edges of the object to each axis. When you move an object, these three values change accordingly. You can also type the desired values here, and the object will follow the new coordinates. There is also the possibility to swap from meters to centimeters, millimeters, inches or feet at the Translation Unit drop down list. Scale values change whenever you change your object's size. You can specify here the exact dimensions you want. Rotation values, change too as you rotate an object. Rotation units can be switched between degrees and radians.

Note: this panel is equivalent to the first tab of the Transform panel that user can see in the Viewport (see Figure 4-106).

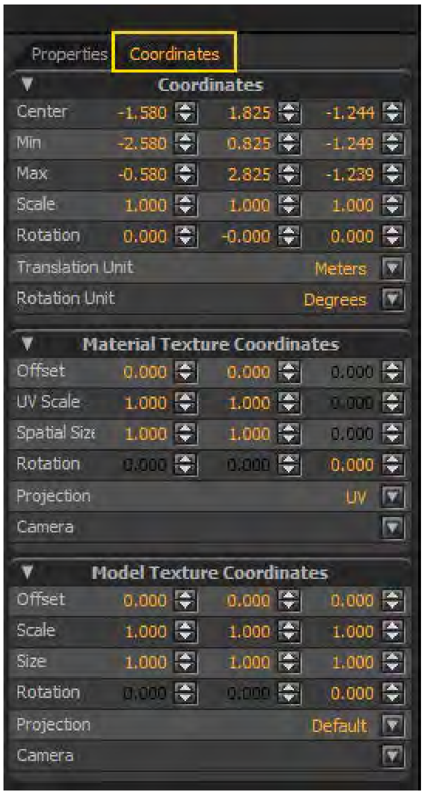


Figure 4-107: Selection Coordinates

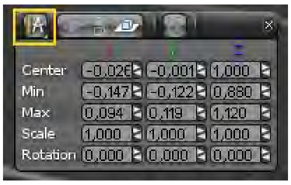


Figure 4-106: Transform Panel

Material Texture Coordinates: if you select a texture from the list of the Tree View or by choosing the model that has it (as model may has many textures, one of them will be viewed here), you can edit here the texture coordinates of the selected material.

Let us note that a material may have several bitmaps applied at other channels. A bitmap may be applied for the diffuse channel, another for reflection, another for bump map etc. At the Material Lab each time we click on a texture, a panel with this texture details appears (Figure 4-108). From there we can edit this texture scale, projection etc. These selections are applied to the specific texture. Once someone wants to apply textures changes to all the textures that a material has (and not edit each texture separately), the Material Texture Coordinates panel (see Figure 4-107) can be used. This panel is equivalent to the Bitmap tab of the Transform panel that user can find in the Viewport Toolbar (see it in Figure 4-109).
From these two panels (Properties and Transform panel), user can change texture X,Y,Z Offset, Scale, Size, Rotation, Projection and the camera that is used to see these changes. So, for separate editing of each texture, we can click on it at the Material Lab, while for changing the coordinates of all textures of a material, the Material Texture Coordinates Panel at Properties Tab is used.

Figure 4-108: Bitmap Options at Material Lab

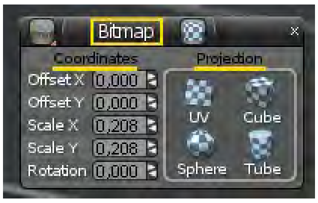


Figure 4-109: Bitmap Properties at Transform Panel

Model Texture Coordinates: these coordinates refer to the textures that are applied to a specific model. In other words, after having set the textures of a material (separately or all together as we described before) we can apply them to different models and transform again all of them for the current model.

Note: while the values of Offset, Scale, Size and Rotation act as multipliers to the previously given values (meaning that if the scale of a texture was set to 2 for X dimension and we now set Model Texture Scale for X axis to 3, the total scaling of the textures will be 2*3=6 times), the Projection overwrites the previous settings. This is why it is given the Default value at first, at the drop down list, so that the projection will be as specified for the material. By selecting another projection though, all material textures are projected with the new way.

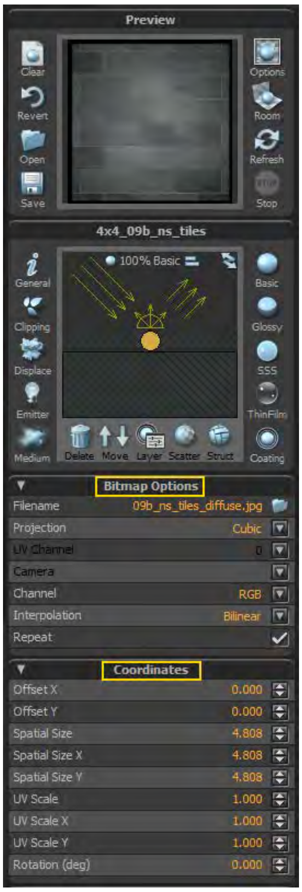


Figure 4-110: Diffuse Bitmap Options and Coordinates for Selected Tiles Bitmap

We'll give now a small example to see the way mataerial textures and model textures coordinates work. We assume we have a bitmap of some tiles that we want to assign at the Diffuse channel of a material, and then apply this material to 4 different objects: a floor, a rectangle, a pavement and a sphere. In Figure 4-110, we see the options and coordinates of the Diffuse Bitmap.

We apply the material, the way it is, to all the models that we want and we see the rendered image in Figure 4-111.
Afterwards, we go to the Material Texture Coordinates panel and we change the scale (x10) and the Projection (from Cubic to Cylindrical) of the textures that are applied to this material and we apply the material to all models again as before (see Figure 4-112).
After that, we edit the Model Textures Coordinates for each model separately. The results are shown in Figure 4-113, where we see that for the floor frontal projection is used, for the sphere a spherical one and lower scaling, for pavement we have Cubic projection and even smaller scaling and for the rectangle a Cylindrical projection and almost zero scaling. Besides these changes, material properties are still as they were before expect of the Projection which each time overwrites the one previously used. So, the global coordinates affect the way the material is displayed on the model and not the material settings.

Figure 4-111: Cubic Projection and same Scale for all Models

Figure 4-112: Cylindrical Projection and increase of Scale (edit Material Textures Coordinates)

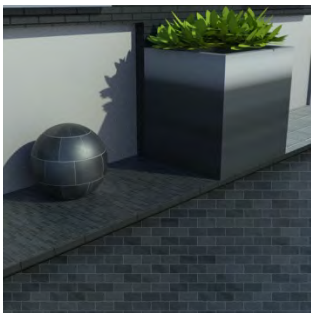


Figure 4-113: Model Textures Coordinates have been changed for each model

4.7 Properties tab

Properties Tab hosts all the necessary properties of a selected object. In the next figures we see the way it looks for different selections: for a model, for a light and for a camera.

Figure 4-114: Properties Tab - Selected Object is a Model

Once the user has selected a model, the Selection Properties panel looks as seen in Figure 4-114. As we see, properties of the model are similar to those we saw at the right click options for a model at the Tree View list (see page 92) are displayed.

General: from here, user can decide whether a model will be Enabled, Visible, Shadow Tight, Shadow Caster, Shadow Receiver, Caustics Receiver and Caustics Transmitter by selecting/unselecting the corresponding boxes.

UV Channels: we see here a list of all the available Channels (for example the Diffuse, the Refraction, the Bump etc. channels) and the number of the map that is linked to it. As many times, the inserted models have multiple UV channels, here the user can make the connection, by selecting the corresponding map from the numbers list. A diffuse texture can be mapped to channel 0 and a displacement texture to channel 1. You can also define this matching at the Material Lab panel, by clicking on a selected texture. At UV Channel, default value will correspond to the material part you are currently editing (for example its bump or its diffuse part etc.). You can though select a different channel to link at the certain texture.

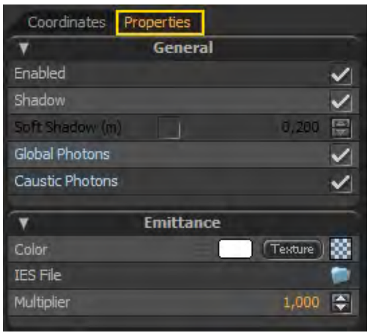


Figure 4-115: Properties Tab - Selected Object is a Light

In Figure 4-115, we see the Properties tab for having selected a Point Light. At the first panel we see some General options, while at the second one, more specific properties for its emittance.

General: user can select if the light will be enabled or not, if it will create shadows and soft shadows to the rest models in the scenes. The options in blue color are used for Adaptive (BSD) engine and give for each light source the minimum and maximum Rays that emit and define if the selected light source will be part of the Global and Caustic Photons (Photon Mapping render method).

Emittance: you can choose here the desired color or texture of the emitted light, its Power (in Lumens, Candelas, Watts, W/sr, W/nm, W/nm/sr), its Efficacy in lm/W and its Attenuation (None, Inverse, Inverse Square).

Figure 4-116: Properties Tab - Selected Object is a Camera

When a camera is selected, the Properties panel is like in Figure 4-116. The three main categories for camera properties are the Film, the Lens and the Depth of Field.

Film: user can select from here the desired resolution of the camera either from the existing list of resolutions or by clicking and entering the desired one (resolution text area is editable). Film Height and Focal length can be also specified.

Lens: user can define the camera projection (Perspective, Cylindrical, Spherical or Parallel), define the Shutter Speed (by decreasing it, shutter is open more time and so we can increase the motion blur in animations).The next options shift the X and Y dimensions of the Lens (in mm) and specify the Diaphragm (Circular or Polygonal with custom blades number).

Depth of Field: at this panel, the f-number of the camera can be set (Pinhole, which corresponds to no Depth of Field, from 1 to 22 which produces the maximum Depth of Field effect). Focus Distance can be edited also from here, or been visually defined by the Focus tool of the Viewport Selection bar. Once you click to a certain area in the Viewport with this tool, distance is automatically updated and focus is applied to that point. Icon of "Running Man" corresponds to the animation that may have been created in the scene. We then define the Depth of Field we want to add to it. Auto Focus makes the camera focus at the center of the scene once is enabled.

Z-Clipping: with this option, user can enable Z-Clipping for the selected camera for either near, far or both distances and insert in this way one/two vertical section(s) to its view. You can see an example of these options in Figure 3-70, Figure 3-71 and Figure 3-72.

THEA RENDER
phyisically-based unbiased, biased & gpu render engine

Chapter 5: Darkroom

Image by Patrick Nieborg

5. Darkroom

5.1 Introduction

Darkroom is the actual space where you can manipulate your rendered image and apply any post-processing. You can go to Darkroom by clicking on the Darkroom tab of the Workspace panel (the tabs are located at the bottom).
In Figure 5-1, we see the way the Darkroom is structured. In this Chapter, we will describe all the available options in detail.

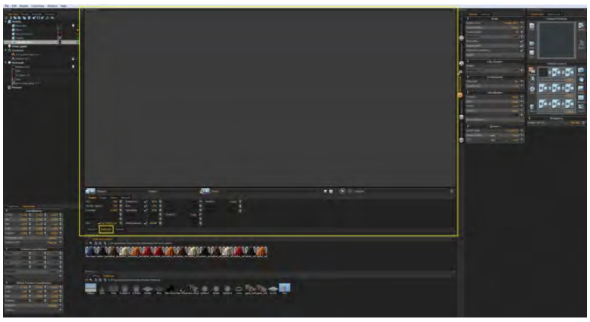


Figure 5-1: Thea Darkroom

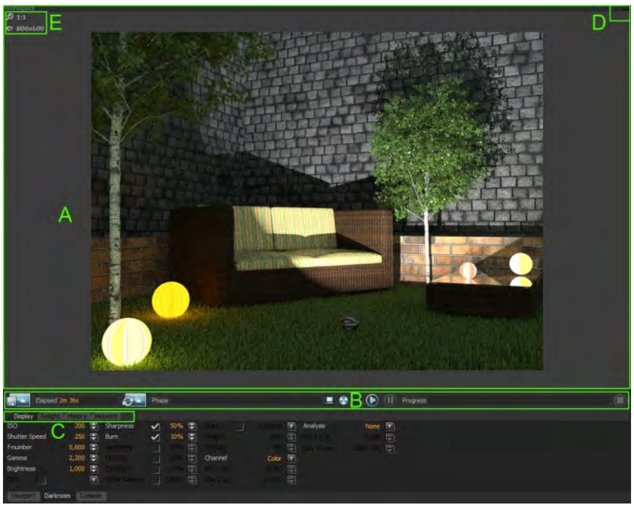
Note that upon clicking on the Darkroom tab, Render Settings window changes from Interactive Render Settings Options (seen as long as Viewport is open) to Production Render Settings options (needed settings for Darkroom and the final – Production – rendering).
Note: these tabs can be changes by double clicking on them too.

Figure 5-2: Biased Engine Selected for Production Rendering

Figure 5-3: Unbiased or Adaptive (AMC) Engine Selected for Production Rendering

Figure 5-4: Presto Engine Selected for Production Rendering

5.2 Darkroom Layout



In Figure 5-5, we see how the Darkroom looks like, after we have rendered a scene.
At the upper side of the Darkroom there is the area where rendered images appear, once rendering has started (area A). The resolution of the rendered images is the same as we have specified at the Render options pop-up window, just before starting a render. Below it, there is the render status bar. From this bar, you can quickly start/stop a render and save/refresh an image but also check on the render progress (area B). Just under it, you can select from four tabs, corresponding to four different functions: Display, Relight, History and Network (area C).

Figure 5-5: Darkroom Parts

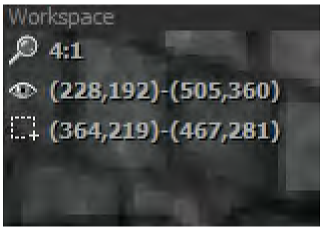


Figure 5-6: Darkroom Details

We are going to analyze the following options:

1. Render Status Bar
2. Display
3. Relight
4. History

Note: Network will be analytically described on a next Chapter (see later Chapter).

Tip: you can **maximize** the Darkroom either by pressing the small corresponding button at the top right of the panel (Area D) or by double clicking somewhere in Area A (on a rendered image).
Area E (see it in Figure 5-6) gives information for the viewed image region and also for the zoom that is applied on it. You can zoom in or out the rendered image by scrolling your mouse wheel. Once you do that, you will see next to the magnifying glass the zoom to change. For example, 4:1 means that we have zoomed 4 times the rendered image. Below, at the eye icon we see the coordinates of the area of the image that is now visible in the Darkroom. The third line is not always visible; it appears if we perform a selection of a region with right click and drag. It shows the coordinates of the selected area. For example for an image with resolution of 800x600, if we select the whole area, these coordinates will be: (0,0)-(800,600).

Tip: by clicking on the magnifying glass icon this information will appear with normal **font** rather than bold and with another click it will be hidden. By clicking again on this area (Area E) you can make it visible again.

5.3 Render Status Bar

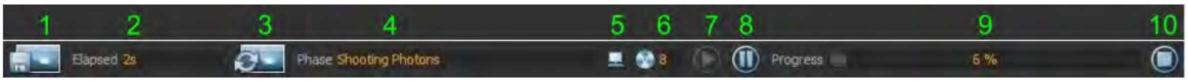
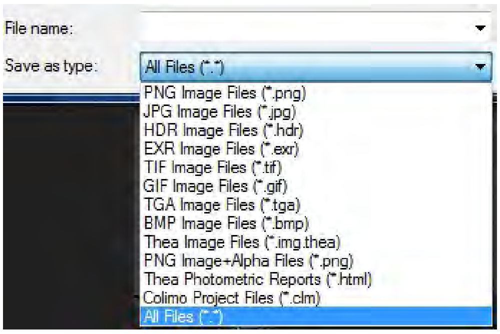
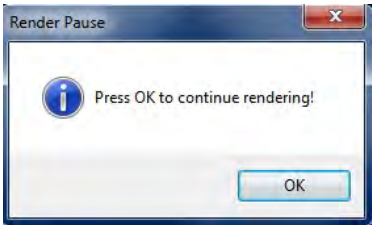


Figure 5-7: Render Status Bar

In Figure 5-7, we see the Render Status Bar, after a render has started. From left to right, we have the next visual elements/options, which are analyzed in the next table.

Option	Description
1. Save Image	This button helps you to save the rendered image on a storage device (disk) in all available image formats (png, jpg, gif, etc.) and in some other, more special formats, as you see in Figure 5-8.  Figure 5-8: Save Image - Available File Extensions

	PNG, JPG, HDR, EXR, TIF, GIF, TGA and BMP Image Files that you see in the first places of the list, are all common Image File types. The next four options in the list though correspond to special functionality. These are: a. Thea Image Files (*.img.thea): this type makes it possible for the user to save the full image buffer and reuse it later to change post-processing, apply Relight or continue rendering from that point. For doing the latter, you need to save the *.img.thea file and also your scene as it was before rendering. Once you reopen Thea Studio, you need to open both scene and rendered image and resume (from Top Menu>Render>Resume) to continue rendering from where it was stopped. Note that this method is not applicable for Adaptive BSD engine. b. PNG Image + Alpha Files (*.png): this type saves a png image in 32 bit, including, apart from the color information of the image, the alpha channel as well. You can later open and edit it in an image processing program, where you can change, for example, the background of the image in post-process. c. Thea Photometric Reports (*.html): this option is connected with the Photometric Analysis Report (option in the Display tab which will be analyzed later) and makes it possible for the user to create a report with the luminance and illuminance properties of the rendered image. d. Colimo Project Files (*.clm): this option is only available if the user has checked the Repaint option (at Render Settings tab) and at least one material is Repaintable (material general options). It helps user to export the rendered image to Motiva Colimo application and then change colors and textures in post-process.
2. Time Passed	This element displays the time that has passed since you started rendering an image or an animation sequence. (h:hours, m:minutes and s:seconds)
3. Refresh Image	While rendering or afterward, you may need to change some of the settings concerning the display. Refresh button helps you to see these changes in the image. Note that some controls refresh the image automatically, as for example choosing a different channel.
4. Render Phase	Here you get a brief explanation of current render process. For example, if you choose to render with the use of photon mapping, you will see that the first step is the shooting of photons and then the ray tracing. For unbiased and progressive methods, you see the passes. It depends on the render engine you have chosen.
5. Network Status	This icon, which is by default as you see in Figure 5-7 (at fifth place), shows whether or not your machine works in normal or server mode (client mode is also available in client running mode). In case you set up a network and allow other computers contribute to rendering, this icon will change and will show 3 computers, with the first one in orange color (the server machine).  Figure 5-9: Machine used as a Server You can find instructions for setting up your network at Chapter 17.

6. Render Threads	Here, you can see the threads that are used during each render phase from your computer. Almost all render phases are multi-threaded, so this number usually corresponds to the user defined number of threads.
7. Start Render	With this button you can start rendering an image or an animation.
8. Pause Render	Since rendering procedure takes some time and uses much of the computer power, users may need to pause it, to do something else and later continue rendering from the point it was paused. This button is used to pause rendering. A pop up window appears and once you press ok, rendering starts again (Figure 5-10).  Figure 5-10: Pause a Render
9. Phase Progress	At this visual element, you can see the progress, in percentage, of each phase you are currently in.
10. Stop Render	Once you are satisfied with the result, when you render with an unbiased or progressive method, you can press Stop button to stop rendering and save your image. You may need to stop rendering anyway, in order to perform some changes and staging in the Viewport, so, in this case, you can hit Stop button again. Note that if you go and start rendering afterward, it will start from the beginning. If you accidentally pressed stop though, and you haven't changed anything in your scene, you can go to the upper menu of Thea Studio, at Render and press Resume.

5.4 Display

Figure 5-11: Display Tab

At the Display tab we can see many options, which are related to the way we see the rendered image. They are the same with the ones in Display Properties panel. Once you make a change to one panel, the other panel is updated with the same value.

These options could be separated in 5 categories: Exposure, Filtering, Channel and Analysis as you also see in Figure 5-12 and are analyzed below.

Figure 5-12: Exposure, Filtering, Channel and Analysis

5.4.1 Exposure

Option	Description
ISO	ISO value defines how sensitive the image sensor is to the amount of light present. It is a term used in photography to describe the sensitivity at the camera sensor film. Value 100 is a low value used mostly for exterior shots under a clear sky and sun lighting (as for example in Figure 5-15 where we have an exterior scene). We have also the possibility to go even lower for extreme lighting situations. Higher values, usually between 400-1600 are used mostly for interior shots (see Figure 5-14).

 Figure 5-13: Simple Interior (ISO 100)	 Figure 5-14: Simple Interior (ISO 500)	 Figure 5-15: Exterior Scene (ISO 100)	 Figure 5-16: Exterior Scene (ISO 50)

Shutter Speed	Shutter speed corresponds to the duration a camera shutter stays open. It can be measured in inverse time units (1/sec) correspondingly to grabbed frames per second. In photography, when increasing the time the diaphragm is open (meaning that frames per second are less), two things happen: motion blur is getting more and more visible and more light arrives on the sensor. In Thea, these two features are controlled **separately** in order to assure easier tuning. When we change the Shutter Speed in the Camera Properties (see Figure 5-17), we affect the motion blur on the image. When we change the Shutter Speed at the Exposure panel (Interactive Tab) of the Settings (see Figure 5-20) or in Darkroom Display, we affect the brightness of the image. In next images we see visually, the way each parameter changes the rendered image. We see that for larger values of Shutter Speed in the Display (more frames per second) the image is getting darker.

Figure 5-17: Shutter Speed Affecting Motion Blur

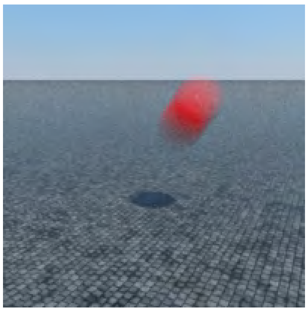


Figure 5-18: Animation Frame with Shutter Speed at 25.000 with Obvious Motion Blur

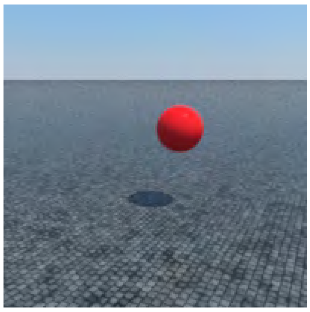


Figure 5-19: Same Animation Frame with Sutter Speed at 250.000, with almost Invisible Motion Blur

Figure 5-20: Shutter Speed Affecting Exposure

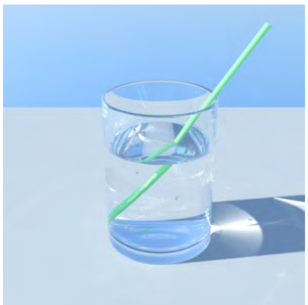


Figure 5-21: Brightness is Affected by Shutter Speed=200

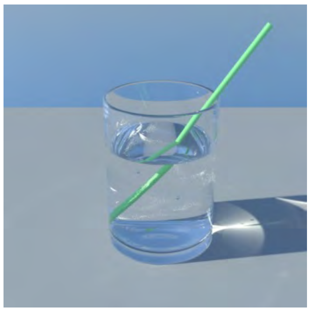


Figure 5-22: Brightness is Affected by Shutter Speed=400

f-number	The lens aperture, usually specified as f-number, is the ratio of focal length to effective aperture diameter. The f-number is given by the ratio f/D, where f is the focal length, and D is the diameter of the effective aperture. By increasing the f-number, two things can happen at the same time: increase of the depth of field (the space where objects appear sharp in the image) and decrease of image brightness (less light passes through the aperture). These two results, for easier tuning, are **separately** handled in Thea Render. By changing the f-number at the camera settings before rendering, in the Properties Panel (see Figure 5-23), you can control the amount of depth of field you have in your image (you can see the different results in Figure 5-24 and Figure 5-25). The f-number value that can be found at Exposure panel of the Interactive tab (at Settings) and in Exposure panel in the Darkroom, which are connected and stay the same, affect the brightness of the image (Figure 5-26). This value can be changed during and after rendering.

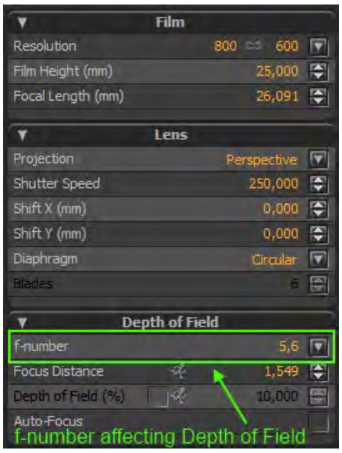


Figure 5-23: The f-number value is Affecting Depth of Field

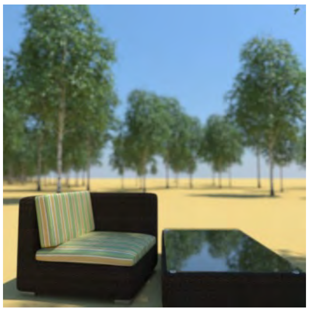


Figure 5-24: f-number at Camera Settings set to 1.0 Gives a Very Small Depth of Field – Objects Appear Sharp in a Very Small Space

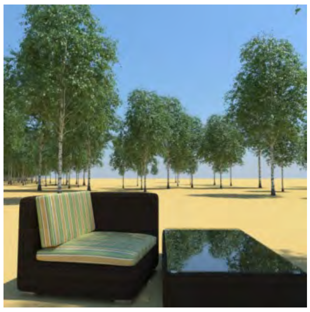


Figure 5-25: f-number at Camera Settings set to 22.0 Produces a Large Depth of Field – Objects Stay Sharp both Close and Far Away from the Camera

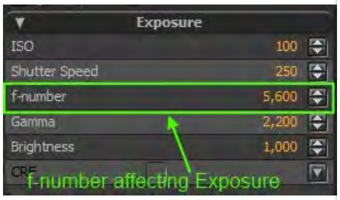


Figure 5-26: The f-number value is Affecting Brightness

Figure 5-27: f-number at Display / Darkroom Settings set to 1.6 Increases the Brightness of the Image as if the Image was Produced with a Camera of f-number 1.6

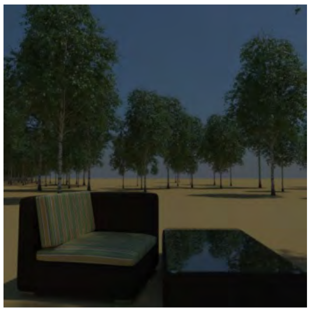


Figure 5-28: f-number at Display / Darkroom Settings set to 16.6 Decreases the Light in the Image as if the Image was Produced with a Camera of f-number 16.6

Gamma

Each pixel in a digital image has a certain level of brightness ranging from black (0) to white (1). These pixel values serve as the input for the computer monitor. CRT monitors have a nonlinear output based on these values, approximated by a power function:

$$Output = K * Input^{Gamma}$$

This Gamma factor typically ranges from 1.0 to 2.5. In order to compensate for this "darkening" of the image due to nonlinear output, we need to apply a gamma correction scheme to the pixel values before displaying the image.

While the new monitors have not inherited the nonlinear output of the older CRT monitors as a technical limitation, gamma correction is still being applied. A value of 2.2 or Gamma is the mostly used (see an example in Figure 5-30) with lower values displaying a dark image (as in Figure 5-29) and higher values displaying a washed-out image (see Figure 5-31).

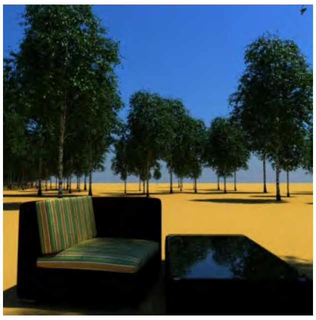


Figure 5-29: Gamma set to 1.0


Figure 5-30: Gamma set to 2.2

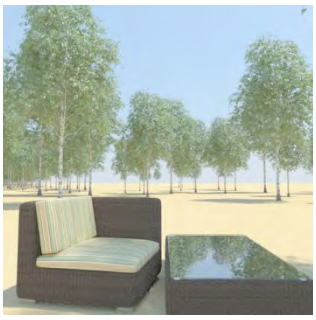


Figure 5-31: Gamma set to 5.0

Brightness

Just like gamma correction is used to compensate for the nonlinear display of monitors, the brightness is used to compensate for a linear scaling of the image by a monitor (factor K of the Output function). In the next images we see the way the rendered image looks for different brightness values.

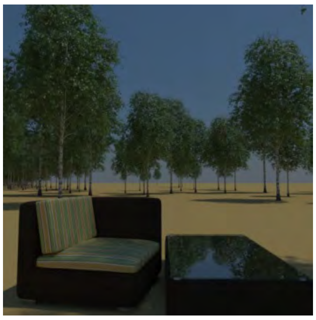


Figure 5-32: Brightness at 0.5


Figure 5-33: Brightness at 1.0


Figure 5-34: Brightness at 1.5

CRF

CRF stands for "camera response function" and refers to how the irradiance arriving on image film/CCD, after passing through the lens, is transformed to actual pixel "brightness" values. The easiest and usual transformation that we apply is the simple brightness+gamma. But in practice, where photo cameras are involved, this transformation is much more complex and manufacturers themselves provide this transformation in the form of tabular data.

What the above means is that, by using the specific real data provided by the manufacturer, we can enjoy realistic (non-linear) display of the results, as if the image was coming out of the specific photo camera. The camera is easily selectable from the drop down list. In the next figures, we are testing some of these real cameras functions, for our rendered image. You can see the differences they have with the Figure 5-30, which has a standard gamma at 2.2.

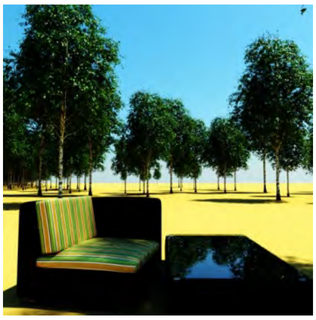
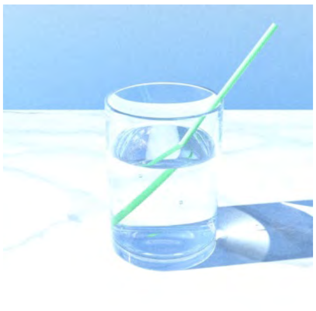


Figure 5-35: Codachrome-25


Figure 5-36: Agfa-scala-200xPull1


Figure 5-37: Ektachrome-400xCD

5.4.2 Filtering

Option	Description
Sharpness	The Sharpness filter is the most crucial for controlling the filtering during downsampling the image and it is advised to be enabled at default 50% value which is a balanced value between blurring and sharpening. A value near 0% will produce a more blurred image (see Figure 5-39), while a value near 100% produces a more sharpened image (see Figure 5-40).
	 Figure 5-38: Image with no Sharpness Enabled  Figure 5-39: Image with 0% Sharpness  Figure 5-40: Image with 100% Sharpness
	Note: sharpness control is only applicable, when **supersampling** is set to Normal or High. For supersampling None, the effect of sharpness is not visible at all. Supersampling option can be found at Settings panel, at Render tab, at General. By setting it to Auto, Adaptive (BSD) engine uses no supersampling, while the rest engines use normal supersampling and downsampling takes place.
Burn	The Burn control can be used to compress a high dynamic range (HDR) in a low dynamic range image (LDR), presentable on screens and other limited range devices. Setting burn to 100% (Figure 5-41) means that there is no compression (meaning that it behaves the same like disabling the control).
	 Figure 5-41: Disabled Control equal to 100% Burn Value  Figure 5-42: 0% Burn Value Minimizes the Burnt Areas  Figure 5-43: Burn Value at 50% creates an Intermediate Effect
Vignetting	In photography and optics, vignetting is a reduction of an image's brightness or saturation at the periphery compared to the image center. This is because less light comes through the Lens near its edges, creating a looking-through-the-tunnel effect.

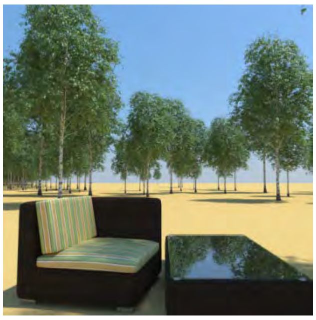


Figure 5-44: Image with No Vignetting

Figure 5-45: Vignetting set to 50% creates a Kind of Darkening around the Image

Figure 5-46: Vignetting set to 100% creates a Stronger Darkening around the Image

Chroma	Chroma filter (0% is the same as if option is disabled) enhances the colors of the image as it is increased, acting as a saturation control.

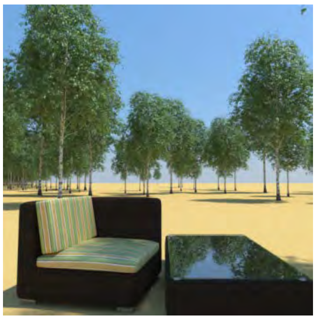


Figure 5-47: Chroma Filter is Disabled (or equal to 0%)

Figure 5-48: Chroma Filter is set to 50%

Figure 5-49: Chroma Filter is set to 100%

Contrast	Contrast is the difference in luminance and/or color that makes the representation of an object in an image or display distinguishable. In visual perception of the real world, contrast is determined by the difference in the color and brightness of the object and other objects within the same field of view. Contrast 0% equals to a disabled control as you also see in Figure 5-50. Contrast 100% is the maximum value that can be set, enhancing the separation of objects and their details.

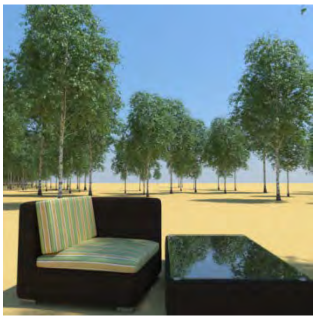


Figure 5-50: Contrast set to 0% equals to Disabled Control

Figure 5-51: Contrast set to 50% - Bright and Dark Areas are more Distinct

Figure 5-52: Contrast set to 100% - Bright and Dark Areas are even more Distinct

White Balance	White Balance filter can be used to change the overall color balance of a render, so that it matches the expected phenomenal appearance - for example, room walls

appearing always white whether they are lightened by sun sky or interior incandescent lamps.
Balancing an image using color temperature, makes an exact compensation for any color shift of white objects when lightened by a blackbody emitter of the same temperature. In a typical scene, where there are multiple secondary bounces from colored objects, the optimal white balance temperature may be slightly different than the correlated temperature of your emitters – some experimentation may be needed for optimality. A temperature of 6500K is usually used to balance lighting coming from sun and make white walls appear white, despite sun power being more yellowish.


Figure 5-53: White Walls appear Yellowish because of the Sunset - No White Balance is Applied


Figure 5-54: White Balance set to 5000K makes the Walls appear Whiter


Figure 5-55: By Increasing White Balance to 8000K, Sun affects even more the Image, with its Yellow Color

Glare
Weight
Radius

Glare is the effect when a high amount of photons arrives at film, causing lighting to flood also nearby areas. The shape of the glare itself depends on the shape of the diaphragm.

In order to create that kind of effect, as if a real camera was used, you need to finish render first as usual. After having rendered the image, you can enable the glare option and choose the type of glare you want by selecting how many blades you want, 6 for example, like in Figure 5-57 or Radial (Bloom) like in Figure 5-59. Then specify its weight (how intense will be – pretty intense for example as in Figure 5-59) and its radius (how long its blades will be). By hitting Refresh Image button you can see the corresponding results.

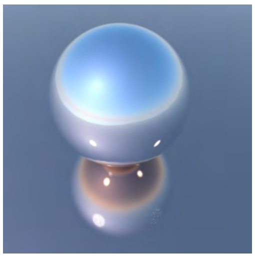


Figure 5-56: Rendered Image with No Glare


Figure 5-57: Added Glare, with 6 Blades, 20% Weight and 20% Radius


Figure 5-58: Added Glare, with 12 Blades, 40% Weight and 5% Radius

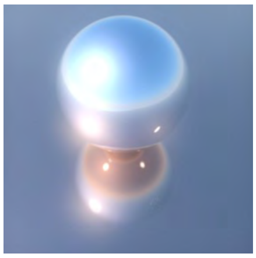


Figure 5-59: Radial Glare (Bloom), with 70% Weight and 50% Radius

Note: in order to be more accurate, we need to mention that ISO, Shutter Speed, f-number, Gamma, Brightness, Burn, Chroma, Contrast and White Balance, affect the **Tone Mapping** of the image. Sharpness is a **Filter**, while Vignetting and Glare are **Effects**. For easier User Interface though in Thea Render, they have been separated in two big categories (Exposure and Filtering) as we have analyzed.

5.4.3 Channel

Channel
Min Z (m)
Max Z (m)

Channel options make it possible for the user to switch between other rendered channels of the initial scene. The default channel, which is rendered every time, is the Color Channel. In order to see the rest channels in the drop down list, you need to select and enable them first (before starting rendering).
After switching to the Darkroom, at Production panels, for each selected engine the list with available channels appears (as seen to the following figures). In this way user can select prior to rendering the channels that will be rendered.
During and after rendering, these channels can be seen at the drop-down list of the Darkroom (see Figure 5-63).

Figure 5-60: Select Channels for Biased engine

Figure 5-61: Select Channels for the Unbiased engines

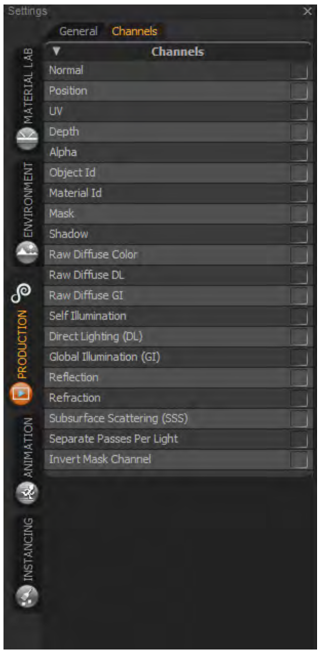


Figure 5-62: Select Channels for the Presto engines

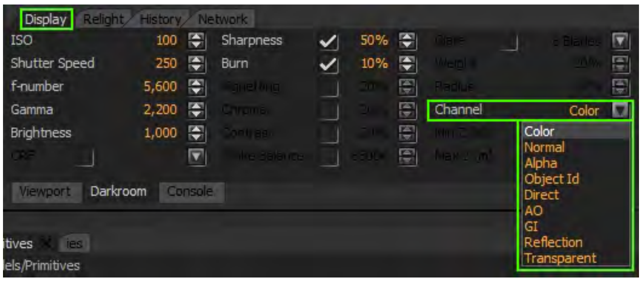
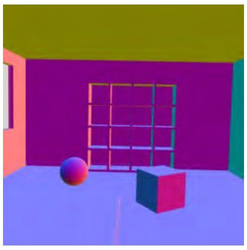
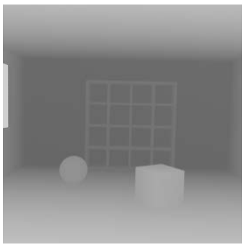
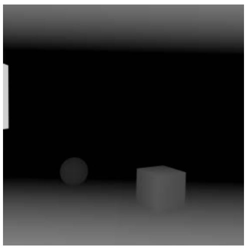
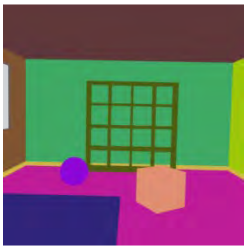
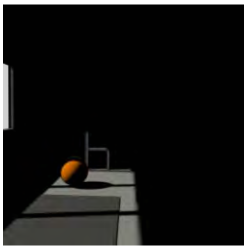
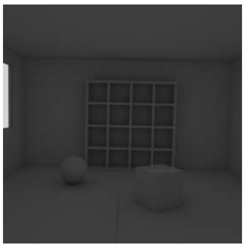


Figure 5-63: Choose the Channel you want to see (it is already rendered) by the Drop Down List in the Darkroom

Note: Min Z (m) and Max Z (m) options, which are located underneath the Channel choice, are only used with the **Depth** Channel. Although, setting Min/Max Z can be done completely as post-process, it is suggested to have some good initial values in order to avoid aliasing issues (when no supersampling is present).

At the next table we see all the available channels and their use.

 Figure 5-64: Color Channel	This is the default channel that has information about the colors of the image.		This channel is storing the normals of the first hit objects in the scene. Black color is assigned to vector (-1,-1,-1), while white color is assigned to vector (1,1,1). Due to the normalization of surface normals, these values are never reached, instead we get intermediate colors.	 Figure 5-65: Normal Channel
 Figure 5-66: Depth Channel (min=0, max=10)	Depth Channel gives the depth (distance along camera Z-axis) of the first hit objects in the scene. The depth values will be mapped afterwards to a gray-scale image according to Min/Max Z.		Different MaxZ, “hides” some object in the back (like they are far away – have a big depth), while a bigger value would make them all visible.	 Figure 5-67: Depth Channel (min=0, max=5)
 Figure 5-68: Alpha Channel	Enabling this parameter will create an opaqueness grayscale image with respect to the background. A black color corresponds to no opaqueness (background is fully visible) while a gray color corresponds to partial opaqueness.		Enable this channel to get an image of distinct colors for each scene object.	 Figure 5-69: Object Id Channel
 Figure 5-70: Material Id Channel	Enable this channel to get an image of distinct colors for each scene material.		Enable this channel to get an image of direct lighting component.	 Figure 5-71: Direct Channel
 Figure 5-72: Ambient	This channel gives an image of Ambient Occlusion lighting.		This channel gives an image of global illumination component, computed by field mapping and final gathering modules.	 Figure 5-73: Global Illumination

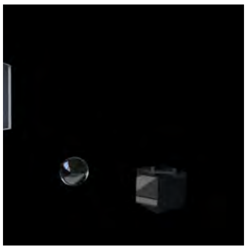
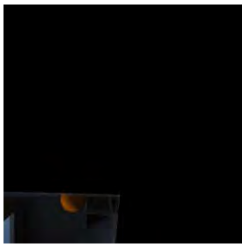
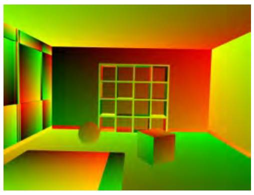
Occlusion Channel (Adaptive (BSD) only)				Channel (Adaptive (BSD) only)
 Figure 5-74: Reflection Channel (Adaptive (BSD) only)	This channel gives an image of reflection component which corresponds to perfect only reflection (glass reflection and glossy/coating zero roughness reflection).		Enable this channel to get an image of refraction component. This corresponds to perfect only refraction (glossy/coating zero roughness refraction). In the image beside, we have applied a water surface instead of the carpet, to show the way refraction channel is working.	 Figure 5-75: Refraction Channel (Adaptive (BSD) only)
 Figure 5-76: Transparent Channel (Adaptive (BSD) only)	This channel gives an image of transparent component. This corresponds to thin film (glass) and alpha mapping transparency.		This channel, shows the Irradiance, computed by photon mapping and final gathering and interpolated using the Irradiance Cache (if used). This channel is used in conjunction with illuminance photometric analysis (see next table).	 Figure 5-77: Irradiance Channel (Adaptive (BSD) only)
 Figure 5-78: Position Channel	This channel displays the position of each point of the scene regarding to the Global frame and is useful for post processing purposes.		The UV channel is used for displaying the UV coordinates of the scene objects.	 Figure 5-79: UV Channel

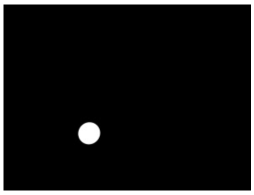
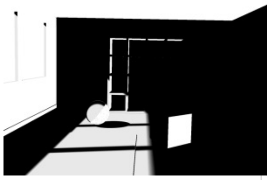
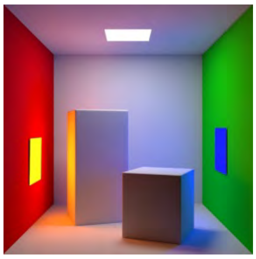
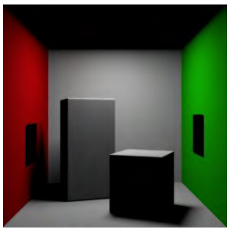
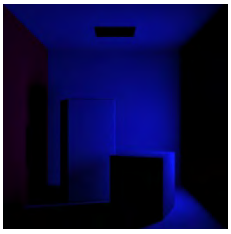
 Figure 5-80: Produced Channels for the corresponding Mask Indexes	With the use of the Mask Indexes found at models properties, user can define to mask selected objects/groups and create masks useful to post processing purposes. At the Channels list, all the available masks that have been applied to scene objects appear.		At our example, the carpet and the cube have been assigned with mask index 1 while the ball with index 2. The corresponding Mask channels appear in Figure 5-81 and Figure 5-82.	 Figure 5-81: Channel Mask #1  Figure 5-82: Channel Mask #2
 Figure 5-83: Inverted Channel Mask #1  Figure 5-84: Inverted Channel Mask #2	With the Invert Mask Channel option, the appearing channels are inverted compared to the original Mask channels. This means that indexed objects appear in black color while the rest have white color (see Figure 5-83 and Figure 5-84). Note: Mask Channel should be also enabled once the Inverted Channel option is selected.		A Presto exclusive channel currently, where the shadow can be rendered alone in a separate image. With the use of other channels like the Mask or Object ID, it can produce at post processing several effects like objects with shadow in png format.	 Figure 5-85: Shadow Channel  Figure 5-86: An image created in post processing using the Shadow and Mask channel (Mask Index at the floor)
 Figure 5-87: Raw Diffuse Color	This Presto exclusive channel produces the raw diffuse color component of the scene (all materials diffuse color).		A presto exclusive channel too, used to produce the raw Diffuse Lighting (not multiplied with the diffuse color of the scene) component of the scene.	 Figure 5-88: Raw Diffuse Lighting

 Figure 5-89: Raw Diffuse Global Illumination	This channel, available only in Presto engine, is used to give the raw Diffuse Global Illumination (not multiplied by the diffuse color) component of the scene.		Self Illumination channel gives the image of the self illuminated parts of the scene.	 Figure 5-90: Self Illumination Channel
 Figure 5-91: SSS Channel	Subsurface Scattering (SSS) channel produces the SSS component of the scene. At our example the sphere has an SSS material.		Separate Passes per light is an additional option (enabled along with the rest channels we need) that produces the corresponding different passes per light source. In this way, if the scene is illuminated by more than one light sources, separate passes will be produced for each source and for each enabled channel: for Self Illumination channel, Direct or Global Illumination Lighting channels, Reflection or Refractions channels.	 Figure 5-92: Color Channel of a room with three area lights
			 Figure 5-93: Direct Light Channel of light #1	 Figure 5-94: Direct Light Channel of light #2  Figure 5-95: Direct Light Channel of light #3

5.4.4 Analysis

Analysis Min Il-Lum Max Il-Lum	**Luminance and illuminance** properties of a scene are the two key factors in lighting design; they describe the energy arriving to our eyes and space correspondingly, but in the way we, humans, perceive and interpret lighting. These properties can be computed out-of-the-box, in parallel with the rendering process. Besides the cool false-color rendering, user can select multiple regions of interest where he can analyze the extreme points and distribution of values. In addition, a full report can be easily generated, that can be viewed in any web browser. In order to see the

Photometric Analysis, you need to choose the Photometric Analysis option from the drop down menu, as you see in Figure 5-96. Once you have switched to Photometric Analysis view, you can save a full report, in the way you save the image, but by choosing as a file type the Thea Photometric Reports (*.html) (see Figure 5-97). You can then open it with any browser or application supporting html files.

Figure 5-96: Photometric Analysis

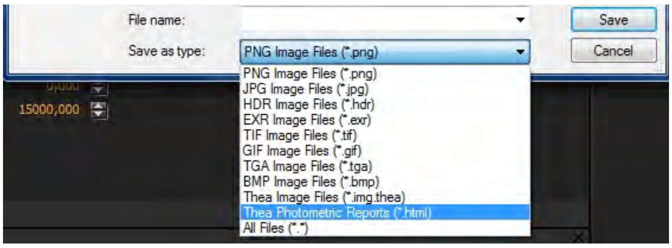


Figure 5-97: Creating a Photometric Report

Min Il-Lum and Max Il-Lum represent the range of the Luminance (cd/m^2), as you also see in Figure 5-98 and Figure 5-99. By changing these values, the false color image is being adjusted accordingly.

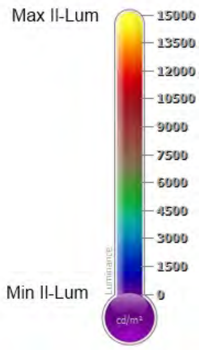


Figure 5-98: Luminance Range (0-15000 cd/m2)

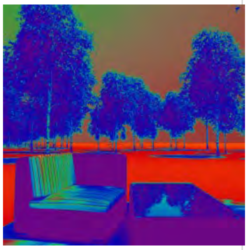


Figure 5-99: Luminance Analysis

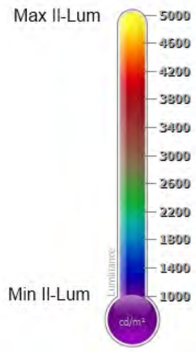


Figure 5-100: Luminance Range (1000-5000 cd/m^2)

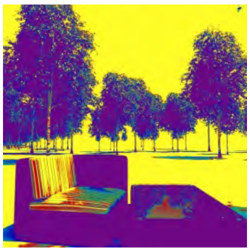


Figure 5-101: Luminance Analysis

Tip: at the right bottom side of the Luminance Range bar a small icon exists, that once is pressed, a more detailed - **extended** Range bar appears, as the one we see in Figure 5-102. Here we not only see the minimum and maximum luminance values of the scene, but also the way they are distributed.

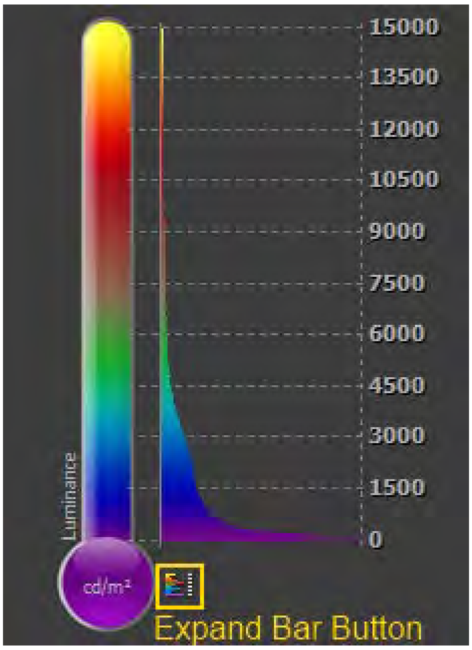


Figure 5-102: Expanded Range Bar

Tip: as we have already said, you can select **multiple regions** of interest to analyze the extreme points and distribution of values. In order to do this, you can right click and drag a region inside the photometric analysis image, in order to specify the area of interest (see Figure 5-103).

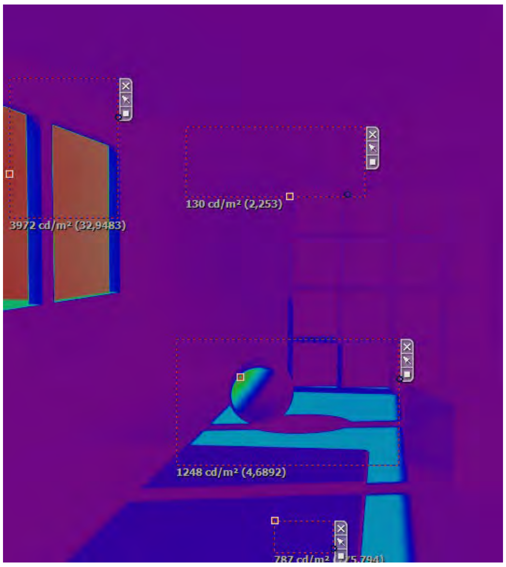


Figure 5-103: Multiple Regions

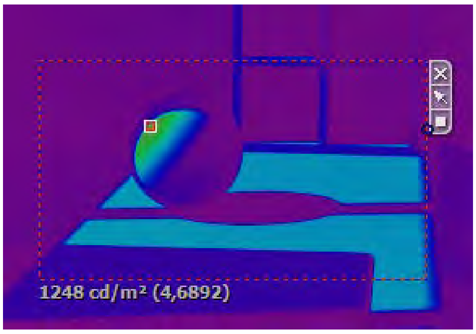


Figure 5-104: One Selected Region

As we see in Figure 5-104, each selected region, has tree buttons attached at the bottom right side. The first one (x button) is used for closing the region selection window. The next one (cursor button), while is pressed, helps you drag the region window to another area of interest. Once you release it, the selected region is the new one.

The last button, the square one, is used to select each time only one of the selected regions and see more details of it at the Luminance bar. When a region is selected, the square becomes orange and the same time, if we have pressed the Expand Bar button, an extra sign next to it appears to indicate that the details of the bar correspond now to the selected, active, region (see it in Figure 5-106).

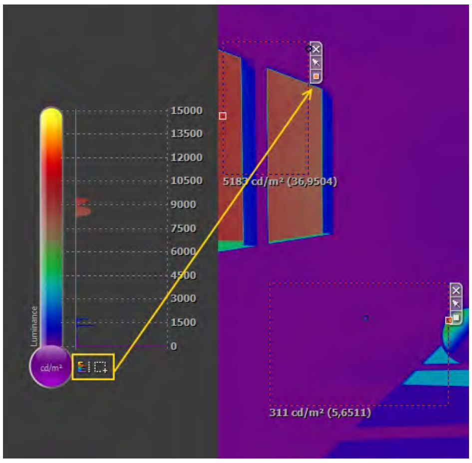


Figure 5-105: See Luminance Details for one Selected Region

As we see in Figure 5-105, one area at the top of the image is active (square button is in orange color) and the expanded bar shows the luminance distribution of the selected area.

Once we want to see again the total luminance distribution of the scene, we need to press the Region Button at the Range Bar and deselect the region.

Figure 5-106: Expand and Region Buttons

In the full report, in case you have also selected some regions, apart from the whole image analysis, which is there by default, you will see the selected regions analysis as well. You can see this report in Figure 5-107, where we see the Range Bar, the rendered image in cool false-color and the luminance distributions of the whole area and of specific regions.

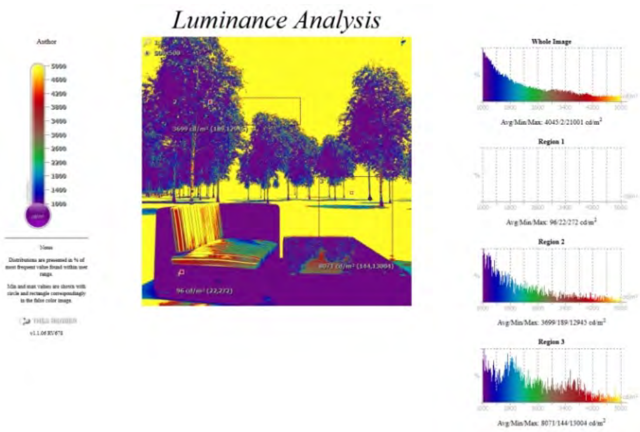


Figure 5-107: Luminance Analysis of the Whole Image and Specific Regions

Illuminance Report can be created once we have switched to Irradiance Channel (Figure 5-109) and works only for Adaptive (BSD) engine. All of its other functions (regions selections, creation of report etc.) are the same as for Luminance Analysis.

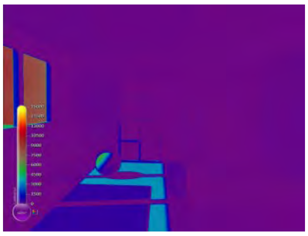


Figure 5-108: Luminance Analysis – Chosen Chanel is Color

Figure 5-109: Irradiance Channel of our Scene

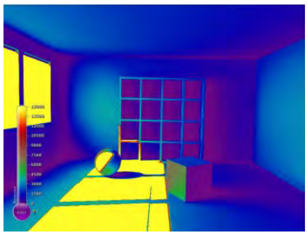


Figure 5-110: Illuminance Analysis – Chosen Chanel is Irradiance

5.5 Relight

Figure 5-111: Relight Tab

The relight option is the second tab that we see in the Darkroom (see Figure 5-111). The relight panel can be used for relighting a scene by changing emitter power and color. It also makes use of key-frame based animation control from a single render. Currently, relight functionality can be only used for an unbiased render (TR1/TR2) or by Presto engines (Presto (AO) or Presto (MC)).

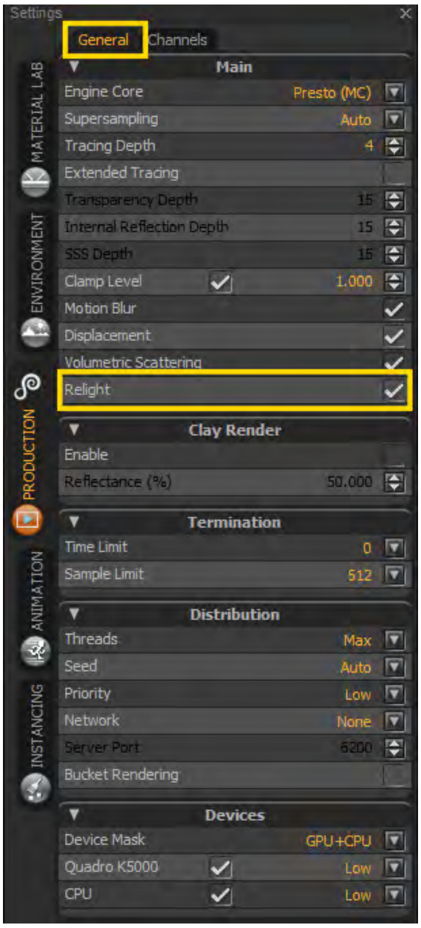


Figure 5-112: Enable Relight Option before Render

The relight option is located at the Unbiased engine or Presto engine tab at the Production Mode panel, at General, as you see in Figure 5-112. You need to enable this option before rendering in order for the post-processing controls to be available.

During initialization, multiple buffers – one for each light group – are allocated in order to give the capability of blending their results and producing an animation sequence. This means that Relight is more demanding in terms of memory. Since, each of these light buffers must converge, it is easy to see that overall convergence in this case will be slower than rendering into a single buffer (where a bright emitter may quickly hide noise from a dim one). Due to the above reasons, it is advised to disable Relight when only a single render is needed.

Nevertheless, when used to produce an animation or lighting study, the benefits amortize the extra render time.

Before presenting a small case study, where we will explain analytically all the options, here are the main steps (briefly) you need to follow in order to make Relight possible:

1. Enable Relight Option from Render Settings, at General, Relight as it is seen in Figure 5-112.
2. Select an unbiased method (TR1 or TR2) or a Presto engine.
3. Start rendering as usually.
4. Then go to the Relight panel, as you see in Figure 5-111.
5. Each light or group of lights in your scene is displayed as a thumbnail at the bottom (use the thumbnail icon to change the display, as we will see also later).
6. You can change interactively the color, power, enable/disable light (by clicking the green icon) or leave only this light available in the scene (by clicking the left small circle).
7. To see the changes, click on Refresh Image button (at the Render Status Bar or in the Relight panel).
8. Once rendering is finished, you can use the timeline where you can set key-frames for animating light attributes.
9. Then, you can save a simple image or image sequence in case of animation.

Note: Relight procedure, uses the defined emitters and adds a multiplier to them, when you change their color, upon the existing one. This means, that if the color of your emitter is set to red (at the emitter properties), after rendering, at the Relight tab, if you choose to change it to a blue color, the result will be a purple color. For avoiding this color mixing, it is advised, to use the **default white color** or the emitters that will be used in Relight, and change their color at Relight tab, according to your needs.

5.5.1 Relight Case Study

In this case study we have created a simple scene (a small yard with furniture) and four emitter balls that are used as lights. After creating the scene, we enable the relight option and we start rendering as usually. In the next figures we see the initial scene and the rendered image.

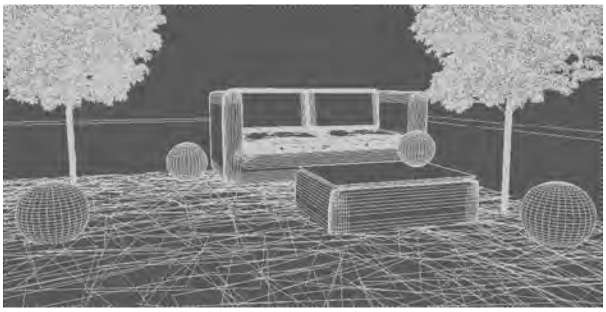


Figure 5-113: Example Scene – Hidden Line Preview

Figure 5-114: Example Scene - Rendered Image

Once you go to Relight Tab, you will see the options as shown in Figure 5-115. There are three main areas, which we are going to use.

Figure 5-115: Relight Panel Available Options

Area A: these help you in creating an animation where lights will change color and intensity. Window value defines how many frames will be visible in the frames bar (for example, by setting it to 10, we see 10 frames, from 5th to 15th, as in Figure 5-115, something that allows easier navigation between the frames). Frames value defines the total frames that we will have in the animation, while Selection shows the key frame that is active each time. By entering there the number 6 for example, light attributes (color and intensity) are adjusted for the 6th frame. The same function is achieved by clicking in the frame bar, to the desired frame. In area A we see two bars.

The first one is used for cases where we have many frames and only some of them are visible in the next, main, frame bar. By dragging the gray rectangle (which covers frames 5 to 15 as it is seen in Figure 5-115), the corresponding key frames are shown in the main frame bar. In other words, the above bar “zooms” to the frames that are inside the window rectangle and are presented in the lower bar. For our animation, we choose 200 frames in total and we set a key frame every 20th frame.

Area B: here are gathered some very useful buttons for creating your relight animation. Refresh button refreshes the rendered image, once you make a change in the lights (in area C). Save button, saves all the key frames you have created or selected ones. A pop-up window, as it is seen in Figure 5-116, allows you to choose if you want to save them all or the current one or a selection of them. You can add for example 1-5, 13, 30- in order to save the frames 1 to 5, the 13th, the 30th and all that exist after 30th. Thumbnails button changes the way the lights are seen in area C. Instead of the name of the light, its intensity and color, a small preview of the scene is also created, to show how this specific light affects the scene (without taking into account the rest lights). You can see these previews in Figure 94.

The rest three buttons are used to set a key frame, remove it or clear them all. If, for example, you need to change some lights at 20th frame, you make the corresponding changes, and while being at that frame (selection value=20), you press the Add button and the frame is set. This can also be accomplished by first adding the frame with the Add button and then making the changes in the light colors and intensities.

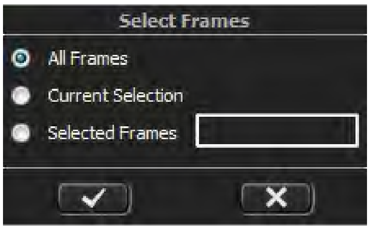


Figure 5-116: Pop-up Window for Saving Frames

Figure 5-117: Thumbnails Preview

Area C: here are presented all the enabled light sources that exist in the scene. As we see in Figure 5-117, the four emitters (Yellow, Green, Orange and Red Lamp) are present. Apart from them, we also see the sun (as we had sun enabled in the scene) and the Sky/IBL (whichever we have enabled – sky for us here). Each light source has two small circles on both top corners. The left one, once it is clicked, leaves only this light enabled in the Relight (exactly as it is seen in Thumbnail preview).

So, each time you click this circle, only this light source is used and all others are disabled. The right circle makes it possible to enable-disable the light source. Green color circle shows that the light is active, while red color circle shows that this light is disabled. In Figure 5-118, we see that Yellow and Orange lights are disabled, as they have a red circle, and their preview is also just a black image – they are assumed to emit no light at all in the scene. By hitting refresh button of the Relight panel or at Render Status Bar, the rendered image is now as we see it in Figure 5-119.

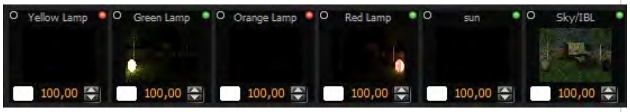


Figure 5-118: Yellow and Orange Lamp are Disabled – Their Right Button is Red and their Preview is Dark


Figure 5-119: Image is Refreshed and Yellow and Orange Lamp are off, as we have set it

In the next figures, we are changing the lights (enabling-disabling them, changing their color and intensity) and setting some key frames (for example every 20th frame, we set a key frame) to create an animation. The in between frames are calculated using an internal interpolation procedure so that we have smooth lighting transition effect. In the end, we can have all the frames saved and create the animation in a movie making program, such as Virtualdub.


Figure 5-120: Only one Lamp is Enabled and Sky


Figure 5-121: By Increasing the Power of the Lights, they Emit more Light in the Scene


Figure 5-122: By changing the Color of the Emittance, Lights are Emitting other Color Light

Tip: in order to **re-open** your scene and edit your Relight animation later, you need to save, apart from the scene, the rendered image as well, with the extension **img.thea**. Then, open both of them in Thea Studio and continue editing.
You can download the created animation of this case study here and the scene here.

5.6 History

5.6.1 Available Options

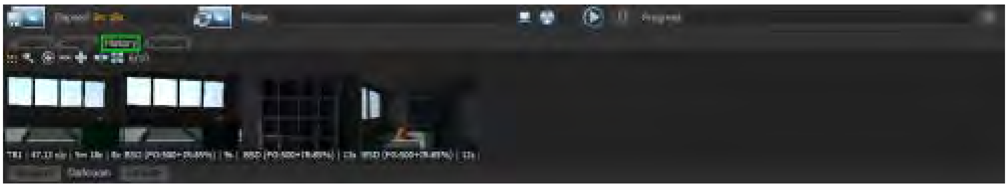


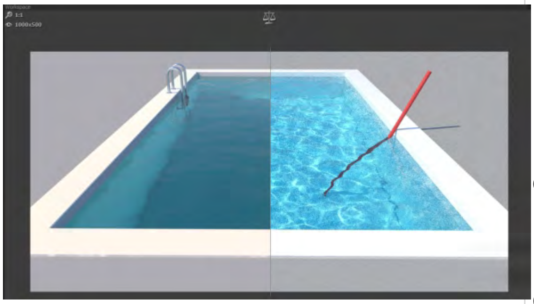
Figure 5-123: History tab

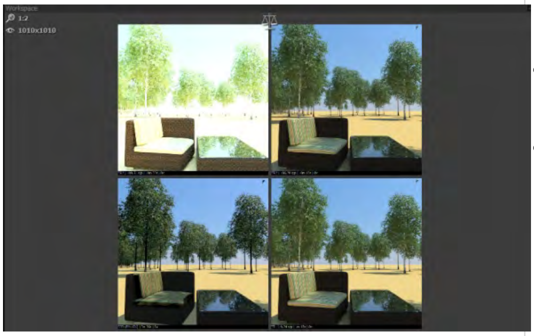
The next tab that we see in Darkroom is History. With this option you can see the renders you have recently made and compare them. Assuming you have performed several renders in one scene, with different cameras or different render engines, History panel will be similar to Figure 5-123.

Figure 5-124: History Options

User can perform several tasks within History panel and here they are explained in detail.

Options	Description
 Figure 5-125: Toggle Names	Toggle Name Option, enables/disables the description that appears at the bottom of each previously rendered image. That text, below each image, contains information for the engine that was used, the time until the render is completed or stopped.

 Figure 5-126: Toggle Icon Size	By clicking this button, the size of the images appearing in History panel changes, switching from a small preview to a larger preview and vice versa.
 Figure 5-127: Toggle Automatic Addition	Whenever the cross in Figure 5-127 is orange, it means that every time a render is finished, it is afterward saved in History. Once this button is pressed and orange cross becomes gray, automatic addition in History stops. From now on, the rendered images are no longer automatically added and presented there. You can though add manually a desired render to a History empty slot (adding an empty slot will be presented below) by double clicking on the slot.
 Figure 5-128: Toggle Start/End Position for New Images	These buttons help user to decide if automatically added images will be placed from left to right or the opposite. When the left arrow is orange, like in Figure 5-128, new images will be added at the left side of the list. When the right arrow is orange, new images will be added at the right of the list.
 Figure 5-129: Add New Buffer	By pressing this button, you can create a new empty slot in the History tab, in order to be used for a later render addition. You can double click on the empty slot and store there the current render shown in the Darkroom. You can insert as many buffers as you want. You can see how many of them you have, at the indicator that can be found after these buttons (see Figure 5-134), where the maximum slots are shown. For example 6/10 means that from total 10 buffers, 6 are empty. By pressing Add New Buffer, 10 will become 11 and 6 will become 7, and so on.
 Figure 5-130: Compare (2 images)	This button makes it possible for the user to compare two rendered images by placing them one on top of the other partially showing each one of them. You can select one image and with control+click select a second one as well. Afterwards, by pressing Compare button, the two images divided in the middle appear in the Darkroom (as you can also see it in Figure 5-131). The dividing line follows the mouse cursor and we can see a different separation of the renders by hovering the cursor to the appropriate position.
	 Figure 5-131: Comparing Two Renders In Figure 5-131, we have compared two rendered images, one with Photon Mapping method (left) and one with TR2 (right). The balance icon on top means that we are comparing two renders. The line on the middle can be dragged left and right to reveal/hide the corresponding render; by dragging it rightwards, the left image is appearing, while by dragging it leftwards, the right image is appearing. In this way, user can compare details in both images and decide which one is more suitable.
 Figure 5-132: Compare (4 Images)	Sometimes, it is necessary to compare more images than two, so with this button you can compare up to four renders. With control and click again, you can select the desired images. The Darkroom now will display these images at the same time, as seen in Figure 5-133.

	 Figure 5-133: Comparing Four Renders In Figure 5-133, we see four rendered images all together. You can also see the details below each one, concerning render method and times.
 Figure 5-134: Available / Max Slots	This indicator shows each time, the rest available (empty) slots of the maximum available slots for the History. For example, in Figure 5-134, we see that from the 10 slots that we can use, we have 6 empty remaining, while 4 of them are "hosting" an image. You can increase the maximum slots, by pressing the Add New Buffer button (Figure 106). In this case, instead of 6/10, you will see 7/11.

5.6.2 Right Click Options

Apart from the options that we have already seen here, several other options appear with a right click on top of a rendered image at the History tab (see below image).

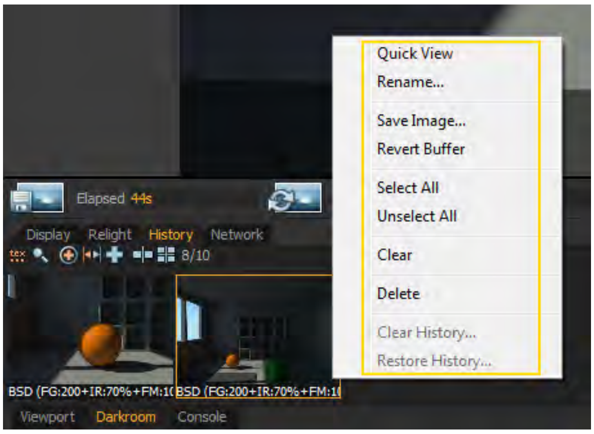


Figure 5-135: Right click options appear in History tab

The options appearing here can perform the following actions:

Quick View	The selected image (the one we right click on it) is now viewed inside the Darkroom. A small clock icon is visible on its top, meaning that we see its preview only. If we try to save this image, as its buffer is not loaded, the image that will be actually saved will be the one that was rendered last (or the one for which we have selected to revert buffer, as we will see below).
Rename	With this option we are able to rename the image. The default name consists of several useful information such as the rendered engine, the time needed, its passes etc., so that a better comparison can be made. But with rename option you can select the name you need for your image.
Save Image	This option opens the Save Image window and is actually the same as the Save button, but now saves the selected image and not the one that is visible inside the Darkroom.
Revert Buffer	With this option you load again the selected image at the Darkroom, but not just as a quick display (like with the quick view option). The whole buffer of the

	image is loaded, so once you press the Save button, the image that is saved is the one you see in the Darkroom.
Select/Unselect All	With this option all the images that exist at the History tab are selected/unselected so that can be used for a comparison or for clearing/deleting them.
Clear	You can remove a rendered image from the selected slot with this option (the empty slot will remain).
Delete	The existing slot can be totally deleted with this selection.
Clear/Restore History	These two options appear once you right click on an empty space of the History tab area. Clear history deletes all the slots that currently exist at the History tab. Restore History option will overwrite the files with those at the temporary disc folder.

5.7 Network

The last tab that we can see in the Darkroom is the Network. Here the user can set a small private render farm of computers that work co-operatively on a single render or animation.
An analytical guide for Network Rendering can be found at a later chapter.

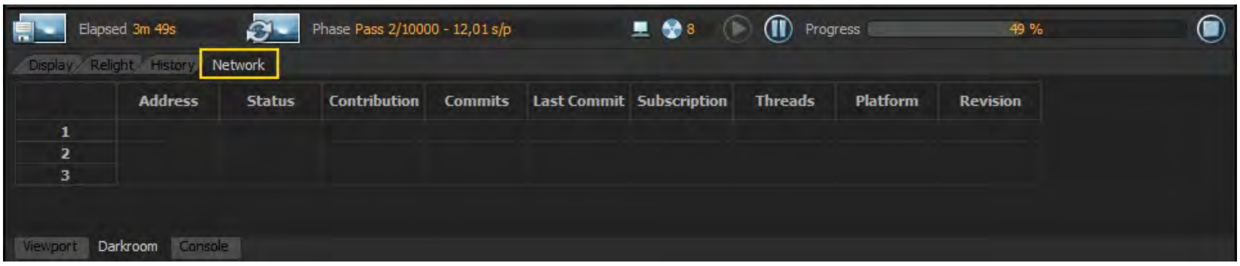


Figure 5-136: Network Tab

THEA RENDER
phyisically-based unbiased, biased & gpu render engine

Chapter 6: Browser

6. Browser

6.1 Introduction

As we have already described, the first time you actually run the application, you will see the Workspace in the center of the program (Viewport/Darkroom/Console), the Scene view and Properties panel on the left side, the Settings panel (Material Lab/Environment/ Render) on the right and a Browser at the bottom. In Figure 6-1, we see the Browser panel, which we are going to analyze in detail at this chapter.

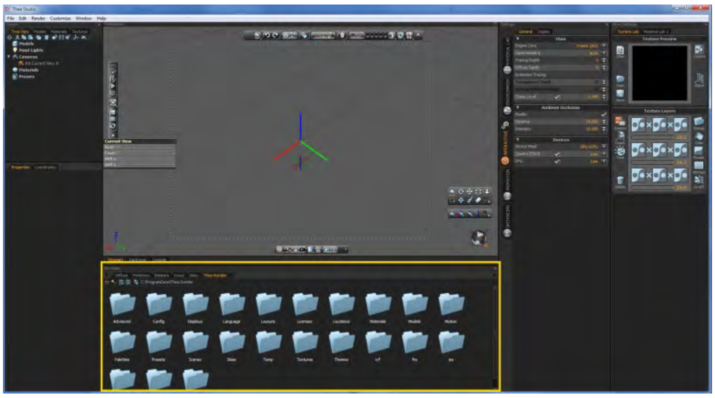


Figure 6-1: Thea Render Browser Panel

6.2 General Overview

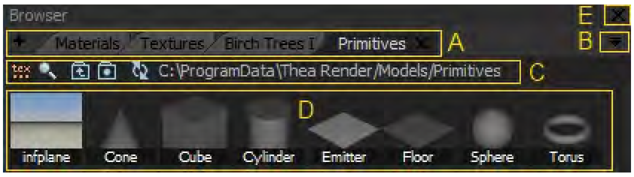


Figure 6-2: Browser Panel separated in Main Areas

As we see in Figure 6-2, in Browser panel, user can perform several actions. The main areas and their use are the following (analytically explained at the next tables):

A. Add Tabs Button & Available Tabs
B. Switch Between Existing Tabs
C. Folder Options and Path
D. Display and Selection Area of the files (Materials/Models/Textures/etc.)
E. Close Browser

Tip: you can **move** the Browser to another position if you wish, by clicking on its top and dragging it around. As rest of the panels, you can also **enlarge** it or **shrink** it, by going at its outer edges and dragging them accordingly, once the cursor is transformed to a double arrow.

6.3 Add Tabs Button & Available Tabs Area

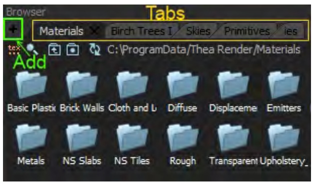


Figure 6-3: Add Button and Tabs areas

Add button is located on the top left of the Browser panel as you see in Figure 6-3. This button gives you the possibility to add new tabs at your Browser, so that each tab will include different files. Once you press it, a list of available options appears (see Figure 6-4).

Remember, that next to each tab, there is an "x" button, in order to close the corresponding tab.

Tip: you can click on a tab and drag it left or right to change the order of appearance of the available tabs.

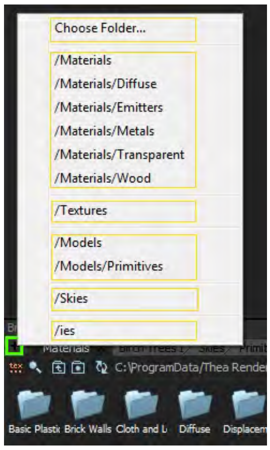


Figure 6-4: List of Add Button

In the list that appears when you press the add button, you can see some typical preexisting folders that you may need for staging your scene.

With the first option you can choose the desired folder from your disk, as it opens a "Browser For Folder" window (see Figure 6-5). You can choose for example to add a tab with a folder "My materials" that includes Thea materials and is located at your Desktop.

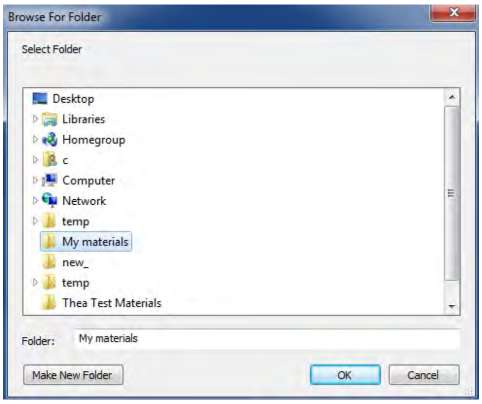


Figure 6-5: Browse For Folder Window

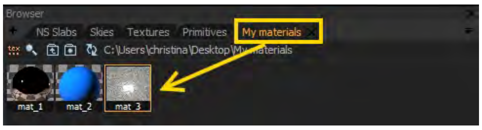


Figure 6-6: My materials Tab

The created tab shows then, all Thea–related files that exist in the selected folder and all sub-folders if exist (see Figure 6-6). By double clicking on each folder, you can open it and see the existing files.

In the second group of Add option (Figure 6-4), which is referring to Materials, user can add a general tab that points to all material folders of Thea Data Folder, or add a more specific folder, with the Diffuse materials for example. If we assume that user presses the Materials folder and then the Materials/Diffuse folder, next images show the way the browser will look like. Note that, in any time, you can see the folder or material location at the path indicator.

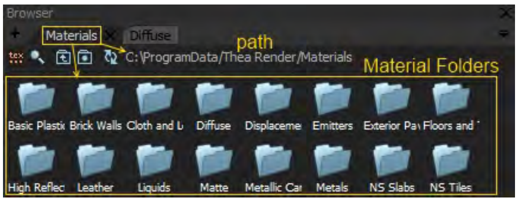


Figure 6-7: Materials Tab

As we see, Materials Folder contains other sub-folders, that stand for material categories (for example Basic Plastic, Brick Walls, etc.). User can select the desired folder, double click on it and open it, to see the existing materials within it.

Figure 6-8: Diffuse Tab

By choosing a more specialized folder, for example the Diffuse folder (see Figure 6-8), the tab has now the name Diffuse and shows all the existing diffuse materials within this folder. This option makes it easier to locate and use the materials, without the need to search within folders, by going in and out.

At the list of Add button (see Figure 6-4), after the Material group of folders, we can see the Textures folder, which opens a tab with the existing textures of The Data Folder (Figure 6-9).
Below it, we see two options that correspond to Models selection. The first one adds a tab at the Browser, with all the available Model Folders (Figure 6-10), while the second one opens the Primitives folder, with pre-installed primitive models (see Figure 6-11).

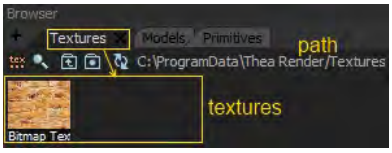


Figure 6-9: Textures Tab

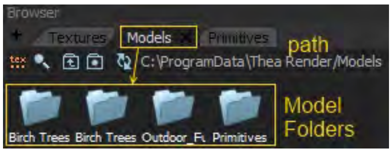


Figure 6-10: Models Tab

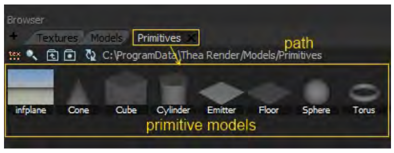


Figure 6-11: Primitives Tab

The next tab that you can add (see Add list in Figure 6-4), is the Skies folder. This tab shows all the skies that are located in Skies folder of Thea Data Folder (see Figure 6-12).
Below it, there is the option to add a tab for IES lights. There are already some samples coming with the application, but you can always add more in the same folder (see Figure 6-13).

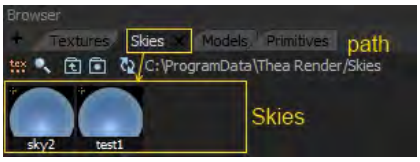


Figure 6-12: Skies Tab

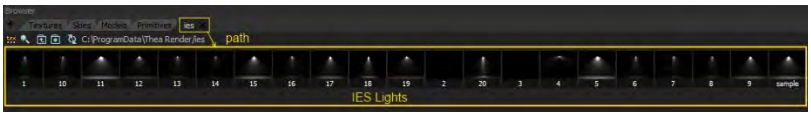


Figure 6-13: IES Lights Tab

Note: it is not obligatory to save the model files in the Models folder, IES lights in IES folder, and so on. This is only a good practice resulting in a better organization of files.

6.4 Switch between Existing Tabs

Figure 6-14: Switch Between Tabs

Let's assume that you have added 4 tabs at the Browser and you need each time to go to the desired one to look for the available files in it. You can click each tab to make it the active one, or, you can use the Switch Tabs button. This button, once pressed, opens a list with your existing tabs (see it in Figure 6-14).

The currently active tab is indicated by a tick symbol next to it, as for example the Textures tab in Figure 6-14. By clicking on another one, this tab becomes active now, and in Display Area (D) we see all the items that are included in this folder.

6.5 Folder Options and Path

At this area of the Browser, user can find some useful options to adjust the way the folders and files appear in the Browser. As we also see in Figure 6-15, we have the following options:

Figure 6-15: Folder Options & Path Area

1. Toggle Filenames
2. Toggle Icon Size
3. Up
4. Select
5. Refresh
6. Path

Below we see a description of these options.

Option	Description
1. Toggle Filenames	This button gives you the option to see or hide the names that appear below each item in the display area (D). As we see in Figure 6-16, below each model, at the Primitives Tab, we see its name (infplane, Cone, etc.). Toggle Filenames Icon is in orange color, to remind us that it is enabled. In Figure 6-17, we have pressed the Toggle File names button, which is now in blue color, and names below files are not visible anymore. We only see their previews.
	 Figure 6-16: Text is Visible  Figure 6-17: Text is Not Visible
2. Toggle Icon Size	This button, with a magnifying glass shape, helps the user to switch between three sizes of the displayed files/items in the Browser. As we see in the next three figures, we have a small (which is the default one and while enabled, the Toggle Icon Size button is in blue color), a medium and a large size (in these two cases, the button is in orange color, to remind us that we have enlarged the

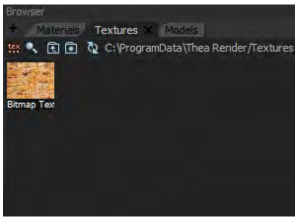
<table>
<tr><td></td><td colspan="3">icons).</td></tr>
<tr><td></td><td>

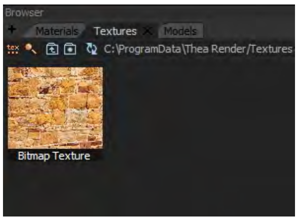
Figure 6-18: Small - Default Icons Size</td><td>

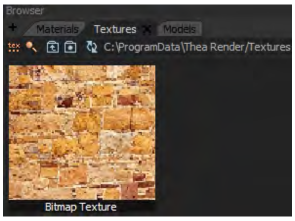
Figure 6-19: Medium Icons Size</td><td>

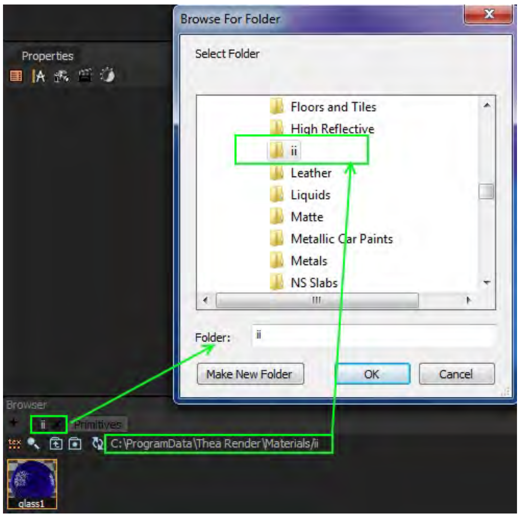
Figure 6-20: Large Icons Size</td></tr>
<tr><td>3. Up</td><td colspan="3">This button makes it possible to move one level up (in the hierarchy of the folders). If you are for example in the Diffuse Materials folder and you press Up button, you will see at your tab, the Materials folder (which includes now the Diffuse Materials sub-folder). If you press it again, you will see the Thea Render data folder and so on.</td></tr>
<tr><td>4. Select</td><td>This button opens the Browse for Folder Window, where the folder of the current tab is selected (see Figure 6-21) and replaces that tab with the new one that you select from the Folder Window. It is performing the same action with the Add-Choose Folder button but, this time, instead of adding a new tab, it replaces the previous one.</td><td colspan="2">

Figure 6-21: Select Option</td></tr>
<tr><td>5. Refresh</td><td colspan="3">Refresh button reloads the content of your folder. Sometimes, while you have Thea Studio open, you may add new files to the existing folders (or create new ones) from your operating system environment. By hitting refresh button, the folders are updated with the new files. It also works together with the next option, the Path. As we will see, you can edit the path pointing to your desired location. Refresh button brings inside the tab, the content of the path you have entered.</td></tr>
<tr><td>6. Path</td><td colspan="3">Path area shows the path of the selected folder in your disk. Except from its use as an indicator, path text area is also editable. By clicking on it, you can type the location of a folder in your system and open it (by using the Refresh button). If the path does not exist, the program will show a message informing you about the wrong entry.</td></tr>
</table>

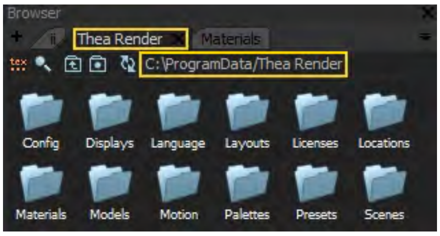


Figure 6-22: Path shows where the folder of the tab is located

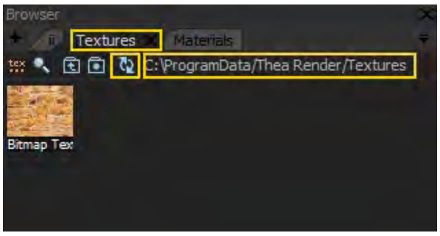


Figure 6-23: Type the path you want, hit Refresh and see its contents inside the current tab

By doing a right click inside the path area, a list that looks similar to the one in Figure 6-24 appears. This list depends on your Operating System, which gives you several options with respect to editing a box. Most common commands here, are the Cut, Copy, Paste, Select all, Delete and others.

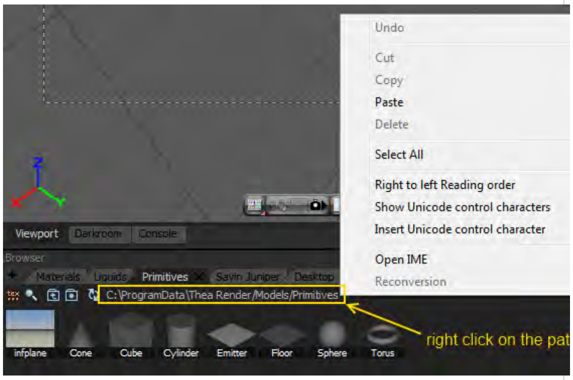


Figure 6-24: Edit Path Options

6.6 Display and Selection Area of Files

Figure 6-25: Display Area

This is the main area (see it in Figure 6-25) where the folders and their files are displayed. Once you have selected a file that contains Thea related files, their preview will become visible in this panel.

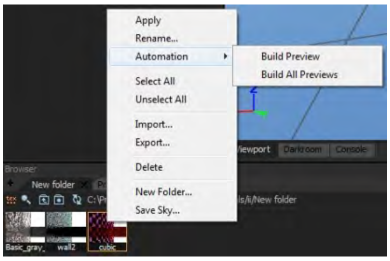


Figure 6-26: Right Click Appearing List

In this area you can perform several actions related to your materials or models. By doing a right click on an item in the tab or anywhere in this area, a pop-up window appears with a list of available options (see the list in Figure 6-26).
Below we analyze these options.

<u>Apply</u>: this option is enabled if you have selected a certain material and an object in the Viewport. By clicking on it, the object is assigned this material. As we previously have said, you can also double click on a material and the selected object will instantly get this material. If the initial selection at the tab was a model, by pressing Apply, the model is added in your scene.

<u>Rename</u>: you can change a folder or file name by this way and enter a new one.

<u>Automation</u>: two options exist here; the Build Preview and the Build All Previews. Build Preview option gives you the possibility to re-create the preview of your material, altering the way it is displayed. The

new preview is created according to the specifications given for the Preview at the Material Lab.

As we have explained at a previous chapter, you may have, for example, a material with a preview as shown in Figure 6-27. Changing the room and editor options in the Material Lab (see Figure 6-28) and hitting Build Preview, the material has now a new preview, as it is shown in Figure 6-29. This preview is now saved directly in your disk, without affecting your current scene in anyway. The changes are now seen at the Browser materials previews. The option Build All Previews is building recursively **all** the previews that exist in your folders and files, overriding any selection.
Note: some materials that come with Thea installer have a locked preview and rebuilding them will fail.

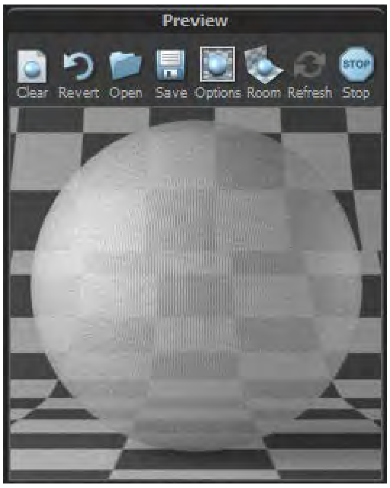


Figure 6-27: Initial Material Preview

Figure 6-28: Material Lab Room Selection

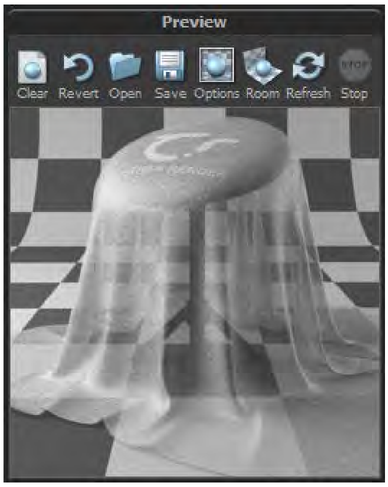


Figure 6-29: New Preview, after Building Preview

Select All: this option selects all the files that exist in the current, active, tab.

Unselect All: by clicking on this option, all the selected files in the current tab become unselected.

Import: this option opens a new window that helps us browsing package archives and import and extract files from Thea Material Package Files (*.mat.pack), Thea Texture Package Files (*.tex.pack) or Thea Model Package Files (*.mod.pack).
Another way to add in the current tab a new material that you have created in the Material Lab is to click on it (at the Preview of the Material Lab) and drag it in the Display Area of your Browser. The same mechanism works when clicking and dragging materials from the Models tab of the Scene panel.

Export: this option is enabled if you have selected one or more files and you want to create an archive at a desired location.
Tip: for case of multiple materials you can select between two options: Single Package (for maximum compression) where all selected materials are being added to one mat.pack and Individual Packages (for online repository) that exports each material in a separate mat.pack containg its description file and its preview (making uploads at Online Repository easy and fast).

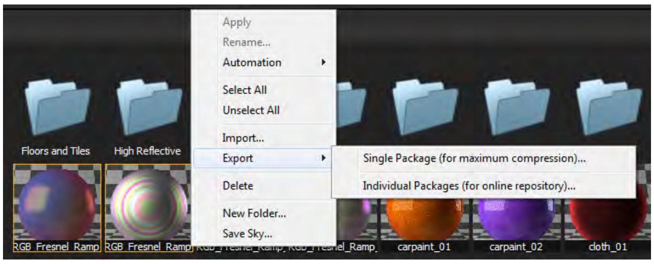


Figure 6-30: Export Options

Upon selecting the desired option, a window appears where you can select the location you want to save the material/texture/model/sky/etc. as the corresponding pack file (*.mat.pack file for a material, *.mod.pack for a model and so on).

Delete: this button deletes the selected file(s). A pop-up window appears to ask you if you are sure for your choice. By pressing Yes, the selected files are deleted from the disk.

New Folder: you can create a new folder in the current tab. In the pop-up window you can enter the desired name and the new folder is created (see Figure 6-31).

Figure 6-31: Creation of New Folder

Save Sky: once you have created a sky (with sun or IBL settings) you can press this button to save your sky to the current folder. As we have previously explained, there is a dedicated pre-installed folder with the name Skies (see Figure 6-12), where you can save your skies and re-use them in other scenes as well, by a simple drag and drop.

6.7 Close Browser

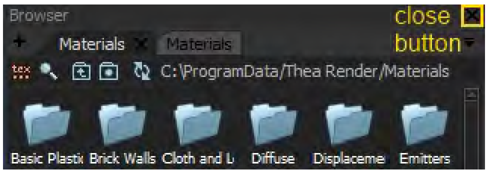


Figure 6-32: Close Browser Button

At the upper right corner of the Browser, there is the x button, with which you can close the Browser panel (see Figure 6-32). Once you close the Browser, you can reopen it by clicking at the Browser option, at the Menu Bar, at Window sub-menu (see Figure 6-33). There is also a second, identical browser (Browser #2), that you can enable and see it in the Studio layout, above the existing one, in order to facilitate exchanging files (see both Browsers in Figure 6-34).

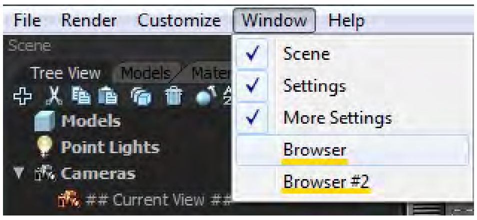


Figure 6-33: Open Browser and Browser #2


Figure 6-34: Two Browsers are Visible

Note: in the display area, you can find models and materials among other Thea-related files. Concerning a model, you can import it in the scene in three ways. First way is to **click and drag** it to the desired point in the Viewport (object will be placed at Z=0 surface, with X & Y coordinates as indicated by the mouse cursor. Second way is to click and drag a model to the **Models tab** of the Scene panel (see it in Figure 6-35). Third way is to **double click** on the model. With the last two ways, the object will be placed at the position where it was initially saved.

Concerning a selected material, you can apply it on an object, by having the object selected and **double clicking** on the material. The new material is now applied to the object, is displayed at the Material Lab and is added at the Materials tab of the Scene panel (see Figure 6-36). In case no object is selected, with the double click, the material is automatically displayed at the Material Lab and is also added at the Materials tab of the Scene panel.

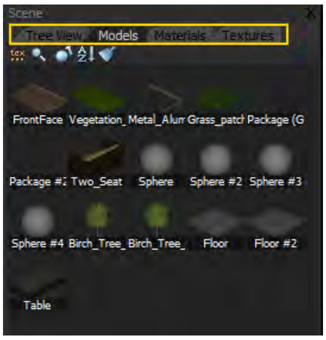


Figure 6-35: Models tab of the Scene panel

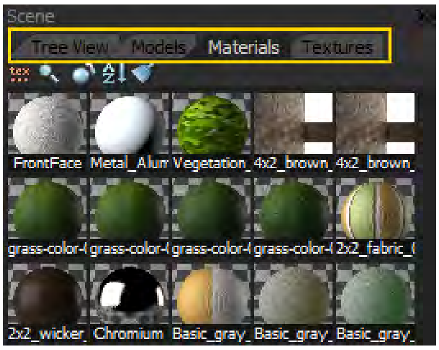


Figure 6-36: Materials tab of the Scene panel

THEA RENDER
phyisically-based unbiased, biased & gpu render engine

Chapter 7: Material Lab

7. Material Lab

7.1 Introduction

Thea Render uses a unique physically-based material system that delivers highest quality realism to your images.
Material Lab is actually the material editor of Thea Render and is the area where you can edit and preview your materials. You see the way the Material Lab looks like in Figure 7-1. You can find it at the first tab of the Settings Panel.

From a quick view at the right side of the Material editor, you can see that there are four reflectance models (Basic, Glossy, SSS and Thin Film) and one special used as Coating for layered materials. Thea Render materials are physically-based meaning that the models used, not only do not violate any physical laws, but they have been also developed based on an analytical physical framework. All materials have a uniform logic, as they all are built with both reflectance and transmittance and can be used as building blocks for even more complex materials through an innovative layering scheme.

The materials may not only be mixed together (horizontal direction), but also be stacked or modulated by special coating material (vertical direction) as we will analyze later. The modulation results in highly energy conserving materials which simulate real world materials – usually involving paints and varnishes – and are in general too difficult to produce from single material models.

All these possibilities and the parameters of the Material Lab that affect the creation of a material will be analytically explained at this chapter.

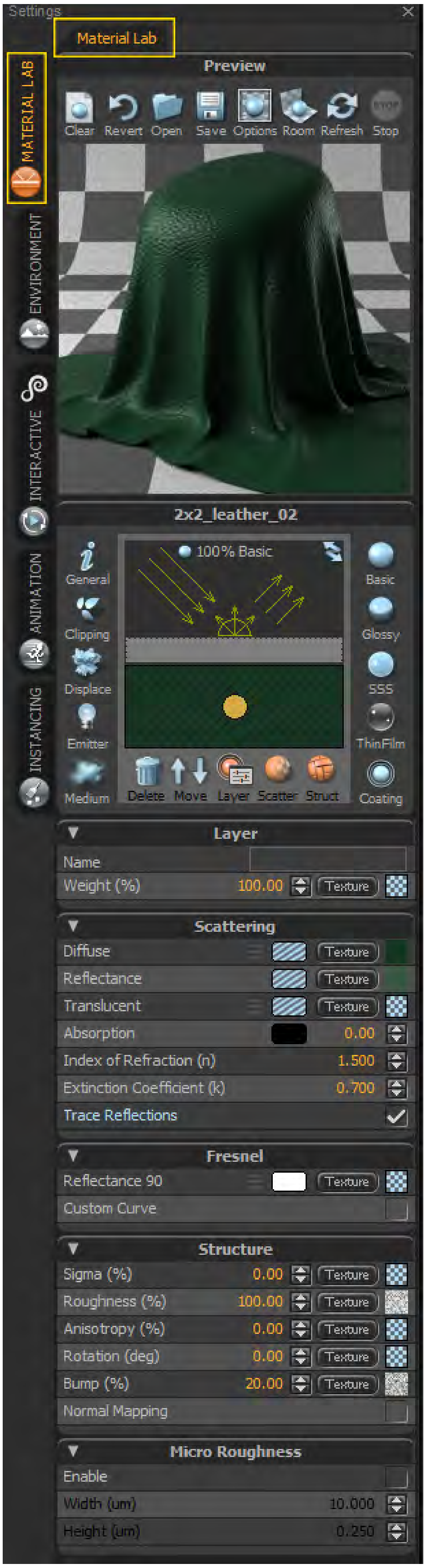


Figure 7-1: Material Lab

7.2 Parts of the Material Lab

By first look of the Material Lab, we can distinct three main panels: the preview panel on top, the layer schematics panel below and the properties panel at the bottom. In order to make Material Lab explanation easier, we can split the Material Lab area in some smaller categories, as we see them in Figure 7-2 in green boxes.

Figure 7-2: Parts of Material Lab

At the next table we see briefly these parts -areas- and the actions they perform.

Part	Panel	Action
A	Preview Panel	File/Undo Operations
B		Room Selection/Rendering
C		Material Preview Area
D	Layers Panel	General Properties
E		Geometric Modifiers: Clipping and Displacement
F		Area Light/Inner Medium
G		Layer Scheme - Clickable Area
H		Switch to Schematics List View
I		Add - Layer Operations
J		Layer Operations
K	Properties Panel	Materials Properties Panels (this panel is hosting each time the corresponding properties options)
L		Description

As we see, the first panel, where we can see the material preview and some generic options consists of the areas A, B and C. The next panel, with the layer schematics and all the options to tweak your materials, includes the areas D, E, F, G, H, I and J. The properties panel below them hosts the areas K and L.

Tip: both the preview and layer areas support **drag and drop**. This is very useful since –in conjunction with the browsers– you can easily store and assign materials. Whenever a model is selected, its corresponding material is seen in the material lab where you can edit it.

7.3 Preview Panel: File/Undo Operations, Room Selection/Rendering & Material Preview Area

7.3.1 File/Undo Operations (Area A)

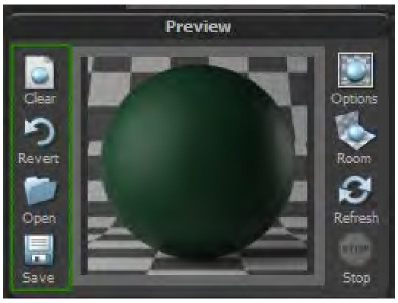


Figure 7-3: File/Undo Operations

At this block of options, as we see it in Figure 7-3, user can perform four basic actions, concerning a material, by pressing the corresponding buttons:

1. Clear a material
2. Revert a material
3. Open a material and
4. Save a material

At the following table we see some further details concerning these actions.

7.3.1.1 Clear

By selecting to clear a material, all the properties of the material are deleted and instead you have an empty material. This option may be useful in cases you need to start editing a material from scratch.

Tip: by pressing **Control + Clear** buttons on your keyboard, instead of erasing the current material, you can create a new, empty one, in the scene. In Figure 7-6, we see the new material at the Scene panel.


Figure 7-4: Material Before Clearing it

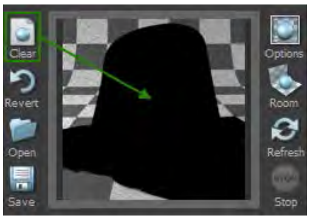


Figure 7-5: Material After Clearing it

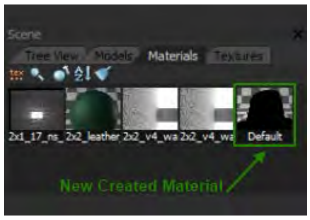


Figure 7-6: Control& Click Creates a New Material

7.3.1.2 Revert

With the revert option, you are able to undo all the changes made to your initial material during editing. Note that after selecting another material and then returning back to it, this option does not work.

7.3.1.3 Open

By selecting to open a material, a pop-up window appears (see it in Figure 7-7) to help you open a *.mat.thea file.
Another way to open a material is as we have seen in the previous chapter from the Browser panel (see the Browser panel in Figure 7-9), where the existing tabs, let you see the materials in the corresponding folder along with their previews.

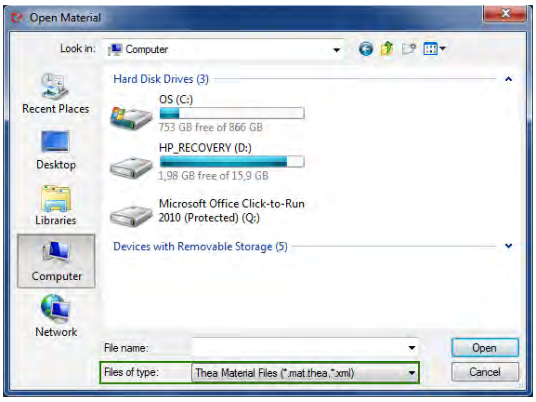


Figure 7-7: Open a Material

7.3.1.4 Save

Once you are satisfied with the material you have created, if you need to save it, you can press the Save button. This will open a new window (see it in Figure 7-8) where you can specify the name and the location of your new *.mat.thea material.

You can also drag and drop the material, to the folder you want at the Browser (Figure 7-9) and by this way, the material is saved under this directory automatically. You can then rename it (by doing a right click on it and selecting Rename).

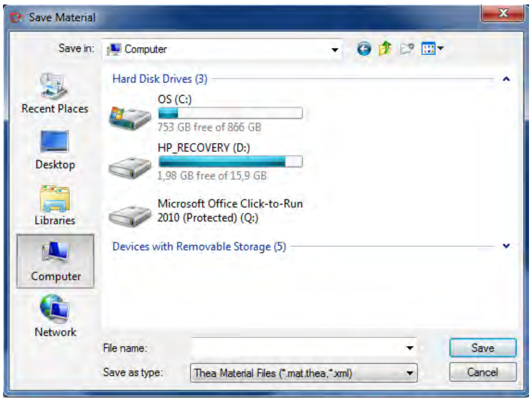


Figure 7-8: Save a Material

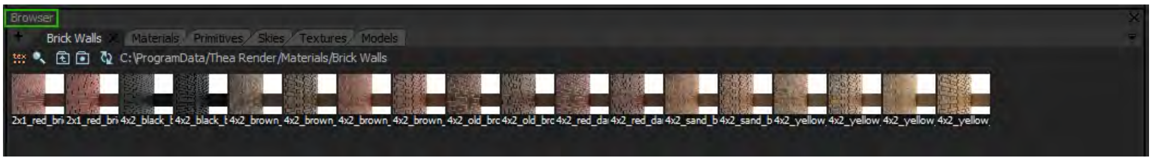


Figure 7-9: Thea Browser with several Tabs

7.3.2 Room Selection/Rendering (Area B)

Figure 7-10: Room Selection/ Rendering

At the right side of the Preview Material Window, we have the options for editing the preview room and specify its resolution, quality etc. (see Figure 7-10). These are the existing buttons that we have:

1. Options
2. Room
3. Refresh
4. Stop

At the next table, we see what actions these buttons perform.

7.3.2.1 Options

By pressing the Options button, a new small window appears, as seen in Figure 7-11, where user can specify the Room Options, meaning the quality of display and the number of threads used.
Tip: all the value inputs (numbers in yellow color) are editable and you can type the value you want. They also have two arrow buttons for **increasing and decreasing** them at their right side. By clicking on the increase or decrease button and while pressing, by moving your mouse above, you will see the value increasing until you stop clicking. If you move it below it, the values will be decreasing until you stop clicking. This feature is applicable to all value options in Thea Studio.
Below the Room Options, you can see the Editor Options and enable/disable the High Resolution, the Auto Refresh and the Auto Clipping. By selecting the High Resolution option, after pressing OK button, the Preview Area (Area C) will be larger than used to be and all the option buttons are now located at the top of the panel (see Figure 7-12).
Auto Refresh, shows the new preview of the material after each change you may have done. By enabling Auto Clipping, each time you insert a bitmap with alpha channel at the Diffuse Channel, Clipping is automatically enabled (Clipping and Diffuse channel will be explained later on). By this way you do not need to enter the same bitmap again at the Clipping slot.

Figure 7-11: Room and Editor Options

Figure 7-12: High Resolution Preview

In the next figures, we insert at the Diffuse channel a bitmap with alpha channel and at first (see Figure 7-13) we have auto clipping disabled, while afterwards, it is enabled (see Figure 7-14). We see that when it is enabled, at the points where the texture has transparency, there is actually no material (clipping is enabled and you can see it automatically checked at the corresponding panel – in area D).

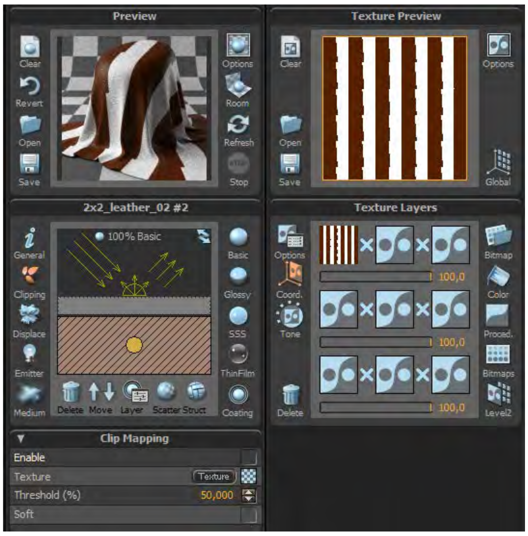


Figure 7-13: Auto Clipping is Disabled

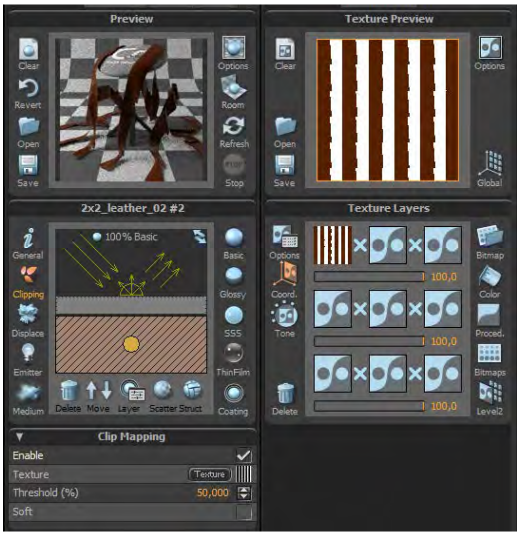


Figure 7-14: Auto Clipping is Automatically Enabled

7.3.2.2 Room

By selecting the Room button, a new small window appears, with a drop-down list below it, to help you select the kind of room you want for the material preview. As you see in Figure 7-15, you can choose among AMS (Advanced Material System), AMS (Image Based Lighting), AMS (Subsurface Scattering), Cloth, Direct, Floor, Front, IES, Translucent, Unbiased and Wall. At the next figures we see the way the previews are built each time.
(For seeing the IES and Translucent previews, we enabled also material emmitance.)

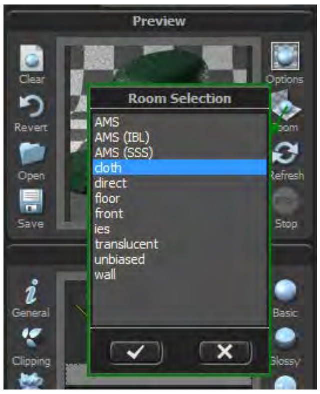


Figure 7-15: Room Selection Window

Note: after selecting a different room, press **Refresh Button**, which is just below the Room button, to see the results.

Note 2: The room used during material editing it is being saved along with the material, if you decide to save the material via Save button or drag-drop to Browser.

Figure 7-16: AMS Preview

Figure 7-17: AMS (IBL) Preview

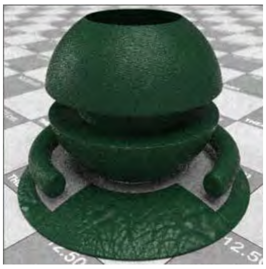


Figure 7-18: AMS (SSS) Preview

Figure 7-19: Cloth Preview

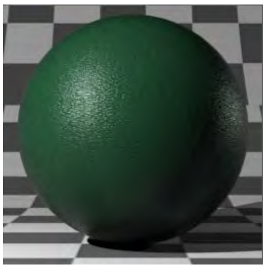


Figure 7-20: Direct Preview

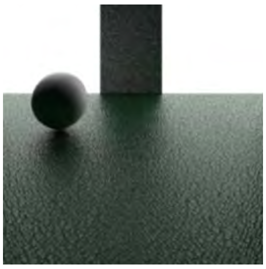


Figure 7-21: Floor Preview

Figure 7-22: Front Preview

Figure 7-23: IES Preview

Figure 7-24: Translucent Preview

Figure 7-25: Unbiased Preview

Figure 7-26: Wall Preview

7.3.2.3 Refresh

By hitting refresh button, the material preview is start to being created again, with all the modifications made, to be now applied, for cases where Auto Refresh option is disabled. As we already said, you need to refresh the preview, after changing the preview room.

7.3.2.4 Stop

For cases that quality, threads and resolution use high values, creating the material preview may need some time. If you want to stop the preview rendering, you can hit Stop button.

7.3.3 Material Preview Area (Area C)

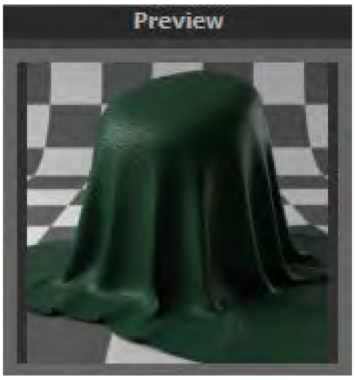


Figure 7-27: Material Preview Area

This area is actually a small window, where we see the material is preview, according to the specifications defined at Options and Room buttons (see this window in Figure 7-27).

It's worth mentioning again, that this area is supporting drag and drop. So, you can drag the material from the preview window to the model in the Viewport. You can also drag the material from the browser to the Preview area and vice versa, from the preview to the browser (and automatically save there your material).

7.4 Layers Panel: General, Geometric Modifiers, Area Light/Inner Medium, Layer Scheme – Clickable Area, Switch Schematics List View, Add - Layer Operations, Layer Operations

7.4.1 General Properties (Area D)

Figure 7-28: General Properties

The first button that we see in this panel, at top left, is the General button.

When you click at the General button as you can see it in Figure 7-28, the button is highlighted in orange color and the General panel appears below this panel (3rd panel, is hosting each time the corresponding Material Properties panel). So, Area K is showing now the General Properties of the current material. As we see again in Figure 30, we have some options in white color and some other in blue, meaning that they only work with Adaptive (BSD) engine.

At the next table, we see and explain all the available general properties that appear here.

Name: here, you can see the name of the material you have selected. You can also click on the text area and write the name you want for your material.

Two-Sided: this enable/disable option makes it possible to make the material two/one sided. With this option you can tell the renderer not to take into account any intersections with the back surface of the assigned objects. Thus, only the front surface will be rendered (some example renders are seen at the Scene Panel chapter). This option is useful also for defining sun/sky portals.

Shadow Catcher: by enabling / disabling this option you can make a material act like a shadow catcher. This is useful for cases when you need your inserted scene, not to seem like floating on the background. You can create a shadow effect, by inserting an infinite plane below your models, delete its material (use the Clear Button) and then make it Shadow Catcher (some example renders are seen at the Scene Panel chapter).

Repaintable: this option is related to Motiva Colimo application and you can define if the selected material will be repaintable or not. By selecting yes, after saving the rendered image as a Colimo project, you will be able to change its material. Note that Repaint option at the Unbiased engine settings needs to be enabled too before rendering.

Dirt (%): by enabling dirt option, you can add some kind of dirt points in corners or dark parts of the models, to make them seem more realistic. Note, that this option is functional with adaptive (BSD) engine only.

Figure 7-29: No dirt is used

Figure 7-30: A Procedural was used as Dirt

Perceptual Level: this option is used by the biased engine (Adaptive (BSD)) in order to accelerate direct light evaluation for the specific material. By default, it is set to 100% (full accuracy) but for various materials that make use of high-detailed textures, this parameter can be decreased to accelerate rendering. The idea behind this parameter is that many textures can mask noise due to their high frequencies and errors in the direct and indirect light evaluation are not easily perceived by the human eye. Thus, the user in these cases can set this parameter to a low value (even reaching values as low as 5-10%) to speed up rendering for the particular material.

Min/Max Blurred Subdivs: by default, minimum and maximum blurry reflection and refraction subdivisions are setup by the render settings. The render settings define the subdivisions globally for all materials. Here, the parameters can be used to change the subdivision on per-material basis. Thus, whenever we want improved accuracy for a specific material, we can tune it using these parameters rather than increasing accuracy settings globally for the whole scene. These settings are related to Adaptive (BSD) engine only.

Tracing Depth: with this option, user can set the value for the Tracing depth (used for Adaptive (BSD) engine) for the selected material.

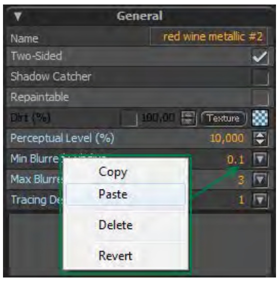


Figure 7-31: Right Click Options Available in Material Editing Panel

Tip 1: if you right click on each option of this panel, a **drop-down list** will appear that helps you copy, paste, delete or revert the corresponding arithmetic values (see this list in Figure 7-31).

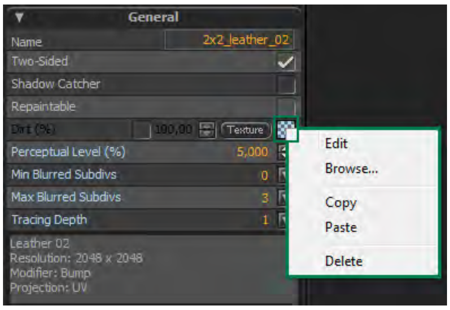


Figure 7-32: Right Click on a Texture Slot

Tip 2: generally, whenever you meet a **slot that a texture** can be inserted, you can do a **right click** on the slot and edit the texture (meaning open it in the Texture Lab), browse your disk to locate a texture and use it, copy, paste or delete it (see this list in Figure 7-32).

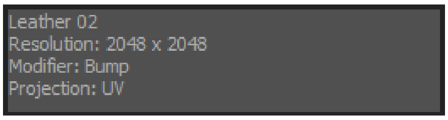


Figure 7-33: Information of the Material

Below of this panel, where the General Properties appear, we also see a small panel (area L as specified in Figure 7-2) showing some information of the selected material (see it in Figure 7-33). We see here the name of the material, the resolution used, the modifier of the material and its projection.

General Tip: as we saw before at the Dirt option, we can load a texture for the dirt. Loading a texture is an available option for many of the features in Thea Studio. It's worth mentioning here, that once you press on an empty texture slot (**left click**), a window appears to help you browse your files to select the bitmap you want to insert (see it in Figure 7-34). If though the cell is having already a texture, by pressing it, a panel with all the **Bitmap Options** appears – as seen in Figure 7-35.

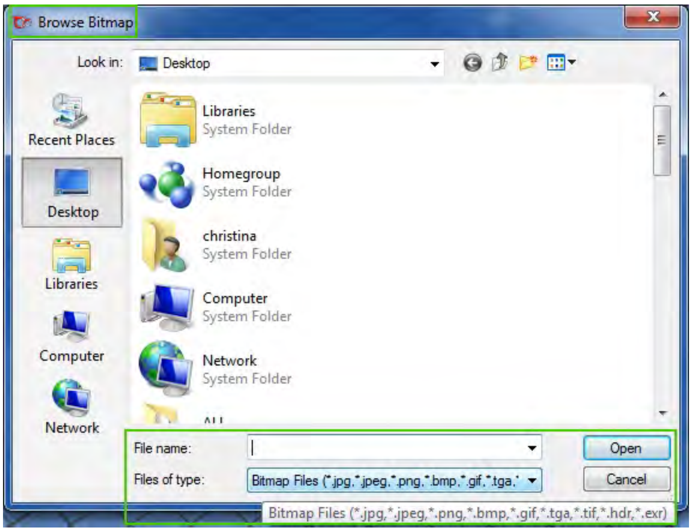


Figure 7-34: Browse Bitmap

Figure 7-35: Bitmap Options

At the Bitmap Options tab, user can select another file, by pressing on the blue file icon, change the texture projection on the material, define the UV Channel and the camera, and choose between RGB and Alpha Channel and among none, bilinear and trilinear for interpolation. The second panel, sets the coordinates of the texture, meaning its X, Y offsets, its X, Y and general scaling and its rotation.
Below, at the Tone Mapping panel, user can set several options concerning the texture appearance, such as Gamma, Saturation, Contrast etc.. Note that these texture modifications are applied to the selected material.

7.4.2 Geometric Modifiers: Clipping and Displacement (Area E)

At the following tables we will see two geometric modifiers, the Clipping and the Displacement.

7.4.2.1 Clipping

The first from the two Geometric Modifiers that we have in Thea Render is the Clipping. Clipping is a procedure that "cuts" parts of the material, based on a given texture. White – Bright areas of the texture are kept, while black ones are cut. We have mentioned Clipping at the Preview panel, where auto Clipping was explained. Here we can see some more specific details concerning this modifier.

By selecting Clipping button (see it in orange color in Figure 7-36), the panel that appears now below, is the Clip Mapping.
By enabling it first, you can select the texture that will be used as clipping map, define the percentage of threshold and if the clipping will be soft.

You can select a texture to insert in the slot, either by dragging a texture from the Texture Lab to the slot, or as we described before by left clicking on the empty slot or by doing a right click and open a browser to select the needed texture.

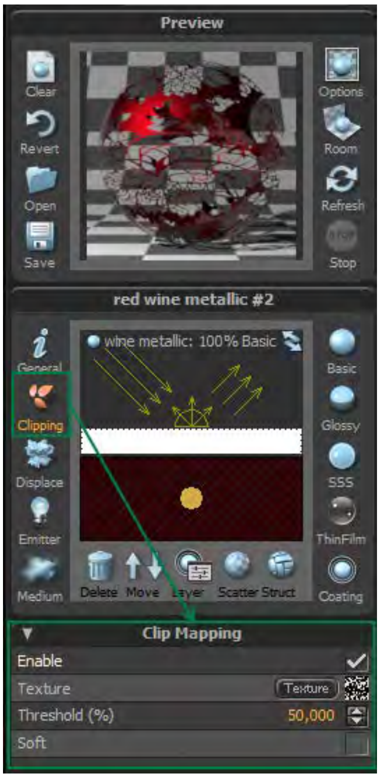


Figure 7-36: Clipping Modifier

Threshold percentage decides if the clipping will be applied on a material at gray texture areas. Setting the percentage very low, only total black and some very dark ones will be "cut" (see Figure 7-37). By increasing it, even more areas, that are brighter, will be clipped (see Figure 7-38). Setting the percentage to 100%, all material will be clipped, as even the total white areas will be considered as points of clipping.

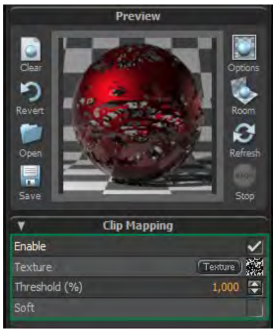


Figure 7-37: Threshold set to 1%

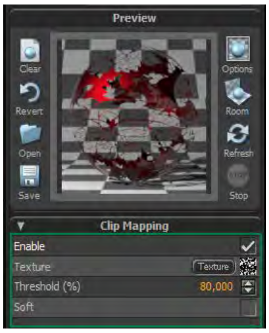


Figure 7-38: Threshold set to 80%

Soft option, is used when the texture is having alpha channel (there are points with gradient). By choosing Soft Clipping, these points will not be completely clipped (as in Figure 7-39), but they will have a transparent effect (see

Figure 7-40). Note that by enabling soft Clipping, gray areas will have that transparent effect and so you can not define the threshold anymore, as there is now no need to set a possibility percentage that will apply or not clipping to gray areas.

Tip: with Soft Option enabled, a color can be added to the slot (you can drag it from the texture lab directly there) and create a semi-transparent material (the amount of the transparency is controlled by the shade of gray).

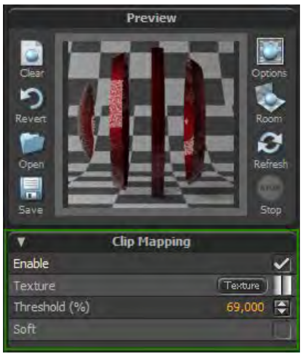


Figure 7-39: Soft Option is Disabled

Figure 7-40: Soft Option is Enabled

Figure 7-41: Darker Gray results in increase of material transparency

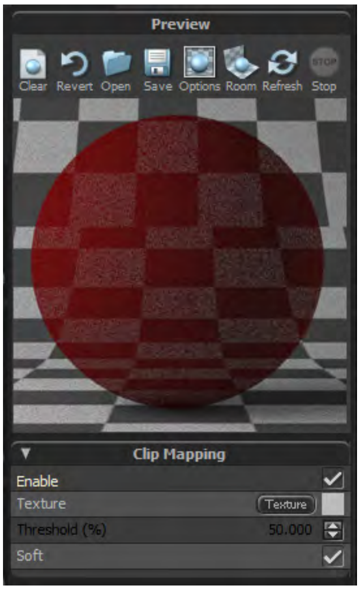


Figure 7-42: Lighter Gray decreases material transparency

Tip: Clipping Button is a **drop target**, meaning that you can click on a texture at the Texture Lab, drag and drop it on the Clipping Button and automatically the option will be enabled and the texture will be placed in the slot. Displacement and Emitter buttons that follow support the same functionality as well.

7.4.2.2 Displacement

The second Geometric Modifier that exists is the Displacement. As we see in Figure 7-43, by clicking on Displacement button, it becomes orange and a new panel appears below, with the title Displacement.

Figure 7-43: Displacement Panel Options

Displacement mapping is a computer graphics technique that uses a (procedural) texture or height map to cause an effect where the actual geometric position of points over the textured surface are displaced, often along the local surface normal, according to the value the texture function evaluates to each point on the surface. It gives surfaces a great sense of depth and detail, permitting in particular self-occlusion, self-shadowing and silhouettes; on the other hand, it is the most costly of this class of techniques owing to the large amount of additional geometry.

A displacement map is a black/white map like a bump map and the gray values of this map represent how Thea should displace the mesh. Areas with black mean no displacement at all and white means 100% displacement (corresponding to the "height" you have given). This is true when center is set to 0.000, but if you change center to 0,500 then 50% gray color of the displacement map will represent no displacement and if you set center to 1,000 then 100% white will represent no displacement (in other words it will displace in the opposite way). This inverted displacement is sometimes useful, like for the ground plane displacement where you want to avoid intersecting with objects that are on the ground, as for example a car wheel that is on a displaced ground, so in this case you would set the center to 1,000.

In order to get proper results while using displacement, especially for geometry that has edges, one always has to set model Geometry Smoothing to smooth, but if model surface has actually sharp edges (geometry is more "a box" or a plane) you must disable normal smoothing under displacement properties.

To understand the difference between Displacement and Bump, think a wood floor for example, where displacement will be for the boards and bump for the wood grain. Height means how high or far the mesh will get displaced while center means which part of your displacement map represents the center from where it get displaced.
Tight Bounds helps to render faster, but initialization will last longer, but is more preferred to have it enabled. You also might try some subdivision in the modeling application that you use so that there are nice edge-loops. Good mesh topology is important.
There are two things you need to do to get smooth results. The first is the geometry itself. Right click at the geometry and turn Smoothing on. The second is under Displacement Properties. The center setting will "move" the face up or down based on the direction it is facing. This is useful for countering any movement that displacement may have done to your original plane. For example, adding a displacement map to a carpet may make it look like it is floating. Reducing your center will bring it back down to the floor.
Below, we see some examples of using displacement and the way each option is applied.

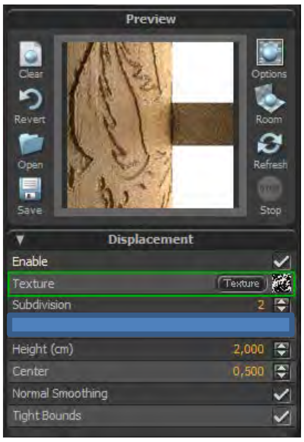


Figure 7-44: A flower pattern is loaded and we see the way the wall, where the material is applied, is changing and looks like having a silhouette.

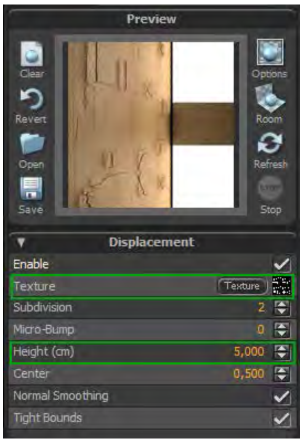


Figure 7-45: By choosing another map texture and increasing the Height, we see that the glyphs on the wall are seemed even larger.

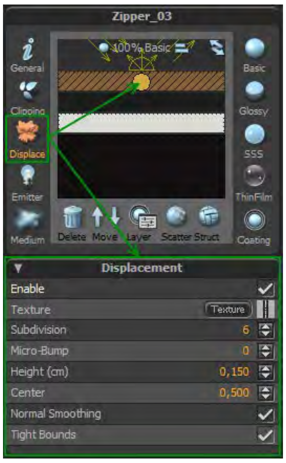


Figure 7-46: Displacement is applied to the whole material.

Figure 7-47: Rendered image of previous displacement settings.

Figure 7-48: Displacement on a thin film material.

Figure 7-49: Rendered image of previous displacement settings.

Note: for Presto, Currently though, the texture used at the Displacement slot, must be described with a single bitmap texture (i.e. no texture layering support).

7.4.3 Area Light/Inner Medium (Area F)

At the next two tables we describe the Emitter and the Medium material options.

7.4.3.1 Emitter

Thea Render supports both area and point light emitters. The area emitters are applied to a surface (sometimes are also called mesh emitters when the surface is a mesh). Typically, the area emitter has a diffusion-like emission model and it uniformly distributes light along all directions in the above hemisphere. Nevertheless, more complex emission models can be defined by making use of an IES file.

Figure 7-50: Emitter Options at the Emittance Panel

As seen in Figure 7-50, the fourth button that we meet at the left side of the material editing panel is the Emitter button, that once pressed, opens the Emittance Panel. By enabling this option for a material, it is emitting light. There are several settings that help user define the properties of the emitted light.

User can select the color of the light by pressing on the color slot (see white box at the Color option, in Figure 7-50) which opens the Color lab window, or load the texture that will be used for light.

Tip: next to the Color option button, you can see **three small horizontal and parallel lines**. You will see these lines next to each color slot. By pressing it, the color space window appears just below it. You can see this window in Figure 7-51.

The first space that appears is the HSV (Hue, Saturation, Value) and by pressing the colors small button at top left, the RGB space (Red, Green, Blue) is appearing instead.

From here user can select the desired color for the emitter, without opening the Color Lab. By pressing the three parallel lines icon, you can hide this window again.

Figure 7-51: Color Spaces: HSV and RGB

After setting the color of the emitter, we see the Power option. User can define here the power of the emittance. First, you can set the arithmetic value and then select one of the available units of measurement.

As we see in Figure 7-52, the available units are: Lumens, lm/m^2, Candelas, cd/m^2, Watts (total power), W/m^2 (exitance), W/sr, $W/sr/m^2$ (radiance), W/nm, $W/nm/m^2$, W/nm/sr and $W/nm/sr/m^2$.

Note: lm stands for lumens, cd for candelas, sr stands for steradians, W for watts and nm for nanometers.

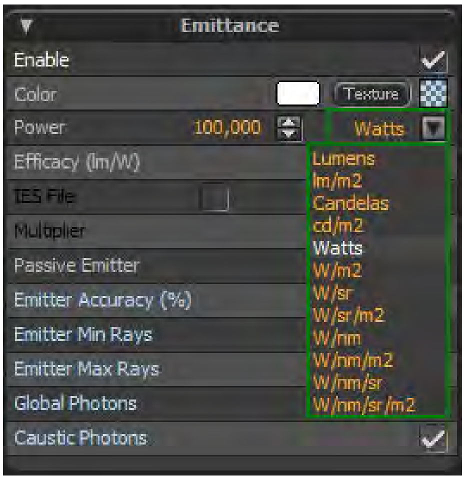


Figure 7-52: Available Units of Measurement for Power of Emittance

Below, we can select the Efficacy of our emitter, my setting the Lumens per Watt (lm/W) value. Maximum efficacy is 683 lm/W which corresponds to lights with no energy loss, meaning that all their power is converted to visible light. This is achieved only for a particular central wavelength where human eye is most sensitive and in practice common lights have efficacy between 2 and 50 lm/W.

The next option is to load an IES file for your selected emitter material. An IES file describes light emission according to measured goniometric data. You can click on the file icon and load an *.ies file and then enable the option. By selecting as Preview room the IES room (see also Figure 7-23), you can see the way this source will emit light. You can also set a Multiplier for the inserted ies light file.

Figure 7-53: Enabling an IES file for the emitting material

The next option here is the Passive Emitter. With this option, an emitter will not cast light into the scene; but one will be able to still see the area emitter "lit". This is useful in lots of (interior) scenes, where we have seen setups with (IES) point lights on the same place with an area emitter.

The rest options that we see at the Emittance panel are in blue color, which means they are applicable for the Adaptive (BSD) engines. Emitter Accuracy (%) is used in the case when an area emitter has been enabled for the material. In that case this accuracy setting is used in conjunction with emitter minimum and maximum rays to define the effort of the direct light estimator for this particular area light. The engine makes an adaptive evaluation starting with minimum rays until either this accuracy threshold or maximum rays have been reached. So, the next two options that are Emitter Min/Max Rays are used in conjunction with emitter accuracy to define the effort of the direct light estimator for this particular area light. Next option defines if the selected emitter will be used for the Global and Caustic Photons (for the photon mapping technique).

Below, we see some example images to show how a material with emittance enabled, looks like.

Figure 7-54: An Emitter panel, from Primitive models, with a diffuse texture and same texture applied to emittance color slot.

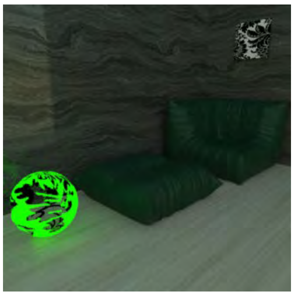


Figure 7-55: A clipped sphere with green emitted light.

Figure 7-56: Two different ies files are loaded to the two lights and they create a different light beam.

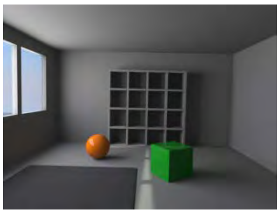


Figure 7-57: By placing an invisible emitter outside of a window (right click on the model and disable visibility), you can illuminate more an interior area.

7.4.3.2 Medium

True volumetric scattering is supported and Thea Render can solve light transport problem that includes participating media. There are a lot of possibilities since mediums can be both homogeneous and heterogeneous and a lot of supported phase functions. The fifth option that we meet at the left side of the material editor is the Medium, which opens the corresponding panel as we see it in Figure 7-58. Below we see all the available options and their description.

Figure 7-58: Medium Panel

Absorption Color: defines the transmittance color – this is actually the color visualized after a distance of 1 meter (assuming unit density and no scattering). When the distance is less than 1 meter, the color shifts towards white and when the distance gets bigger the transmittance shifts towards black. The color change along to distance is strongly nonlinear and thus it is recommended to avoid highly saturated colors.

Scatter Color: defines the scattering color – this is the color that bounced particles (in the medium) have. The sum of absorption and scatter color (multiplied by their corresponding densities) defines the extinction coefficient of a medium which is used to calculate the total absorption at a distance. The scatter color may be applied numerous times for particles that bounce inside the medium (especially for highly scattering medium) and so, it is also recommended here to avoid highly saturated colors.

Absorption Density: this entry defines the density of absorption in 1/m units. The higher this density the higher the absorption. This option gives easy control to the magnitude of absorption and it is possible to set a procedural texture in order to define spatially varying absorption (heterogeneous medium).

Scatter Density: this entry defines the density of scattering in 1/m units. The higher this density the higher the scattering. This option gives easy control to the magnitude of scattering and it is possible to set a procedural texture in order to define spatially varying scattering (heterogeneous medium).

Coefficient File: Absorption and Scatter colors can also be described by numerical data. The file that includes this data has similar format to the nk/ior files and you can enable this option and select the desired file from the list.

Phase Function: a phase function defines the variation of outgoing radiance over the sphere of directions and it is the medium analog of a bi-directional scattering distribution function (which is used for surface). The available functions are the Isotropic, Rayleigh, Mie Hazy, Mie Murky, Mie Retro or Henyey Greenstein (you can also set the asymmetry value below it). Most used phase functions are isotropic and Henyey-Greenstein.

Asymmetry: this parameter defines the asymmetry parameter of Henyey-Greenstein phase function. This parameter is unit less and takes values from –1 (totally back scattering) to 1 (totally front scattering). Obviously the extreme values of –1 and 1 do not actually scatter light outside the particle direction and they are not of practical use. A value of 0 is balanced scattering between back and forth directions and it is the same like using an isotropic phase function.

Figure 7-59: Glass with medium of grape juice.

7.4.4 Layer Scheme – Clickable Area (Area G)

Figure 7-60: Layer Scheme Area

The Layer Scheme area, as we seen in Figure 7-60, is the place where the layers of our materials are presented. This area is not only providing some basic information but is also active and performs several tasks.

The yellow dot in the middle of a layer shows that this layer is the active one, meaning the one we are currently editing. But we can also click on this layer and drag it and create a new, same to the selected, layer. Another source of information found here are the yellow traces that show how the light is reflected or refracted on a surface. At the top, we see a small text area which indicates the kind of material and its weight percentage with regards to the other layers. As we said, this area is active, so by clicking on this text area and drags it to the layers area we can also create one new layer, same to the previous one.

Tip 1: When light hits on a surface (called also an "interface") it is reflected and transmitted through the medium. The complex index of refraction is a medium property that is used to compute how the relative power of the reflected and transmitted ray. This property is in reality a complex, wavelength-dependent, number that consists of the real index of refraction (n) and extinction coefficient (k).

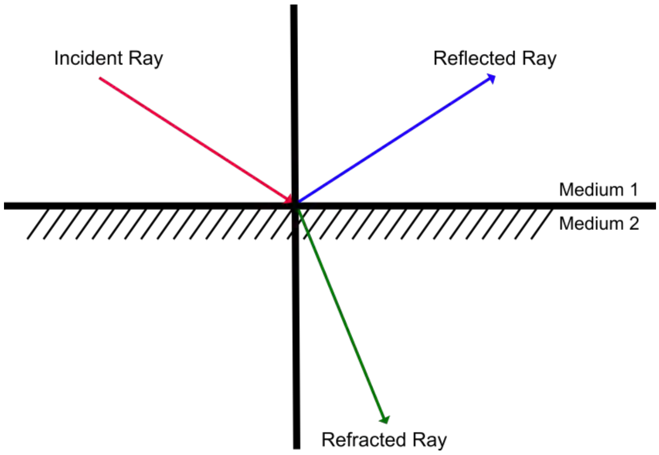


Figure 7-61: Light is reflected or/ and refracted

The relative index of refraction between two mediums, i.e. the ratio of the real index of refraction between them, plays a central role in the "bending" of the ray when transmitted through the medium. When the ray hits a denser medium the ray is bent inwards; this is why we can see, for example, light that enters a glass of water being focused on another nearby surface forming caustics.
The extinction coefficient on the other hand plays a central role in the absorption of the light when traveling inside the medium. It is actually an exponential factor, which means that even a small value can result in very fast lighting decay within the medium. Metals that exhibit very small light penetration (i.e. no transmittance) have a non-zero extinction coefficient. On the other hand, many dielectrics (i.e. glasses) have a practically zero extinction coefficient which makes light traveling inside them without any energy loss.

Tip 2: in Thea Render there are two different layer positions and they are called **mixing and stacking**. In order to explain the differences better, let us give an example.

Let's say we have layer A (in red color) and layer B (in blue color), with weights 50% and 100% in their related entries. For specifying these weights, we can use the Layer button, as is described later. Then:

- Case 1: A and B are mixed (you will see materials at the same level, one next to the other). Then the weighting of them will be normalized, and the final material will contain 33% (meaning 50%/(50%+100%)) of material A and 66% (meaning 100%/(50%+100%)) of material B (see Figure 7-62).
- Case 2: A and B are stacked (you will see the materials to different levels, one at top of the other).

Here, order of stacking matters. Layer A being on top of B differs from layer B being on top of A. In stacking case, layer weight of A will be used for this material, and rest weight for the materials underneath (layer weight of B will be ignored). The final material will contain 50% of material A and 50% (=100%-Layer Weight Of A) of material B (sees Figure 7-63 and Figure 7-64).

Below we see some simple examples of these two techniques and the final **material** created.

Relevant weights of the used layers are as described: A 50%, B=100% and C (thin film)= 80%.
In Figure 7-65, we have mixed A and B colors as in Case 1, and then we have stacked on top of them a layer C of thin film (glass material that we will be analyzed later on), with 80% weight. So the final material has 80% of material C, and the rest 20% is taken from the 33,33% to 66,66% mixing of red - blue, so it finally has 6,66% red and 13,33% of blue.

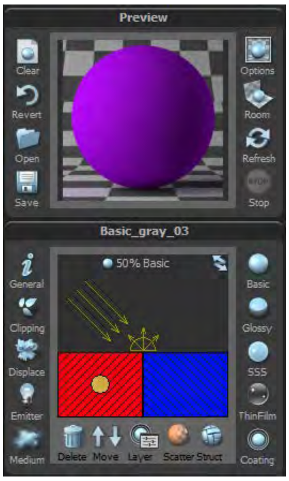


Figure 7-62: A and B are mixed – final material has 33,33% of red and 66,66% of blue

Figure 7-63: A and B are stacked, with blue on top - final material has 100% blue and 0% red

Figure 7-64: A and B are stacked, with red on top - final material has 50% red and 50% blue

Figure 7-65: A and B are mixed and both of them are stacked with C - final material contains 80% of thin film, 6,66% of red and 13,33% of blue

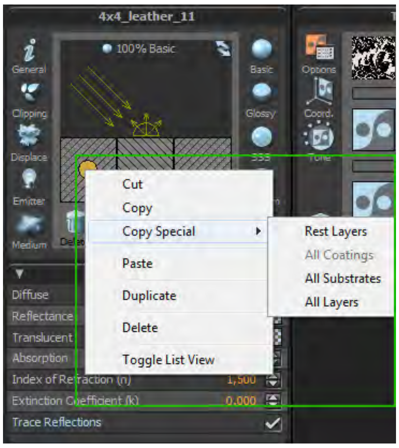


Figure 7-66: Right Click on Layer Scheme Area

Another useful feature concerning layer area is that several tasks can be performed, by doing a **right click** on it.

As we see in Figure 7-66, user can cut a layer, copy it or make a copy special, meaning copy the rest layers (not the one that has selected), copy all the coating layers -if existing-, copy all substrates of the layer or copy all the layers. Then, the copied layers can be pasted to desired point. There is also the option to duplicate or delete a layer.
The last option we see is the Toggle List View option and is identical to the Switch to Schematics List View option (area H), that we are going to describe in the next paragraph.

7.4.5 Switch to Schematics List View (Area H)

Figure 7-67: Switching to Schematics List View

By pressing the small arrow icon that appears on right top of the layer window (or by right click and select Toggle List View), instead of the previous layers layout, we have a new one, the schematics list view, as we see on top of Figure 7-67. Instead of seeing the layers by color boxes, we see a text list with the layers weights and names. The active layer is in orange color.

The horizontal line indicates that we have stacking between the top material and the ones below it. By click and drag the selected layer to another place in the layer window, you can also create a new layer, same to the one selected (with weight 100% though).

By pressing the same double arrows again we can switch to the previous layout again (see the bottom preview of Figure 7-67).

7.4.6 Add - Layer Operations (Area I)

Figure 7-68: Add Layer Operations Area

As we see in Figure 7-68, a list with five material types appears here. There four material models and one special model – the last one - are:

1. Basic
2. Glossy
3. SSS
4. Thin Film
5. Coating

By clicking on each one, a new layer is added to the previous one(s) (if there are any). At the table below, we will show how each material is added to an empty -cleared- material, some of their properties and the way they look in rendering.

7.4.6.1 Basic Material

Basic material is a model that consists of a diffuse, translucent and a Fresnel-based specular component. In Figure 7-69 we see a basic material and in Figure 7-70 the corresponding Scattering, Fresnel and Structure panels (we will analyze these panels later on) that help user edit this type of material. Basic material is a highly energy conserving material and designed to be used mostly for matte and plastic materials.

The translucency is modeled as simple back diffuse scattering and – along with the absorption – it can be used to create translucent materials that are much faster to render than employing a subsurface scattering model. It may also be used as single - sheet back scattering material, for example when rendering curtains. In biased mode, diffuse and translucent components are resolved relatively fast due to a render caching mechanism. So, it is recommended to make use of these components in biased mode in order to efficiently add global illumination elements to your renders. These materials will be rendered faster than making use of specular components of very high roughness.

Although, Thea Render supports accurate Subsurface Scattering materials (SSS), rendering them may take quite some time. Instead, using a translucent component with absorption – while not simulating subsurface scattering – gives many times visually pleasing results. Thus, it is recommended to use basic translucency, whenever possible.

The basic material is useful for defining matte and plastic materials but it may also be used for metals and translucent materials. Metals have in most cases a non - zero extinction coefficient which corresponds to high value of Fresnel coefficient under any viewing angle. In the typical direct room of the Material Lab, translucency cannot be previewed because it is only resolved by global illumination techniques.

Figure 7-69: Basic Material Preview

Figure 7-70: Scattering, Fresnel, Structure and Micro Roughness Panels for Basic Material

7.4.6.2 Glossy Material

Glossy material is a material that simulates reflection and refraction that can be perfect (roughness 0), very rough (roughness 100), or somewhere in between. In Figure 7-71 we see a preview of a Glossy material and in Figure 7-72 we see its Scattering, Fresnel and Structure Panels. This BSDF (Bidirectional Scattering Distribution Function) makes use of Fresnel equations to balance reflection and refraction, which is controlled by the index of refraction (and extinction coefficient). An index of refraction near 1 will make the material less reflective and more refractive (with the marginal case of being exactly 1, which corresponds to a perfect transparent material). As the index of refraction gets higher, reflection becomes stronger and stronger until it nearly matches the user color for very high values.

What is very important to understand is that Fresnel coefficients are based on both index of refraction and incident angle. Thus, even with a very small value of index of refraction, the BSDF will be quite reflective for grazing angles. This is a typical phenomenon observed in real world and, for example, you can see this by observing pool water (if you look straight down you can see the bottom, but looking the pool from far away you can see reflections of the environment).

The glossy material makes use of the complex index of refraction (which as we have said includes the extinction coefficient) and is of particular importance for describing metals. There, the extinction coefficient takes non-zero values resulting in high absorption of refracted light and amplification of the reflection.

The glossy material is useful for defining conductors (metals) and dielectrics. Since it supports the use of measured data, .ior files (or as otherwise mentioned .nk files) it can achieve even higher accuracy. Transmitted roughness is particularly effective when you want to simulate dielectrics with crisp reflections and blurry refractions and it is superior in terms of memory, speed and energy conservation than using glossy/glossy or coating/glossy combinations to achieve the same effect. Use a separate transmitted roughness only when needed though. Dispersion is enabled either by checking and using Abbe number or checking and using measured data of dielectrics. Please note that dispersion increases rendering time quite much, so whenever dispersion can be neglected, do not use these parameters.

Figure 7-71: Glossy Material Preview

Figure 7-72: Scattering, Fresnel and Structure Panels for Glossy Material

7.4.6.3 SSS

The Bidirectional Subsurface Scattering Distribution Function (BSSDF) is a generalization of BSDF where the enter and exit points may differ (while for BSDF these points coincide).
Thus, the evaluation of BSSDF becomes far more difficult, as it involves the interaction of surface reflectance/transmittance along with scattering through participating media. Thea Render SSS model is based on the glossy material where subsurface scattering is also supported. In Figure 7-73we see a preview of a SSS material and in Figure 7-74 its corresponding Scattering, Fresnel and Structure panels.

Besides the surface reflectance entries, there are also parameters describing the absorption and scattering inside the object. In order for the SSS material to be evaluated correctly, the object should be closed (i.e. no holes).

High albedo participating media (i.e. when scatter density is much higher than the absorption density) are particularly difficult to render. A usual technique to accelerate their rendering with minimum loss of accuracy is to turn an asymmetric medium to anisotropic one with synchronous decrease of its scattering density. Assuming that the asymmetry of the medium is g>0, then one has just to set asymmetry to the isotropic value of 0 and decrease scatter density to a new value that is the old one times 1-g. The new medium will have lower albedo and it will render faster with very small sacrifice to accuracy.

Figure 7-73: SSS Material and Preview

Figure 7-74: Scattering, Fresnel and Structure Panels for SSS Material

7.4.6.4 Thin Film

This glass model describes thin glass materials that show perfect (mirror) reflection and transparency. In Figure 7-75 we see the preview of a thin film material and in Figure 7-76 the corresponding Scattering and Structure panels. Thin film models are very accurate models and are great for assigning to thin surfaces, such as windows and thin transparent plastics. Although, one could also use a glossy material with transmittance enabled and index of refraction set to 1, it is recommended to use the glass model whenever you want to achieve transparency.

Another way to achieve transparency is to actually model a surface, such as a window, as thin double interface where refraction takes place at both sides. Using the glass model though is optimal in terms of visual accuracy and additionally, it can be traced during shadow evaluation (something this cannot be done with the double interface model which will create shadows). The glass model does not assume the model to be closed as it does not define an interior/exterior volume. The index of refraction is used as if the model was a double interface, in order to compute the overall transmittance due to double refraction.

Figure 7-75: Thin Film Preview

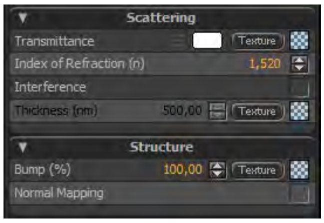


Figure 7-76: Scattering and Structure Panels for Thin Film Material

7.4.6.5 Coating

The coating model is a special reflection model that has only specular component. This model can be effectively used in order to simulate varnishes and paints on a layered material.
In Figure 7-77 we see the preview of a coating layer and in Figure 7-78 the corresponding Scattering, Fresnel and Structure panels.

Several coatings may be used one after the other simulating multiple varnishes and paints. The coating always reflects some light but – when used in layered material – it leaves the rest energy of the light to reach the layers underneath. The extinction coefficient is used both for modifying the reflectance (according to Fresnel equations) but also to define absorption density for the layers underneath. It is used in conjunction with the thickness map of a layered material in order to calculate absorption on microscopic level.

Figure 7-77: Coating Preview

Figure 7-78: Scattering, Fresnel, Structure and Micro Roughness Panels for Coating Model

As we have said, material layers can be created in two ways, by mixing or stacking them. Material models can be added one after the other creating a layered material. The four first types are added “horizontally” (we can change them afterwards), meaning that they are mixed together. The last one, that is the coating material, is added vertically essentially simulating one or more layers of varnishes over a surface. With the materials mixed together, there is the possibility to assign special mixing weights, in order to change the default uniform mixing. Besides that, the coating layers can also have a thickness which is taken into account – along with coating extinction coefficient – in order to compute absorption within the layer.

7.4.7 Layer Operations (Area J)

Figure 7-79: Layer Operations

As we see in Figure 7-79, below the layer preview window, we see some basic operations for layer and material editing. From left to right, we see these options:

1. Delete
2. Move
3. Layer
4. Scatter
5. Struct (from Structure)

Below, we analyze these buttons along with the corresponding panels that they open when pressed.

7.4.7.1 Delete

This button, deletes the current (selected) layer.

7.4.7.2 Move

This button consists of two arrows, one showing up and one showing down.

Up: by pressing the move up button, the selected layer is going up; this means that if the layer is mixed with other layers, by pressing up button, the layer is now above all the others and is stacked (see Figure 7-81). If the layer was already stacked, it is going one place above the previous upper layer (see Figure 7-82).

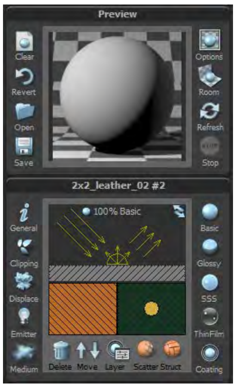


Figure 7-80: Initial Layers Position


Figure 7-81: Green Layer is moving up


Figure 7-82: Green layer is moving up again

Down: by pressing the down arrow button, the selected layers is moving one place down; if it was previously stacked, it goes either below the underneath stacked layer, or if there is none, it is moving to the mixed layers area (see this in Figure 7-84). If it was already mixed with other layers, it is now moved one position rightwards (as in Figure 7-85).

Figure 7-83: Initial Layers Position

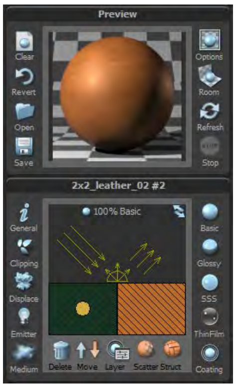


Figure 7-84: Green Layer is moving one place down

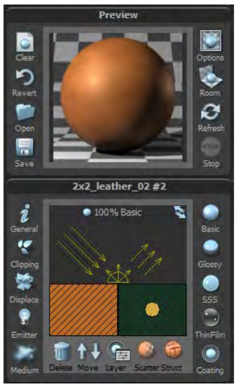


Figure 7-85: Green layers is moving down again

7.4.7.3 Layer

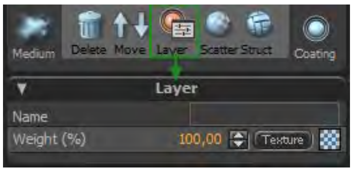


Figure 7-86: Layer Option

When pressing the layer option button, a panel like the one in Figure 7-86 appears, that makes it possible to define the weight (in percentage %) of the selected layer to the other layers.

As we have explained before, this weight has a significant importance for mixing and stacking layers, as it defines the final appearance of the material. The weight defines a mask for coatings and substrates. For coatings, it actually modifies the percentage of light that is allowed to reach the layers underneath. For substrates, all weights are normalized according to their sum, so that each substrate reflectance is modified by a relative percentage (without any weights, the substrates are again normalized to reflect with same weights).

You can also load a texture at the weight option that will be used as a mask to the rest layers, something that helps you create several effects.
In the next figures, we see how setting different percentages and a texture mask, can lead to creation of different materials, even without changing anything else.

Figure 7-87: Grey covering layer has weight 100% and is the only one visible.

Figure 7-88: By decreasing its weight to 20%, the rest 80% let bottom layers to be seen.

Figure 7-89: Without changing the gray layer percentage weight (100%), we apply a texture that works as a mask and at its dark parts allow the bottom layers are visible too.

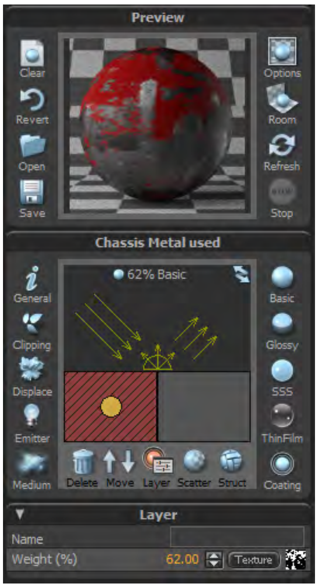


Figure 7-90: With the use of material layers and masks between them several advanced materials can be created.

7.4.7.4 Scatter

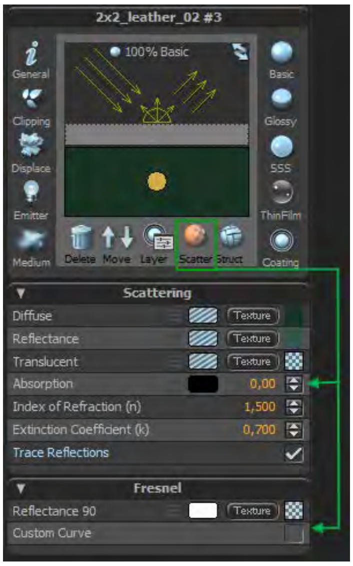


Figure 7-91: Scattering and Fresnel Panels

By selecting this option, two new panels are appearing below the layers window (in area K): the Scattering and the Fresnel panels (see them in Figure 7-91). The first panel has all the options related to the way the material surface is scattered. Fresnel panel, which is described later ore analytically, helps user to define the reflection of light, by the equations that predict it, known as Fresnel reflection curves.

At the next table, we analyze each of the available options that we see in the Scatter window.

Note, that for different materials, some of these options are not appearing. So, at the next table, we have included a column to show at which materials each option is available.

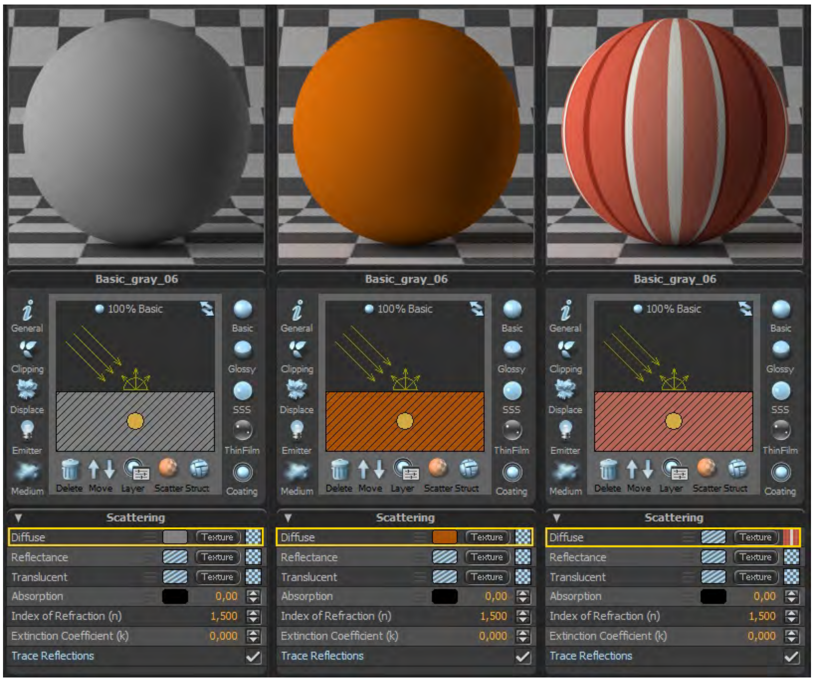
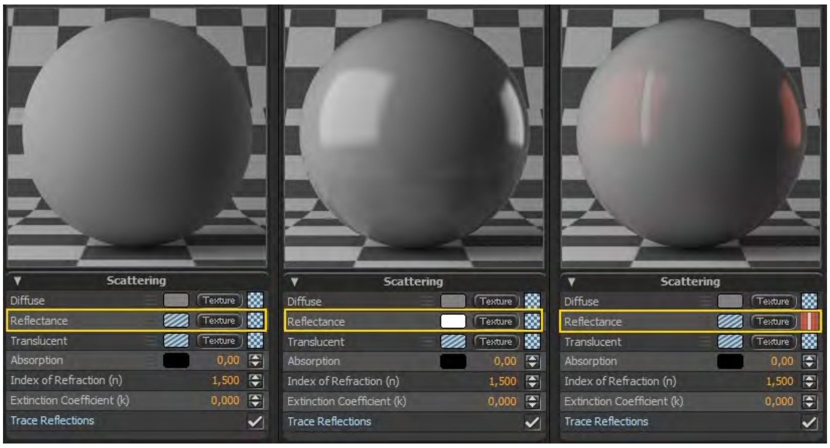
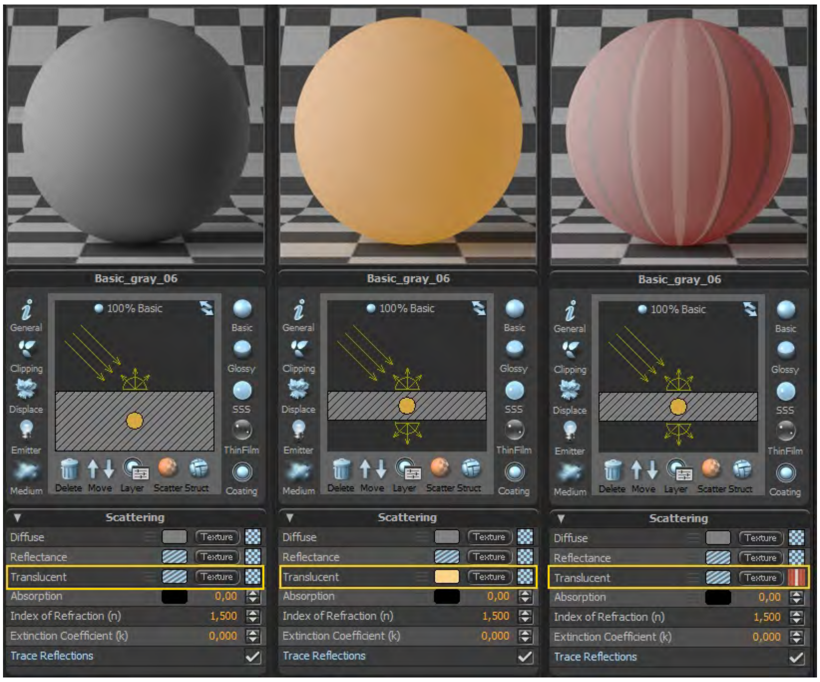
<table>
<tr><th>Scattering Option</th><th>Material that uses it</th><th>Description</th></tr>
<tr><td>Diffuse</td><td>Basic</td><td>At this point user can select a texture for the diffuse component of the selected material layer. If no texture is specified then no diffusion is rendered.
In the next figure (Figure 7-92), we create a basic material and we see that by default, a gray color is added at the Diffuse slot. We can click on the color, open the Color Lab and select the desired color. We can also add a bitmap as a texture instead (as in the 3rd example of the following figure).</td></tr>
<tr><td></td><td></td><td>

Figure 7-92: Diffuse Option - Default Grey color, Selected orange color and inserted Bitmap.</td></tr>
<tr><td>Reflectance</td><td>Basic, Glossy, SSS, Coating</td><td>Reflectance is the texture for the specular component under normal viewing condition (the viewer is right on top of the surface). By defining this reflectance, reflectance at grazing angle (90 degrees) is also implicitly defined. Thus, the specular reflectance is actually calculated as a blending between user Reflectance and Reflectance 90 (default being white) depending on the viewing angle. It is recommended to put near-white colors for the reflectance and modify specular strength by changing the index of refraction and extinction coefficient. This way, more realistic materials can be delivered and layered materials achieve an even higher overall reflectance albedo.
Note: we will see later, at the Fresnel panel, the way to manually edit the Reflectance equations.</td></tr>
<tr><td></td><td></td><td>In the next set of materials (Figure 7-93), we create at first a basic material and we see that by default, it has no reflection. Then, we add a white color reflectance texture (second material). At the last example, we add a bitmap at the reflectance slot to look the way this time the material is rendered.</td></tr>
</table>

		 Figure 7-93: Changing Reflectance from none, to white and then we use a bitmap.
Translucent	Basic	Here user can add a texture for the translucent component. If no texture is specified then no translucency is rendered. In the next materials, we see three cases: having no translucency, having chosen a color for it and having a bitmap instead (see these cases in Figure 7-94).
		 Figure 7-94: Changing Translucency from none, to a color and then to a bitmap.
Absorption	Basic, Glossy, SSS	With this parameter you can change the absorption density and color. The higher the density the more absorptive the material will be. The absorption density can take any positive or zero value and it is in 1/m units. In order to use absorption, for a basic material, you need to have also a color or texture for translucency and for glossy materials, a color or texture for transmittance.
		In the next set of materials, we have used a basic material at first with a white translucency (see the four materials in Figure 7-95). We have added also a dark blue color for the absorption but as we see, by keeping value to 0, no absorption is added. Then, by increasing Absorption value

<table>
<tr><td></td><td></td><td>to 5 (for the second material) and to 15 (for the third material), we see the increase of absorption of the material. At the last example material, we have changed the absorption color to a red one.

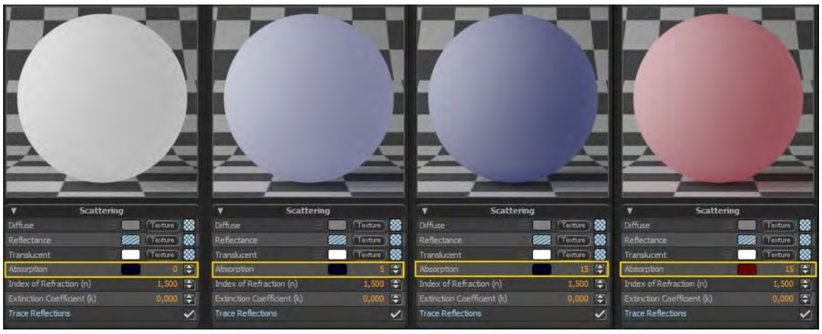



Figure 7-95: Changing the Absorption values and colors.</td></tr>
<tr><td>Index of Refraction (n)</td><td>Basic, Glossy, SSS, Coating</td><td>This is the (real) index of refraction of a specular component. Both index of refraction and extinction coefficient are used in order to compute the Fresnel coefficient which in turn, modifies reflectance and transmittance. The index of refraction can take any positive value.</td></tr>
<tr><td colspan="3">In Figure 7-96, we are increasing the Index of Refraction (n) for the same material, while keeping all other values constant. We have used a gray color as Diffusion and Reflectance textures. From left to right we have the following values: 1,333 (n corresponding to water), 1,500 (n corresponding to air – default value for basic material), 2, 3, 5 and 10. We notice that by increasing the index of refraction, the specular reflectance is increasing too.

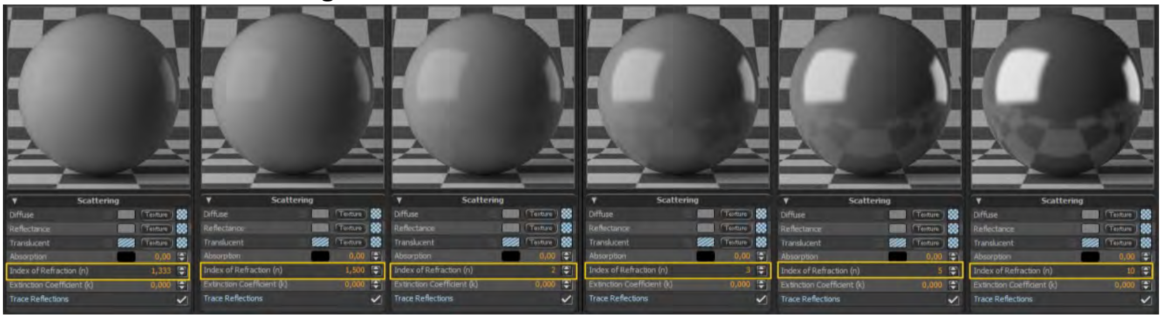



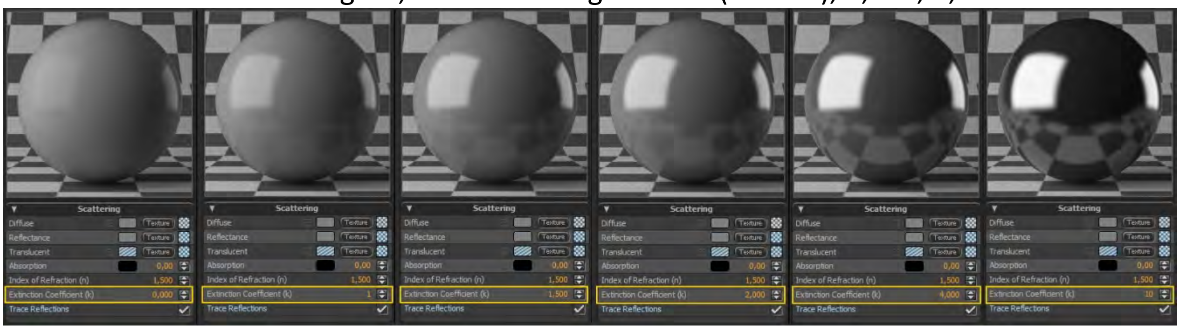
Figure 7-96: Changing the Index of Refraction (n)</td></tr>
<tr><td>Extinction Coefficient (k)</td><td>Basic, Glossy, SSS, Coating</td><td>This is the extinction coefficient (imaginary part of index of refraction) of a specular component. Both index of refraction and extinction coefficient are used in order to compute the Fresnel coefficient which in turn, modifies reflectance and transmittance. The extinction coefficient can take any positive or zero value.</td></tr>
<tr><td colspan="3">In Figure 7-97, we are keeping the Index of Refraction (n) constant at 1.5 and we increase the Extinction Coefficient (k). We see that as higher it becomes, the material takes a more metallic view.
The values we have in the next figure, from left to right are: 0 (default), 1, 1.5, 2, 4 and 10.
</td></tr>
</table>

Figure 7-97: Increasing the Extinction Coefficient (k) from 0 to 10, with intermediate steps.

We need to mention, that the result of increasing the k values, depends on the n value as well.
For example, metals in general have a low Index of Refraction and for making a metal, Diffuse should be empty or use a Glossy material. Roughness should also be lower that the default 10% (see at Structure panel). In the next figure, we are using a glossy material and give different n and k values to see the way the materials are built.

In Figure 7-98, we have used a Glossy material (Roughness set to 5%) and changed some of its settings. More analytically, at first material we had n=1.5 and k=0. Then, we decreased the n to 0.1. At the 3rd material we used a white reflectance instead of the default gray one and at the last time, we have set n, k values to 1.130 and 2.918 accordingly, which are the measured values for a silver material.

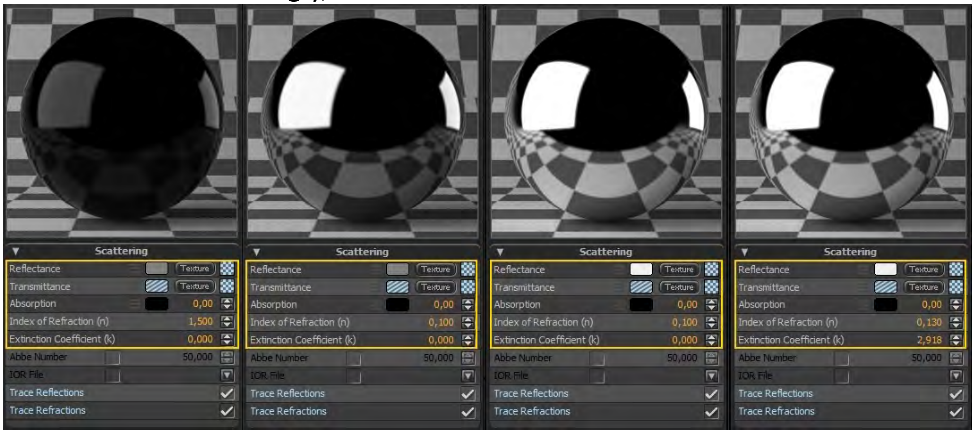


Figure 7-98: Changing n, k values for a Glossy material

Trace Reflections	Basic, Glossy, SSS, Coating	This parameter is only used in biased mode (Adaptive (BSD) engine) and with this you can check whether you want to trace the specular component or not. This is a global illumination element and it adds rendering time in biased mode.
		In the next example, we have used for our materials the Direct Light preview mode. At the first material, Trace Reflections option was enabled, while at the second one, it was disabled. We see that at second time, the reflections of the environment (floor) on the ball are missing.

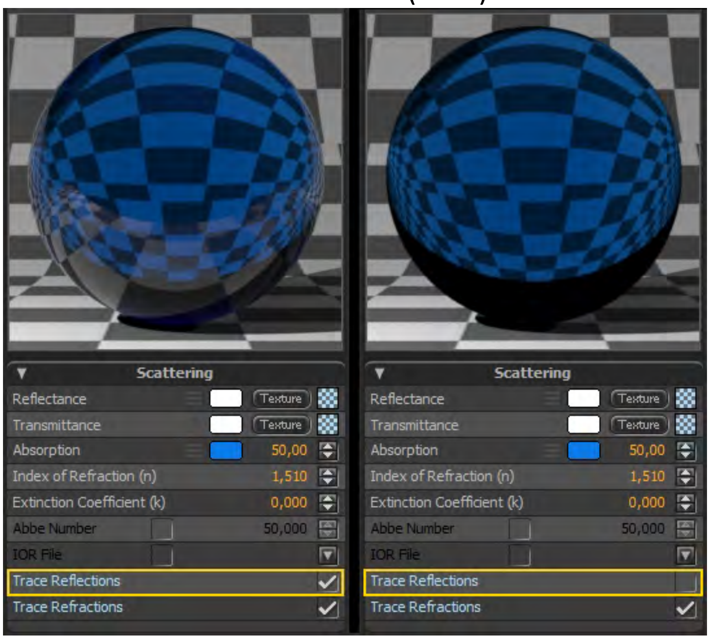


Figure 7-99: Trace Reflections Enabled - Disabled

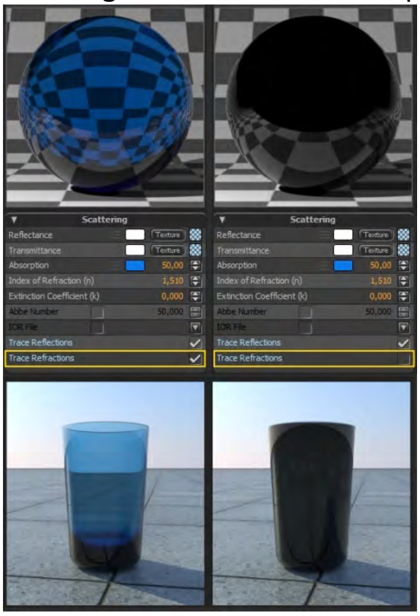
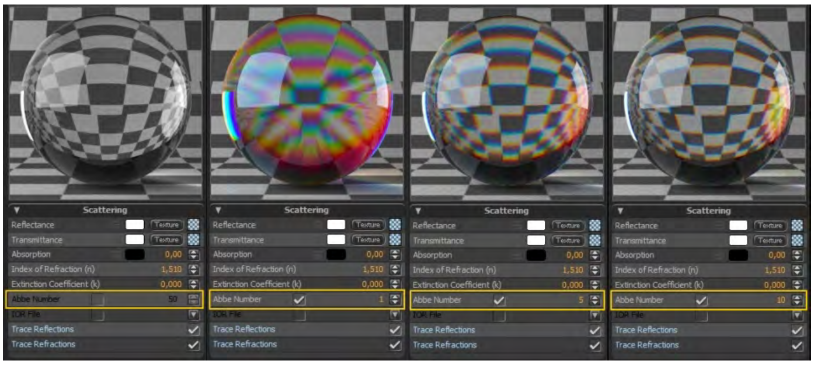
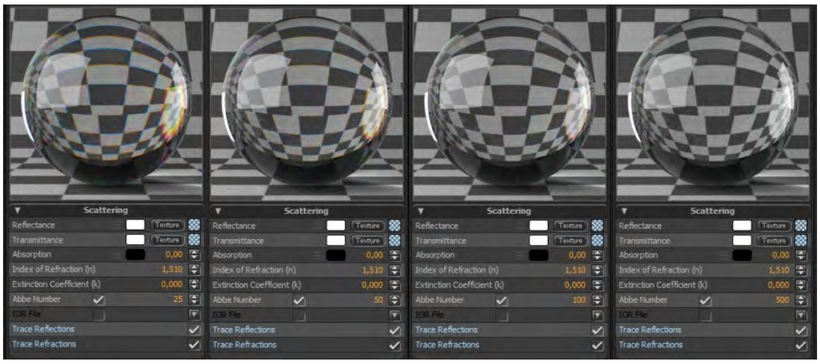
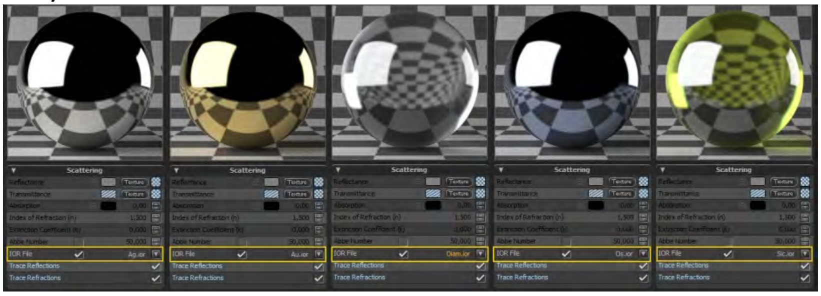
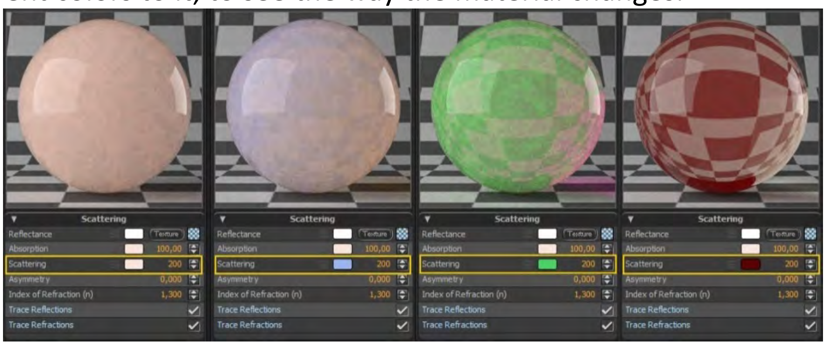
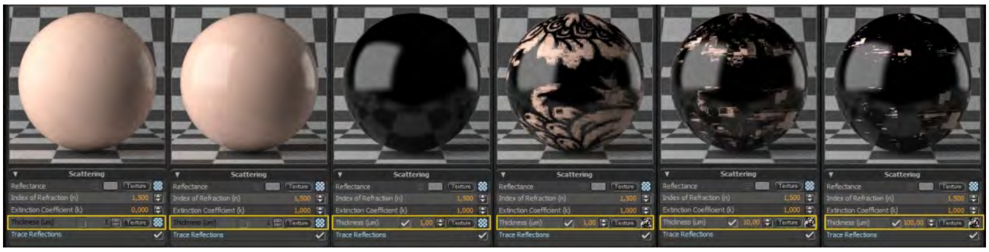
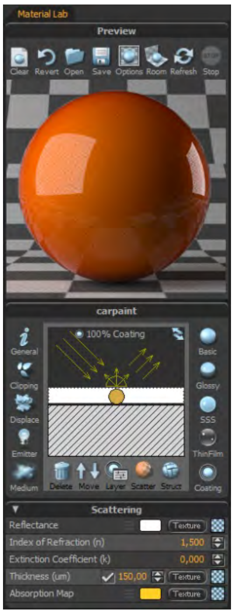
Trace Refractions	Glossy, SSS	This parameter is only used in biased mode (Adaptive (BSD) engine) and with this you can check whether you want to trace the transmitted component or not. This is a global illumination element and it adds rendering time in biased mode.
		In the next example, we have used a crystal glass (glossy material) the first time with Trace Refractions option enabled and then by disabling it. We used the Direct Light room for the preview. Below, we see the corresponding rendered images with the use of Adaptive (BSD) engine.  Figure 7-100: Enabling - Disabling Trace Reflections option
Asymmetry	SSS	This parameter controls the asymmetry coefficient of subsurface scattering medium – assumed to follow the Henyey-Greenstein phase function. This parameter takes values between –1 and +1, with –1 corresponding to perfect back scattering media, +1 to perfect front scattering media and 0 to isotropic media. In Figure 7-101, we have used a SSS material and we have increased (from left to right) its Asymmetry values from -1, to -0.750, -0.250 and 0. In Figure 7-102, we have increased even more the Asymmetry values, which now start from 0 and change to +0.250, +0.750 and +1 accordingly.
		 Figure 7-101: Changing Asymmetry values from -1 (perfect back scattering media) to 0 (isotropic media)

		 Figure 7-102: Changing Asymmetry values from 0 (isotropic media) to +1 (perfect front scattering media)
Abbe Number	Glossy	The Abbe number can also be used to describe the variance of index of refraction with respect to wavelength. The lower the value the more dispersive the material will be. The Abbe number is a usual quantity of describing dispersion - particularly in jewelry industry - and there are a lot of tabulated data. In Figure 7-103, we have used a glossy material, at first with Abbe Number disabled. Then, we enable it and give the values 1, 5 and 10 accordingly. In Figure 7-104, we increase these values even more to 25, 50, 100 and 500. For low values, we see the increased dispersion while we notice that for bigger values, the less dispersive the material becomes.
		 Figure 7-103: At first material, Abbe number option is disabled, while then, is enabled and we increase its values to 1, 5 and 10.
		 Figure 7-104: We increase even more the Abbe value to 25, 50, 100 and 500. We see that for big values, the material has almost no dispersion.
IOR File	Glossy	Besides the scalar values of refraction index, user may also select a coefficient file that contains measured values of index of refraction (n) and extinction coefficient (k) over the spectrum. Using these measured data, we can have accurate reproduction of the corresponding materials. These files have either .ior or .nk file extensions (which are actually the

		same files).
		In the next set of materials (Figure 7-105), we see the way the materials look like for some example IOR files, from the drop down list that exists in Thea Studio. We notice that when IOR File option is enabled, Index of Refraction (n), Extinction Coefficient (k) and Abbe Number options, are disabled, as now there is no need to be used. IOR data specify all the necessary information for the material.  Figure 7-105: From left to right, we have the following example IOR files: Silver, Gold, Diamond, Osmium and Silicon carbide.
Scattering	SSS	With this parameter you can change the scatter density and color for a Subsurface Scattering material. Note that the higher the scattering, the more time it will take to render the material. The scatter density can take any positive or zero value and it is in 1/m units. Note that the scatter color is used both for defining the in-scattering and out-scattering light interaction.
		In Figure 7-106, we have changed the scattering values for a SSS material from 0, to 100, 500 and 1000.  Figure 7-106: Increasing the Scattering values. Then in Figure 7-107, we keep scattering value to 200, but we apply different colors to it, to see the way the material changes.  Figure 7-107: Changing the Scattering Color
Thickness (um)	Coating	This is the thickness of a coating layer and it is used – along with coating extinction coefficient – in order to calculate the absorption when light

		penetrates a coating in order to reach next layer (it may be another coating or substrate layer). The unit for the thickness is micrometers (that is one thousand of a millimeter 10^{-6}m).
		In the next set of materials we have applied a coating on top of a basic material. We increase the Extinction coefficient and enable the Thickness option at first. Then we apply different values along with a texture (at the texture slot). From left to right we see at first a coating with zero k value and no thickness. Then we increase the k value and at the third material, we enable thickness at 1 um. The fourth image has also a texture and then we increase the thickness from 1 to 10 and 100 um.
	 Figure 7-108: Changing the Coating values accordingly.	
Absorption Map	Coating	This feature will produce much more realistic tinted coatings and varnishes. Materials like varnished wood or car paints will greatly benefit from this new addition as it will give extra visual cues that otherwise would be impossible to recreate with such realism and accuracy. To make use of absorption we will have to enable the thickness check box. Now, we will be able to add absorption color or use a texture. The thickness value determines how thick our coating will be and this will influence the intensity of the overall phenomenon. The thicker the coating, the more saturated our color will become and we can even achieve a hue shift. The latter depends on both the absorption color and the diffuse component of the substrate layer.
	 Figure 7-109: Material color changes from a lighter yellow/orange to a more saturated orange.	 Figure 7-110: By using a color for the diffuse component of the Substrate layer and using a different color for the coating absorption, we can produce a hue shift.

		Absorption works the same way as with the glossy material when creating colored glass. The physics behind it are the same; while light is traveling through the coating or glass, some wavelengths will get absorbed and others will exit the medium, altogether composing the final color. The thickness of the coating or glass will determinate how dark or saturated the color will become or, whether a hue shift will take place. This will also depend on the absorption color saturation and value selected. The absorption color value has the same effect like increasing the thickness value to make the color darker. Using a high color value and high thickness value will have the same effect as using a low color value with a low thickness value. Saturation works in a similar way; using low saturation values with high thickness value, can give the same result like using high saturation value with low thickness value (see the following images).

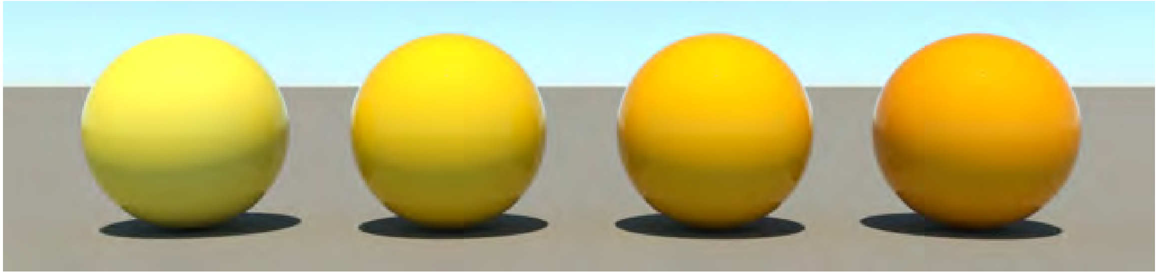


Figure 7-111: Increasing the thickness value while keeping the absorption color constant, will produce a higher influence over the diffuse color of the Substrate layer and can produce a hue shift.

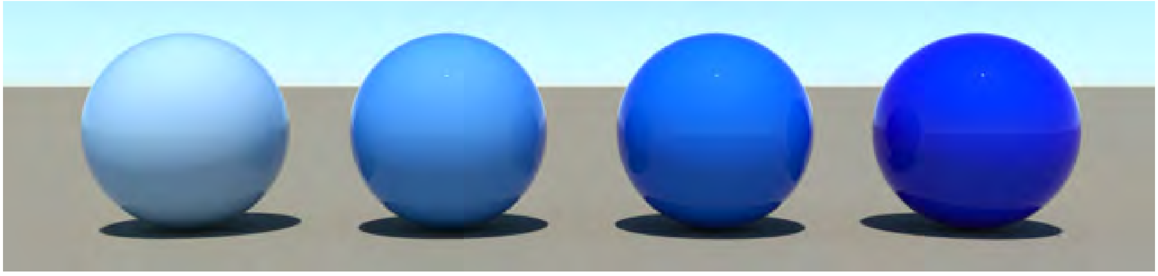


Figure 7-112: In a similar way, keeping the thickness value constant and increasing the saturation value of the absorption color, will increase the influence over the diffuse color of the Substrate layer.

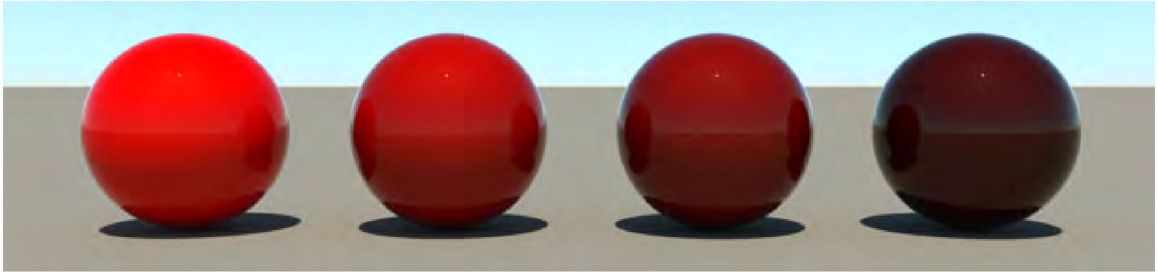
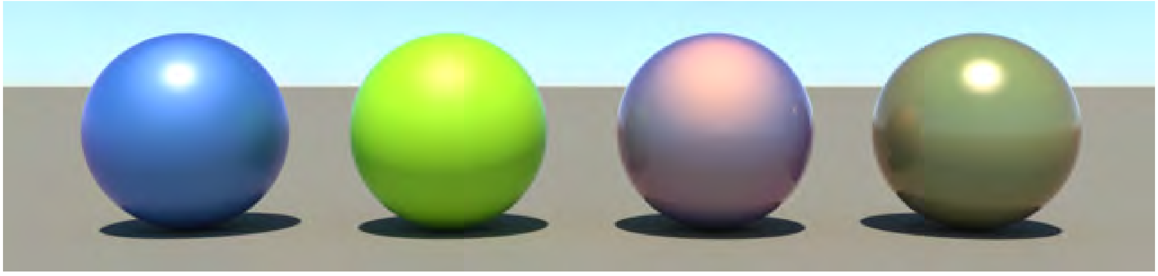


Figure 7-113: Reducing the color value of the absorption color will produce darker colors

<table>
<tr><td></td><td colspan="3">
Figure 7-114: We can add interesting variations to our tinted coating by using a diffuse color on the substrate layer.</td></tr>
<tr><td>Fresnel</td><td>Basic, Glossy, SSS, Coating</td><td colspan="2">All Thea materials have a Reflectance texture and an index of refraction (with the exception of Thin Film). These parameters, along with Roughness texture, control the specular reflectance of a material. The Fresnel equations play a central role in these computations and deliver the variation of reflectance with viewing angle, a visual cue that is really very important elevating the realism of our renders. Firstly, user can define a color or insert a bitmap for the texture of the Reflectance 90 option.

By enabling the Custom Curve Option, a panel with the curve appears where the Fresnel Curve is editable (see Figure 7-115), something that gives even more freedom and power to material creation. Custom Fresnel curve gives the ability now to create certain categories of rough materials that present a "flat" look, like velvet, satin, clothes, etc. In a few words, the user can override the internal interpolation between Reflectance (the texture seen perpendicularly) and Reflectance 90 (the texture seen at grazing angle) with the custom curve.

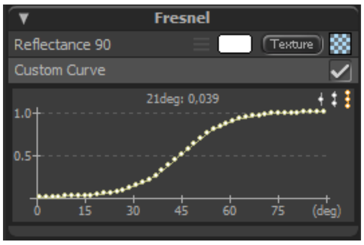
User can change the complete curve from 0 to 90 degrees, by clicking and dragging the curve. By doing a right click on the Fresnel Panel, a drop-down list appears, as we can see it in Figure 7-116, from where user can copy, paste or delete a curve. There are also some presets coming with Thea Studio: linear, parabolic, sigmoid, sinusoidal and square-root. Below them, we can see some curve presets that we have previously created and saved, by the use of Save Curve Option.</td></tr>
<tr><td></td><td></td><td>

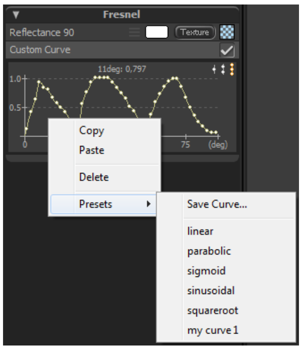
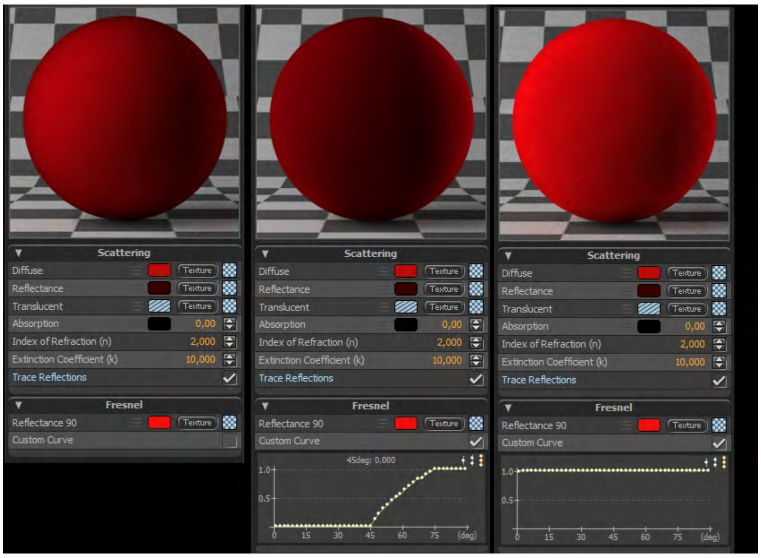
Figure 7-115: Fresnel Custom Curve</td><td>

Figure 7-116: Right Click Options at Fresnel Panel</td></tr>
<tr><td></td><td></td><td colspan="2">In the next set of materials in Figure 7-117, we are changing the Fresnel Curve and we see the way the material looks like each time, by starting</td></tr>
</table>

		from the Reflectance 90 curve.  Figure 7-117: Different Fresnel Curves create different specular reflectances

7.4.7.5 Struct

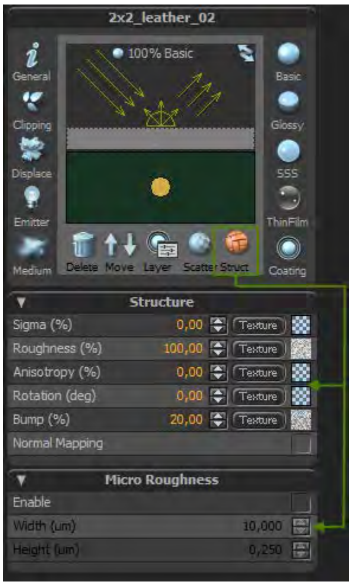


Figure 7-118: Structure Panel

By selecting the Struct Button (Structure), two new panels appear at the bottom side of the Layers window (in area K). You can see these panels in Figure 7-118, where all the options that change the structure of the selected layers and its Micro Roughness are appearing.

In the next tables, we see these options and for which kinds of materials are available.

Structure Option	Material that uses it	Description
Sigma (%)	Basic	Some materials in the nature exhibit diffuse reflection that is remarkably uniform and Lambertian model cannot reproduce them very well. For example, looking at the full moon we may see that it is uniformly bright (while Lambertian model is darker at grazing angles). The Sigma parameter here changes the object appearance from perfect Lambertian (value 0) to more uniformly bright and it is used in conjunction with the

<table>
<tr><td></td><td></td><td>Diffuse texture.

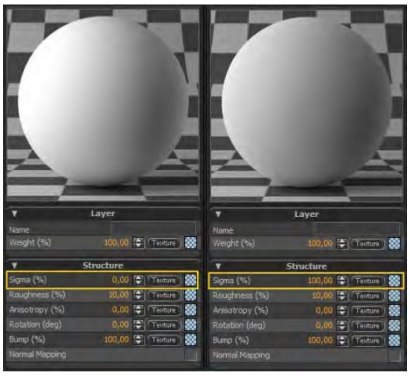
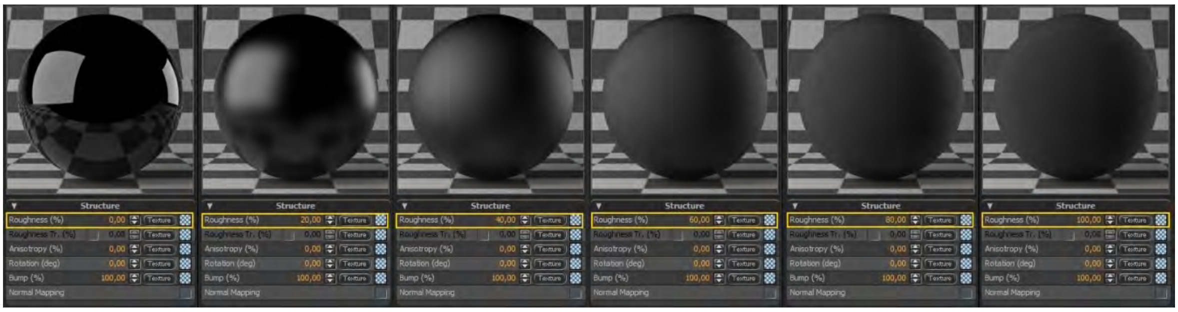
In Figure 7-119, we see a material with no sigma at first and then we increase it at 100%. The third material also has a procedural for texture and its sigma is at 50% and then at 100% accordingly.</td></tr>
<tr><td></td><td></td><td>
Figure 7-119: Increasing Sigma

Figure 7-120: Increasing sigma and use the same bitmap as Diffuse texture.</td></tr>
<tr><td>Roughness (%)</td><td>Basic, Glossy, SSS, Coating</td><td>The roughness parameter is related to the blurriness of specular reflectance and transmittance. A value of 0 corresponds to perfect (mirror) reflection while positive values give blurry reflections and highlights. As the roughness increases, highlights become bigger and the reflections more blurry and less bright. When the roughness reaches very high values (near 100%), the specular component shows a diffuse-like appearance.</td></tr>
<tr><td colspan="3">In the next set of materials (Figure 7-121), we have chosen a glossy material and we see the way it looks by changing its roughness from 0% to 100%, with step 20%.</td></tr>
<tr><td colspan="3">
Figure 7-121: Increasing Roughness from 0 to 100%, with step of 20% for a Glossy material</td></tr>
<tr><td colspan="3">In Figure 7-122, we have chosen a basic material (with reflectance) and we see the way it looks by changing its roughness from 0% to 100%, with step 20% but by inserting a procedural this time at its texture slot.</td></tr>
</table>

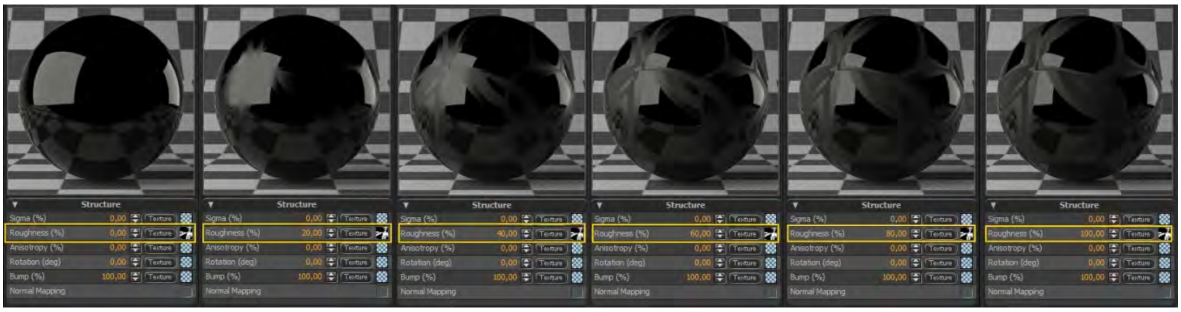


Figure 7-122: Increasing Roughness from 0 to 100% (with step of 20%) with use of a procedural texture.

Anisotropy (%)	Basic, Glossy, SSS, Coating	Anisotropy is an important visual cue of many surfaces, particularly of metals. Due to certain orientation of surface elements, the reflection in one direction appears much more extended than the perpendicular one. In Thea Render, the anisotropy parameter controls this difference, where 0 value means no anisotropy and 100% means full anisotropy (the material is perfect reflector/refractor in one direction and completely rough in the other).

In the materials of Figure 7-123, we see a metal with no anisotropy at first and then we increase it to 10%, 60% and 100%.

Figure 7-123: Increasing Anisotropy percentage

In the next figure, we have chosen a metal material again and we have inserted a procedural texture (concentric) for its anisotropy. Then we increase the percentage of anisotropy from 0% to 100% (with step 20%) and we see the way the material looks.

Figure 7-124: Increasing Anisotropy percentage (with texture) from 0 to 100%

Rotation (deg)	Basic, Glossy, SSS, Coating	Rotation, in degree units, is controlling the direction of the anisotropy (rotation of its highlights). This means that this parameter is used once anisotropy is also used. By changing the degrees, anisotropy is also rotated. If a texture is inserted for rotation, the values for it are now ignored, as the rotation is achieved now with the help of the texture.

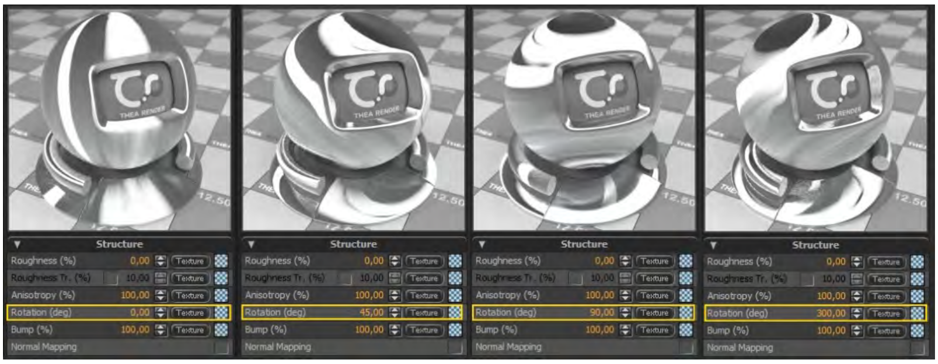
<table>
<tr><td></td><td colspan="2">In Figure 7-125 we see the way a metal looks like for changing its anisotropy rotation.</td></tr>
<tr><td></td><td colspan="2">

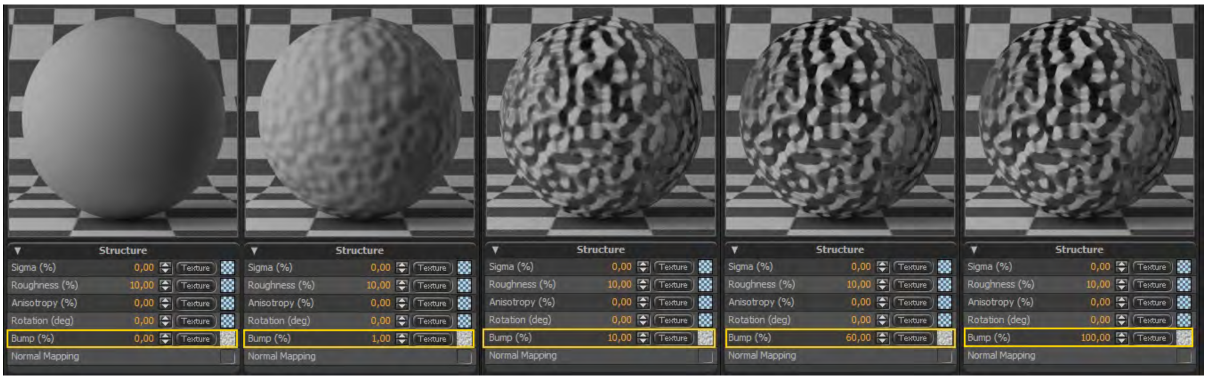
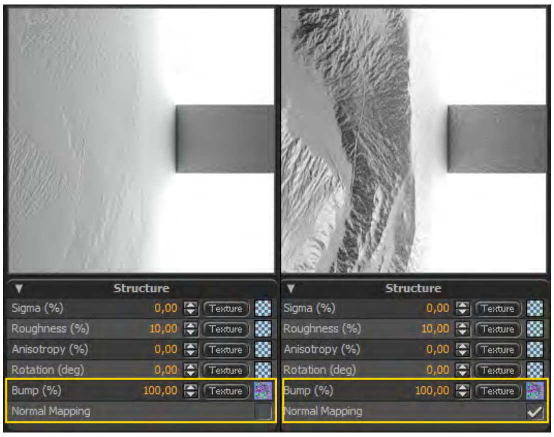
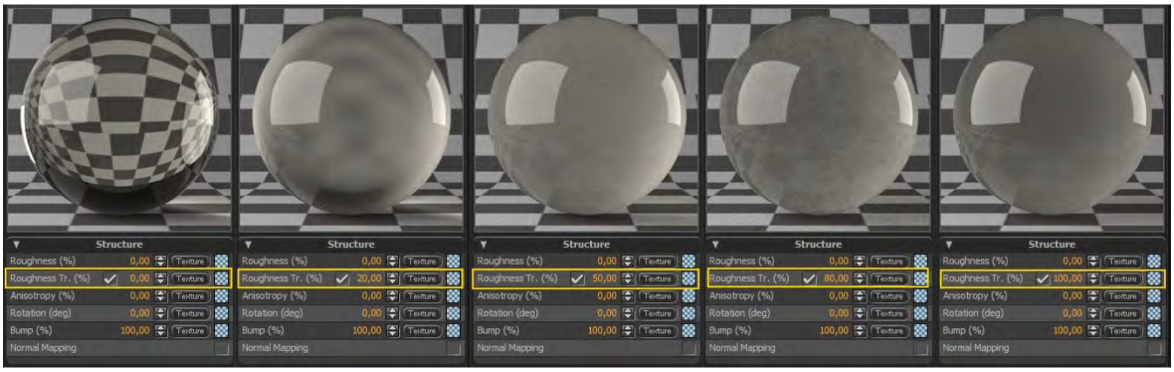
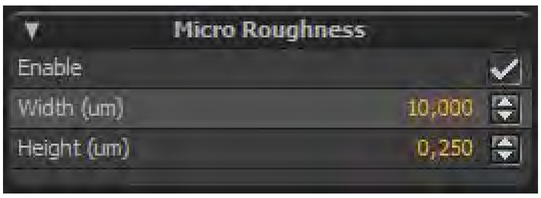
Figure 7-125: Changing Rotation Degrees for Anisotropy: 0°, 45°, 90° and 300°</td></tr>
<tr><td>Bump (%)</td><td>Basic, Glossy, Thin Film, SSS, Coating</td><td>One of the very first geometry modifiers is bump mapping which is available inside all materials. Bump is ideal for enhancing renders with the illusion of more complex geometry and since it only involves local perturbations to normal vectors, it is relatively fast to compute. Each material layer can have its own bump map.</td></tr>
<tr><td colspan="3">In the next set of materials (Figure 7-126), we have applied perlin noise (one of the existing procedurals) at the Bump map slot and changed its value from 0% to 1%, 10%, 60% and 100%.</td></tr>
<tr><td colspan="3">

Figure 7-126: Increasing Bump percentage from 0% to 100% (from left to right) for a Diffuse material.</td></tr>
<tr><td>Normal Mapping</td><td>Basic, Glossy, Thin Film, SSS, Coating</td><td>Normal mapping is a variation of bump mapping where instead of using a height field producing perturbations for the existing surface normals (as in bump mapping), all three channels of an RGB texture are used in order to directly define the normal vectors. The red and green channel values (0…255) correspond to x and y axis taking values from –1 to 1, while blue channel corresponds to z axis taking values from 0 to 1. Normal mapping has similar render time performance with bump, but it needs more storage (bump mapping may be also used with grayscale textures).</td></tr>
<tr><td></td><td></td><td>At the next example, in Figure 7-127, we have used a normal map (colored texture) the first time without enabling the Normal Mapping option, while at second time, it is enabled.</td></tr>
</table>

		 Figure 7-127: Enabling Normal Mapping
Roughness Tr. (%)	Glossy, SSS	The transmitted roughness parameter can be used in order to set separately the roughness for the transmitted component. This is essential when we want to describe some materials, particularly some dielectrics where the reflection is quite crisp while the refraction is blurry. This parameter works just like the Roughness parameter and the user should check this if he wants to use different roughness for the transmitted component.
In the next set of materials, in Figure 7-128, we have a glossy material with transmittance enabled. We have set its Roughness to zero and we only change its Transmitted Roughness from 0 to 100%, with some intermediate values, to see the way the material looks. We see that only the roughness of the transmitted component is increasing.		
 Figure 7-128: Increasing the Roughness Tr. from 0 to 20%, 50%, 80% and 100% (from left to right)		
Micro Roughness	Basic, Coating	Micro Roughness option can take control over the real phenomenon that increases the apparent reflection sharpness, as the viewing angle goes from normal to shallow. With Micro Roughness we have control over two parameters indicating the micro structure of the surface, the average width and height of the micro anomalies on the surface (measured in micro meters). (See Figure 7-130)
		 Figure 7-129: Micro Roughness Panel

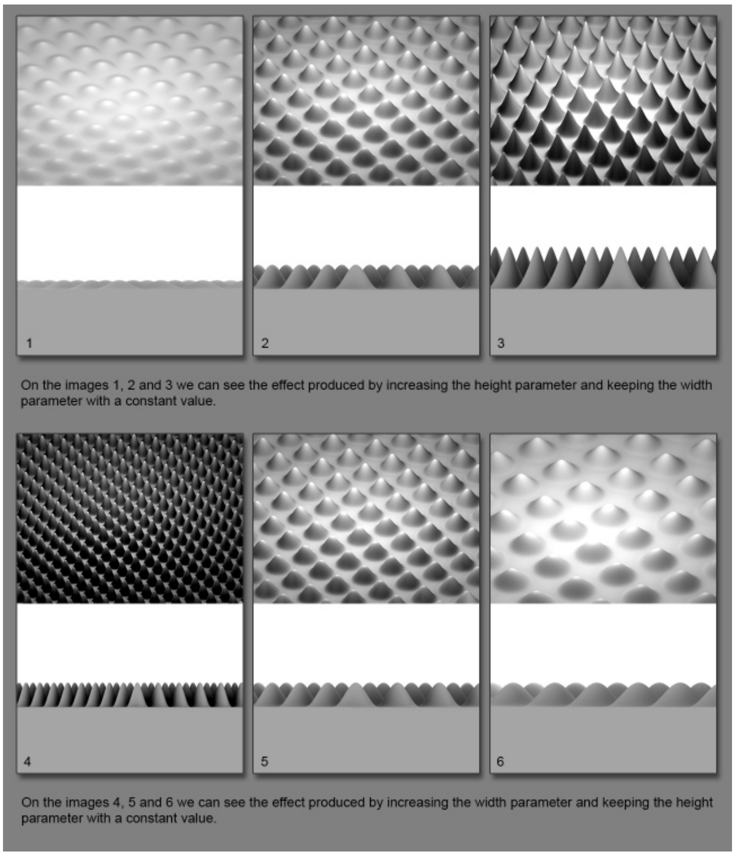


Figure 7-130: Micro Roughness Width and Height options

Figure 7-131: Micro Roughness is disabled

Figure 7-132: Micro Roughness is enabled

Tip: as Scatter, Struct and Layer panels are very useful in editing a material layers, you can press control at your keyboard, once one of them is open, and click on the others. By this way it is possible to have **all of them visible**, as seen in Figure 7-133.
You can notice that the three buttons for Scatter, Struct and Layer are all in orange color as they are active (visible).
By pressing control and click again on one of these buttons, you can close the corresponding panel again.

Figure 7-133: Layer, Scattering and Structure Panels, all Open

7.5 Properties Panel - Materials Properties Panels & Description

7.5.1 Materials Properties Panels (Area K) - This panel is hosting each time other properties options

Figure 7-134: Area K hosts other panels each time.

As we have seen from all the previous analysis, this area of the Material lab (area K), hosts each time a different panel, the General panel, the Clip Mapping panel, the Displacement panel etc. And by the use of control and click on Layer, Scatter and Struct buttons, as we described above, two or more panels are appearing.

You can check each time what panel you see there, by checking its title or the buttons that are highlighted in orange color, as for example Layer and Structure Panels in Figure 7-134.

7.5.2 Description (Area L)

Figure 7-135: Description Panel

This small panel, at the bottom of the Material Lab, appears each time we select the General button and panel (see Figure 7-135). It shows main details of the material we have, such as its name, its resolution, the modifier and the projection used. This information is created the time the material was initially saved and cannot be edited.

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Chapter 8: Color Lab

Image by Massimo Siracusa

8. Color Lab

8.1 Introduction

Thea Render enjoys a powerful color laboratory where the user can define colors visually in many different color spaces, as you can see in Figure 8-1.

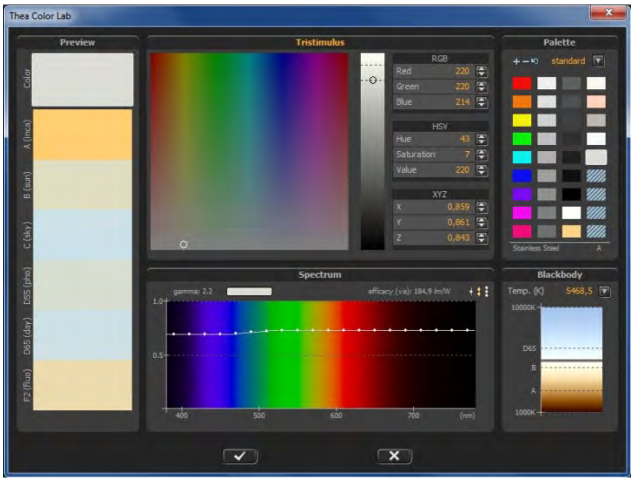

Figure 8-1: Color Lab in Thea Render

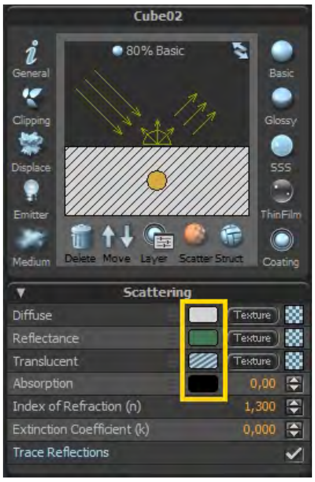

Figure 8-2: Color Textures that open Color Lab

In order to open Thea Color Lab, you need to click upon a slot of a certain material property, which can take as texture input a color.

You see an example of these slots in Figure 8-2, at the Scattering options for a material. You can specify a color for the Diffuse texture, Reflectance, Translucent and Absorption channels. Once you click on one of them, the Color Lab will open.

In next tables, we will explain the main features of this lab.

8.2 Parts of the Color Lab

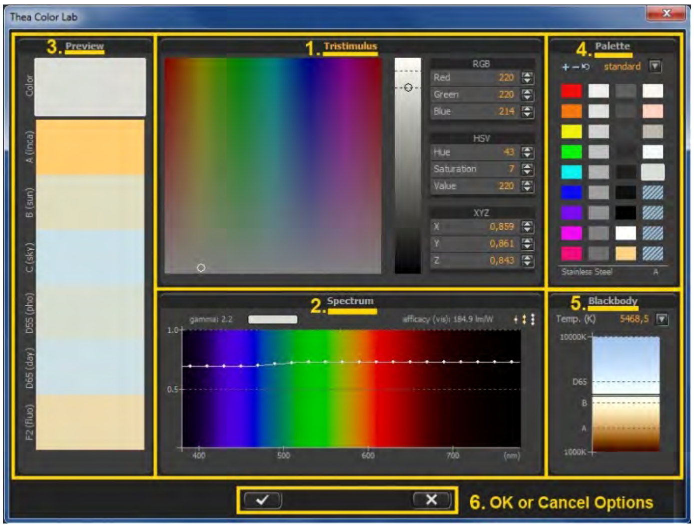

Figure 8-3: Parts of the Color Lab

As we see the Color Lab once again in Figure 8-3, it consists of six parts:

1. Tristimulus panel
2. Spectrum panel
3. Preview panel
4. Palette panel
5. Blackbody panel
6. OK or Cancel options

Note: whenever the color selection is made in Tristimulus, Spectrum or Blackbody panel, the corresponding panel title becomes **highlighted**. This gives a quick hint of the current working space and prevents any mistakes since there is no 1-1 correspondence between these spaces.

8.2.1 Tristimulus Panel

In the tristimulus panel, as we see it in Figure 8-4, at its right side, the color can be parameterized with three different parameters; Red - Green - Blue (RGB), Hue - Saturation - Value (HSV) or the standard CIE XYZ.

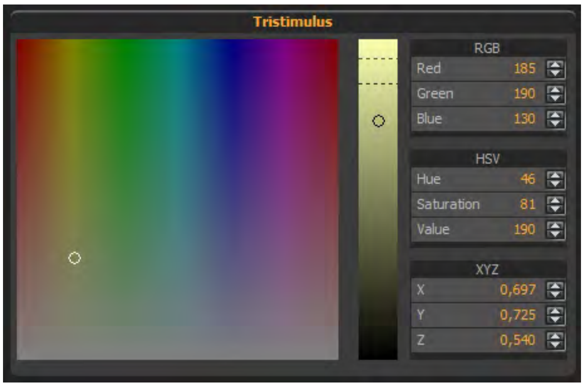

Figure 8-4: Tristimulus Panel

At the left side of these parameters is the tristimulus color picker, a two dimensions pattern with Hue-Saturation axis. In the middle we see a column which represents the Value. These patterns include all colors that can be parameterized in HSV space (and consequently in RGB). The small white and black circles can be clicked and dragged to the desired point and meanwhile see the RGB, HSV and XYZ values changing accordingly.

Tip: in the middle column that represents the value, we see an area on the top between dot lines. Above this area, color values are somehow unrealistic, as in nature, pure colors do not actually exist.

Figure 8-5: RGB Color Space

The RGB color model is an additive color model in which red, green, and blue primary colors are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, Red, Green and Blue.

Figure 8-7: HSV Color Space

HSV stands for Hue, Saturation and Value, and is also often called HSB (B for brightness).

Figure 8-6: Color Spaces Values for the same color

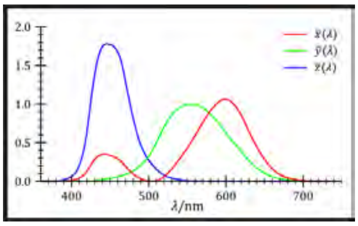

Figure 8-8: XYZ Color Space

The CIE XYZ color space was derived from a series of experiments done in the late 1920s. In this model, Y means luminance, Z is quasi-equal to blue stimulation, or the S cone response, and X is a mix (a linear combination) of cone response curves chosen to be nonnegative.

8.2.2 Spectrum Panel

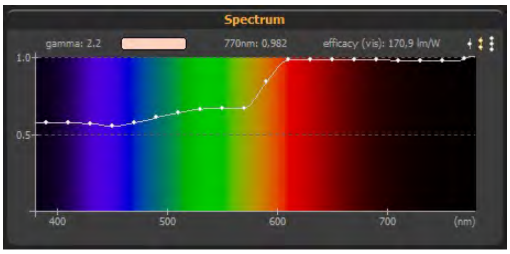

Figure 8-9: Spectrum Panel

Our eyes are sensitive to light which lies in a very small region of the electromagnetic spectrum labeled as visible light. This visible light corresponds to a wavelength range between 400 - 700 nanometers (nm) and a color range of violet through red. In a rainbow or the separation of colors by a prism (see Figure 8-10), we see the continuous range of spectral colors (the visible spectrum).

By choosing a color from the spectrum panel (see it in Figure 8-9), we can directly change the distribution in spectral space (between 380 and 780 nm) by dragging the white dots of the line. The resolution of the edited spectrum can be also increased or decreased by clicking on the corresponding dots on the top-right of Spectrum panel.

Figure 8-10: White light is dispersed by a prism into the colors of the optical spectrum.
(Image by Warnotte Renaud)

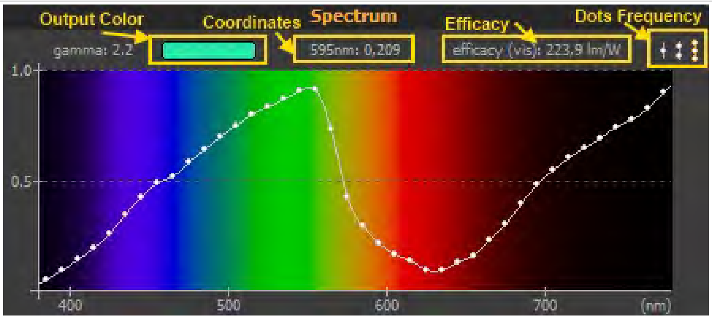

Figure 8-11: Spectrum Panel Details

As we see in Figure 8-11, there is several kind of information available on the top of the spectrum. From left to right, we see that these colors are with regards to gamma value at 2.2. Then we see the output color, the spectral coordinates and the efficacy (in lm/W) of the selected spectrum points. The last option, the dots frequency, makes it possible to see less or more dots in the distribution line, to make editing even more efficient.

8.2.3 Preview Panel

On the left of Thea Color lab we find the color preview panel (see it in Figure 8-12), where we can see the plain color that is currently selected, along with a series of colors that show how the selection is perceived under different lighting conditions. You might find interesting that some colors have totally different appearance when, for example, used for an object near an incandescent light bulb.

These differences may actually be quite important based on the lighting in your scene (nevertheless, in most cases, an unexpected color shift in the render can be compensated by white balance post-process, in the Darkroom settings). The capital letters between each light condition, are the Illuminants* names. Illuminants A, B, and C are representing average incandescent light, direct sunlight, and average daylight. Illuminants D represent phases of daylight; Illuminant E is the equal-energy illuminant, while Illuminants F represents fluorescent lamps of various compositions.
Note: a standard illuminant is a theoretical source of visible light with a profile (its spectral power distribution) which is published. Standard illuminants provide a basis for comparing images or colors recorded under different lighting.

Explanation of Different Illuminants	Quick Description
A (inca): the way the color will look under an incandescent light bulb, which is an electric light which produces light with a filament wire heated to a high temperature by an electric current passing through it, until it glows.	A (inca): Incandescent/ Tungsten
B (sun): if there is a sun enabled in your scene, this is the way the color will look like under the sun. You see that because of the yellow color of the sun, a yellow tone is added to the original color. This may cause a yellowish effect on a white wall, which can be later fixed with white balance tone-mapping tool.	B (sun): Direct sunlight at noon
C (sky): if we use only the sky in our scene, this is the way the color will look like.	C (sky): Average / North sky Daylight
D55 (pho): letter D represents the phase of the daylight with a temperature around 5503K which is around mid-morning/mid-afternoon.	D55 (pho): Mid-morning/Mid-afternoon Daylight
D65 (day): D65 is the most commonly used, having a correlated color temperature of 6504K and is the noon light.	D65 (day): Noon Daylight
F2 (fluo): The F series of illuminants represent various types of fluorescent lighting. F2 is representing the Cool White Fluorescent lighting.	F2 (fluo): Cool White Fluorescent

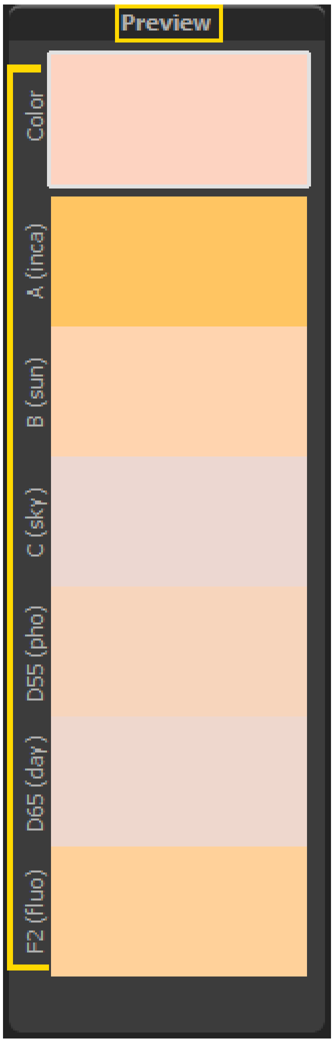

Figure 8-12: Color Preview Panel

8.2.4 Palette Panel

Figure 8-13: Palette Panel

On the top-right side of the Color Lab, there is the current palette of colors (see an example of it in Figure 8-13). We can click anytime on a palette color (see it with a thin white border as the red color in our example figure). You have now selected it and see its properties in the rest panels. By clicking on an empty cell (see the striped-line empty spaces at the right bottom), we can store current color to that place holder. At the top left side, there are controls to add a new palette ("+" icon), to delete a palette ("-" icon) and to undo any changes (arrow icon).

By pressing the Add a new palette, a pop-up window appears (Figure 8-14), to help you define the name of the new palette. By selecting to Delete a palette, a new window appears to confirm the delete of the selected palette (Figure 8-15). By hitting undo button, another pop-up window appears to let you confirm or abort the undo process of all changes made in the palette (Figure 8-16).

Figure 8-14: Add a New Palette

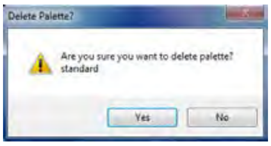

Figure 8-15: Delete an Existing Palette

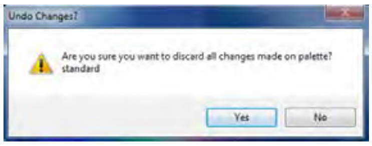

Figure 8-16: Undo Changes

At the top right side of the palette, you can switch to another palette, by pressing the arrow button, which reveals the list of existing palettes.

Below the colors of the palette, at the left side, we see the name of each color. The Default palette, which is coming with the program, has several colors and its names installed. For a new added color, by doing a right click on it, a pop-up window helps you define the name of the new color (Figure 8-17).

We can also browse the colors by their name by clicking on the letter A (at the bottom right of the palette); this will change the view to color pages (Figure 8-18). The current page you see is highlighted with orange color. By pressing A again, you switch to previous, list preview.

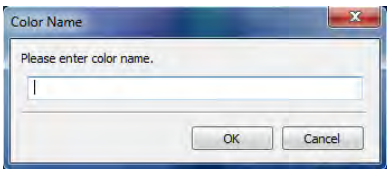

Figure 8-17: Color Name Pop-up Window

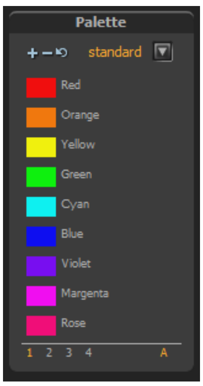

Figure 8-18: View of Palette in Color Pages

Note: every palette is automatically saved whenever you are switching to another one or by closing the lab. This is not happening though for the Standard palette that comes together with the program, which stays as it is.

8.2.5 Blackbody Panel

In the blackbody selection panel (Figure 8-19) we can select a color based on its correlated blackbody temperature. In Figure 8-20, we see the list of the available temperatures to choose from and as we see, they are the same Illuminants we explained at the Preview panel.
You can also write the desired temperature by clicking on the input text area (in blue color in Figure 8-20). Apart from selecting the temperature from the list, you can also slide the horizontal bar up and down and see the color change to other panels as well.
Note: a color selected this way differs by the actual Planckian distribution by a scale factor. This is needed to ensure that the distribution does not exceed 1 and thus can also be used inside BSDF (Bidirectional Scattering Distribution Function) models.

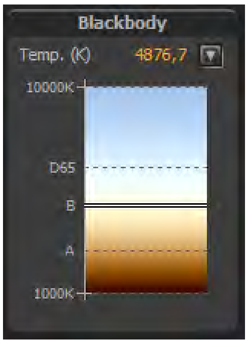

Figure 8-19: Blackbody Panel

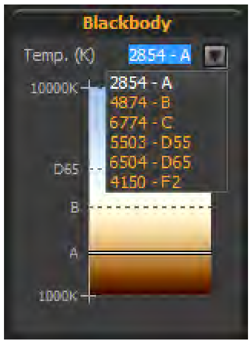

Figure 8-20: Correlated Blackbody Temperatures

Temperature	Name
2854	A
4874	B
6774	C
5503	D55
6504	D65
4150	F2

8.2.6 OK or Cancel Options


Figure 8-21: OK or Cancel Options

At the bottom of the Color Lab you can see the options to select and apply the color (OK button) or to Cancel the selection and return to studio, with no changes made (see also Figure 8-21).

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Chapter 9: Texture Lab

9. Texture Lab

9.1 Introduction

Texture Lab is the editor for textures in Thea Render and is the area where complex textures can be created by using the atomic entities of color, bitmap and procedural (see the Texture Lab in Figure 9-2).

The texture editor is essentially a hierarchy of textures that are added (in a normalized manner), multiplied or synthesized. This lab can be found at the More Settings panel, which can be opened/closed from the Top menu options, at Window>More Settings (see it in Figure 9-1).

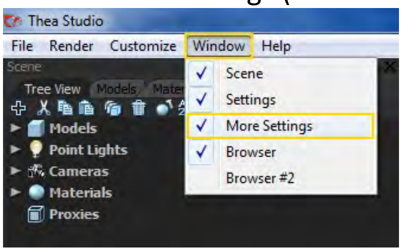


Figure 9-1: View/Hide More Settings Panel, where Texture Lab is located

Figure 9-2: Texture Lab

9.2 Parts of the Texture Lab

Looking at the texture editor in more detail (Figure 9-3), we can see that the Texture Lab can be separated in three main categories: the Preview panel at the top, the Texture Layers panel in the middle and the Properties panel below, which is showing each time the details of the active selection. More analytically, here are the main parts -areas- that can be found in the Texture Lab as they are also seen in Figure 9-3. These parts are explained in this chapter in detail.

A	Texture Preview Panel	Texture Preview Window
B		File/Clear Options
C		Texture Preview Options
D		Global Texture Coordinates
E	Texture Layers Panel	3x3 Texture Grid
F		Texture Options
G		Delete Texture
H		Texture Selectors
I		Texture Level 2
J	Properties Panel	Properties of Active Selection

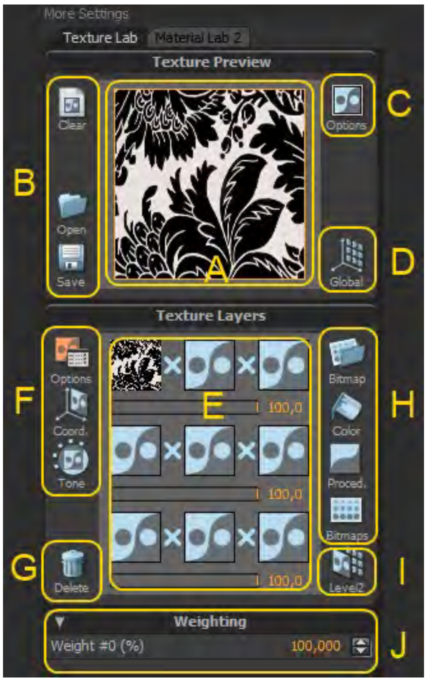


Figure 9-3: Parts of the Textures Lab

9.3 Texture Preview Panel - Texture Preview Window, File/Clear Options, Texture Preview Options & Global Texture Coordinates

9.3.1 Texture Preview Window (Area A)

Figure 9-4: Texture Preview Window

As we see in Figure 9-4, in the middle of the upper panel, we have the Texture Preview Window, where the selected texture appears. This area is showing the selected texture and the way it is modified each time. By double clicking on a texture at the Browser panel or by dragging and dropping it in this area, we can make a texture appear here. We can also drag it from here and drop it to a texture slot of a material channel (at Diffuse for example).

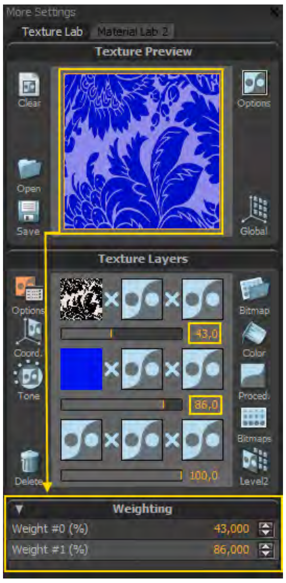


Figure 9-5: Weighting Panel

Tip: by clicking on the Texture Preview window, a new panel appears at the bottom of the Texture Lab (in area J). This panel, with the name **Weighting** (see it in Figure 9-5), shows the weights of each texture level. We will see later more analytically the way a texture can be structured with layers, with a certain weight each. From this panel, you can see the existing weights for each level in percentages and also edit their values, either by using the up/down arrows or by editing (type a number, copy and paste by right click) the arithmetic text.

9.3.2 File/Clear Options (Area B)

Figure 9-6: Clear, Open and Save Options

At the left side of the Texture Preview panel, we see three main options that help user clear a texture, open it or save it.

1. By hitting Clear button, the current texture is reset, so it disappears from the lab.
2. The Open Button, opens an “Open Texture” window (see it in Figure 9-7), from where user can select and open a Thea Texture (*.tex.thea or *.xml) file. This type of files, have been saved at this type at a previous editing.
3. By clicking the Save button, a “Save Texture” window appears that helps you save the current texture in a *.tex.thea format, to the location you want (see Figure 9-8).

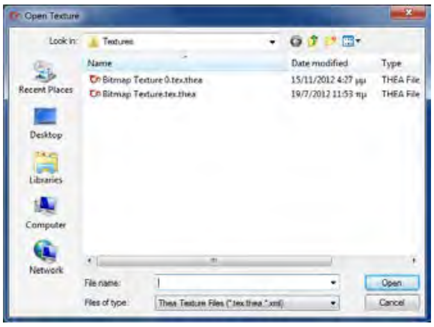


Figure 9-7: Open Texture Window

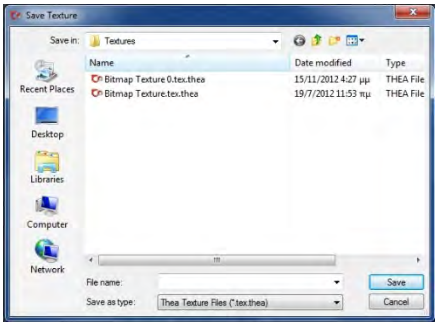


Figure 9-8: Save Texture Window

9.3.3 Texture Preview Options (Area C)

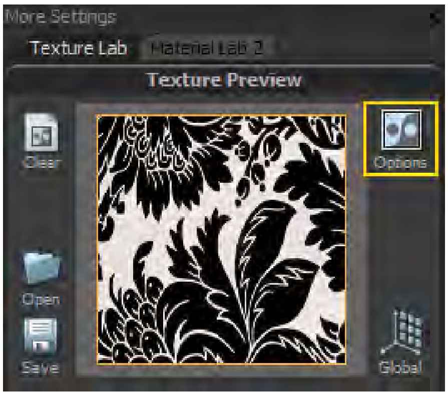


Figure 9-9: Texture Preview Options

At the right side of the Texture Preview panel, we see the Options button (see it in Figure 9-9). Once it is pressed, a new small window appears, as you see it in Figure 9-10, from where user can specify the desired width and scale -in meters- of the selected texture and enable/ disable high resolution for the preview window.

In the next images we see how these adjustments affect the previewed texture.

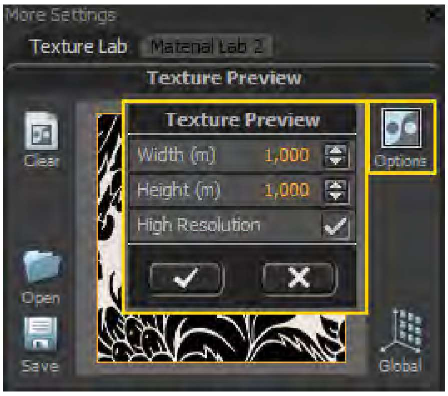


Figure 9-10: Available Options for the Texture Preview window

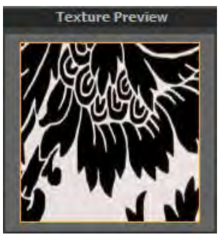


Figure 9-11: Width and Height set to 0.5 meters

Figure 9-12: Width and Height set to 4 meters

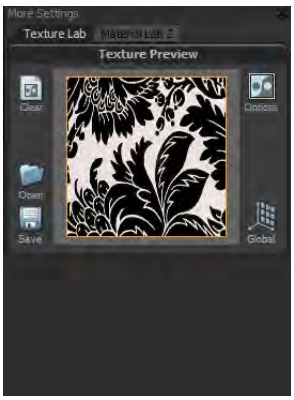


Figure 9-13: Normal Resolution Texture Preview Window

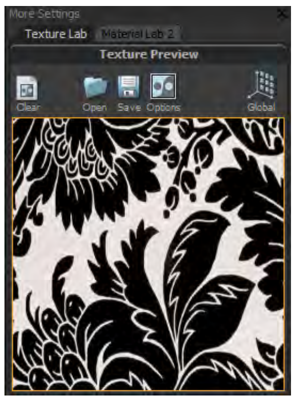


Figure 9-14: High Resolution Texture Preview Window

9.3.4 Global Texture Coordinates (Area D)

Figure 9-15: Global Texture Coordinates

At the right side of the Texture Preview panel, we see the Global button, which after pressing it, opens a new panel, at the bottom side of the Texture Lab, in Area J (see them in Figure 9-15). At the new panel, we see the Global Operation option with the name “Complement”, which can create a complemented texture, to the initial one, like we see it in Figure 9-16.

Figure 9-16: Complement Texture

Note that this kind of inversion is applied to the whole texture, after its layers are edited and all other procedures are applied.

9.4 Texture Layers Panel - 3x3 Texture Grid, Texture Options, Delete Texture, Texture Selectors & Texture Level 2

9.4.1 3x3 Texture Grid (Area E)

Figure 9-17: Texture Grid Area

The second panel of the Texture Lab is the Texture Layers, where in the middle we see the Texture Grid area (see it in Figure 9-17). Here, you can actually edit your textures, add levels and create several combinations. The final texture is seen in the Texture Preview Window.

The layers of textures are arranged in a 3x3 grid. We have three rows and three columns.

Tip 1: the 3x3 grid can be “enhanced in resolution” by editing a texture in a **sub-level**; this can be done by selecting a texture and clicking on Level2 button, as we will see later on.

Tip 2: you can **click and drag** a texture from one cell to another of the grid and in case another one exists there, swap their positions.

Tip 3: by **double clicking** on a cell of the grid which hosts a bitmap or a color, the Browse Bitmap or the Color Lab windows open accordingly.

The operations applied between the layer rows is a normalized addition and the relative weights can be adjusted by the slide bars found under the rows. The orange number text can be edited and user can copy or paste a number there or even type the desired percentage. We can see some examples at the images that follow. By decreasing a row weight, its effect to the final image is also decreased. As we see in Figure 9-18 and Figure 9-19, the white line effect of the second row, is not as visible when its percentage is 13%, instead of 100%.

Figure 9-18: Weight for 1st layer is set to 20%, while for the 2nd to 100%

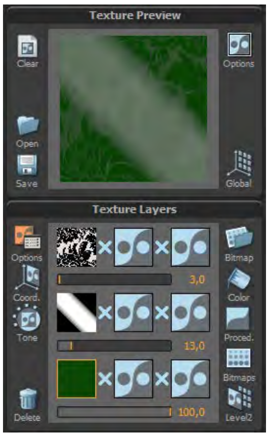


Figure 9-19: Weight for 1^{st} layer is set to 3%, for the 2^{nd} to 13% and for the 3^{rd} to 100%

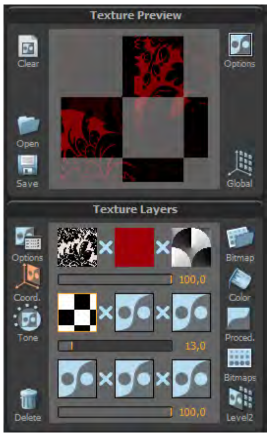


Figure 9-20: A more complex example, with the use of multiplication at the 1^{st} row and 13% weight of the 2^{nd} one.

The operation applied on textures inside one row can be either a multiplication (see Figure 9-21 and Figure 9-22) or a synthesis (see Figure 9-23). The operation is changed by simply clicking on the symbol between the texture placeholders. Synthesis is a special operation where the results of each texture in the row are used to define new coordinates for the next one. In many cases, some unique and interesting patterns can be achieved by this way.

Figure 9-21: Multiplication Operation example

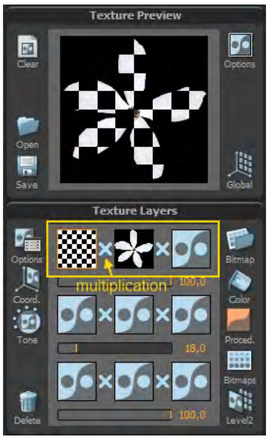


Figure 9-22: Multiplication Operation example

Figure 9-23: Synthesis Operation example

9.4.2 Texture Options (Area F)

9.4.2.1 Options

Figure 9-24: Texture Options

The first option that we see at the left side of the Texture Layers panel is the Options button, which holds the properties specialized to the selected grid cell. By pressing it (while a bitmap from the grid is selected), we see in area J, a new panel appearing, the Bitmap Options panel (see it in Figure 9-24). Below we see the available options of this panel.

Note: these options are different for cases that instead of a bitmap, we choose a procedural. We will analyze these differences later, when describing the procedurals.

Filename: this area shows the name of the selected texture and its location inside your disk – with orange text. The small folder icon at the right side of the text, opens a window, that makes it possible to open another bitmap file instead the existing one (see Figure 9-25). The available bitmap formats are: *.jpg, *.jpeg, *.png, *.bmp, *.gif, *.tga, *.tif, *.hfr and *.exr.

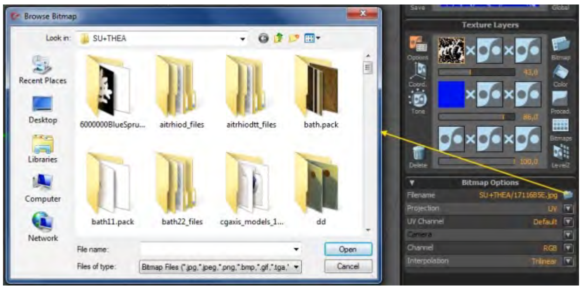


Figure 9-25: Browse Bitmap Window

Projection: this option helps user to select the projection needed for the selected texture. From the drop down list that appears by pressing the down arrow, a projection can be selected among: UV, Cubic, Cylindrical, Spherical, Flat, Front, Shrink Wrap, Camera Map, Cubic (Centered) and Flat (Centered).

UV Channel: we see here a list of all available Channels (for example the Diffuse, the Refraction, the Bump Channels etc.) and each texture can be linked to a selected channel.

Camera: this option helps user define the camera that corresponds to the selected texture, from the list with all available cameras in the scene. This parameter is only used when Camera Mapping is enabled.

Channel: two main channels exist for a texture, the RGB channel and the Alpha channel.

Interpolation: here the user can specify the type of interpolation for the selected image. It can be set to None, Bilinear or Trilinear.

9.4.2.2 Coordinates

Below the Options button, we see the Coordinates button, that once pressed, opens a new panel at the bottom -area J- where the coordinates of the selected bitmap/procedural appear (see it in Figure 9-26).

As we see, the options that can be edited here, are the Offset -in X and Y dimensions-, the Spatial Sizes (X, Y and both), the UV Scale (X, Y Scale and both) and the rotation in degrees. For scaling, value 1 is the one that shows the bitmap as inserted. In the next figures, we see how these options affect the final texture.

Spatial Size is used to correctly account for scaling when changing from UV to Cubic coordinates, while UV Scaling affects the scaling once UV projection is used.

Figure 9-26: Texture Coordinates

Figure 9-27: Initial Texture - Offsets of inserted bitmaps set to 0, Scales set to 1, Rotation to 0

Figure 9-28: Offsets X and Y are set to 0.5

Figure 9-29: UV Scale is set to 3.0 for both X and Y dimensions

Figure 9-30: Rotation is set to 90 degrees

9.4.2.3 Tone Mapping

The last one of the texture options that exists is the Tone Mapping. Once is pressed, in area J, a new panel appears, as we see it in Figure 9-31, where user can adjust the tone mapping of the selected bitmap/procedural. At the next table, we show the available options along with some example figures of textures.

Note that the default values for each parameter are shown in Figure 31: all are set to 0% expect from maximum Clamp which is set to 100%.

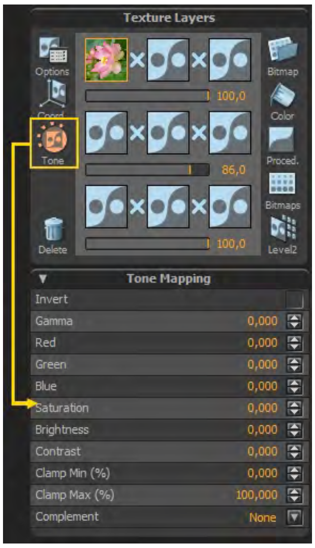


Figure 9-31: Tone Mapping

Invert: this option, inverts all the colors of the texture to their complemented colors.

Figure 9-32: Normal and inverted texture

Gamma: user can edit here the Gamma value of the selected texture. These values range from -100% to 100%. In the next images, we see these values for the selected texture and the way they affect its final appearance.

Figure 9-33: Gamma values at -100%, 0% and 100%

Red, Green, Blue: you can increase or decrease a texture color value for correcting its tone. Values range from -100% to 100%. In the next figures, we set some extreme values for the selected texture, to see the way these adjustments affect the final result.

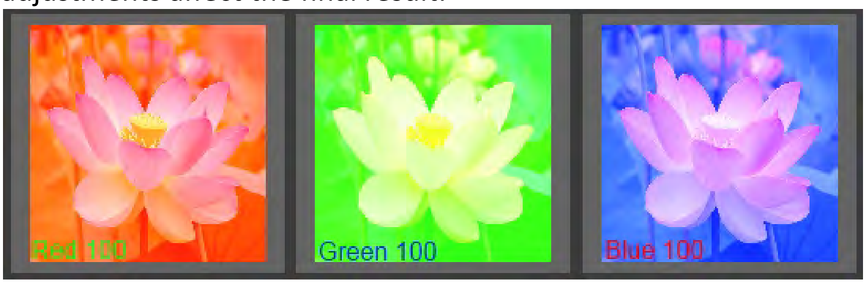


Figure 9-34: Red, Green and Blue are set to 100, while rest ones stay zero.

Saturation: user can change from here a texture saturation, by giving it values from -100% to 100%. At the next textures, we have applied two extreme values for saturation, to see how they affect the tone of the texture.

Figure 9-35: Saturation values are set to -100%, 0% and 100%

Brightness: another feature that affects a texture tone is the brightness. Once again, values range between -100% and 100%. Brightness set to -100% makes the image total black.

Figure 9-36: Brightness is set to -50%, 0% and 50%

Contrast: user can specify here the value of contrast that the texture will have. In the next figures, we have set some example values to show the way contrast affects the texture tone.

Figure 9-37: Contrast values set to -80%, 0% and 80% accordingly

Clamp – Min (%) and Max (%): from these two options, user can specify the minimum and maximum clamp of the selected texture accordingly. RGB colors range normally from 0 to 255. By setting for example minimum clamp 20%, the colors that their RGB values are less than around 51, will be “cut” and get this value. In the next figures, we see some examples. By increasing minimum clump percentage, image turn to be whiter, while by decreasing the maximum clump percentage, image is getting darker colors. For decreasing the maximum percentage and increasing the minimum on the same time, textures tend to appear grayer, as gray color has RGV values around in the middle of the 256 colors (128, 128, 128).

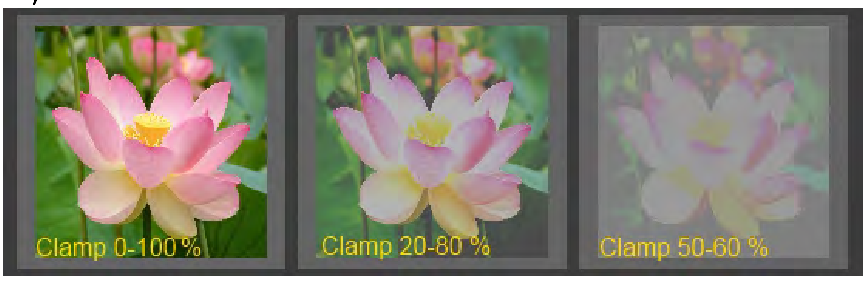


Figure 9-38: Decreasing Clamp range makes the texture show gray

Complement: user can replace all or some of the colors of the image with their complementary colors.
From the drop down list next to this option (see Figure 9-39), user can select to use complementary colors for none of the colors, for all, only for red, green or blue, for both red and green, for both red and blue or for both green and blue.

Figure 9-39: Complement Options

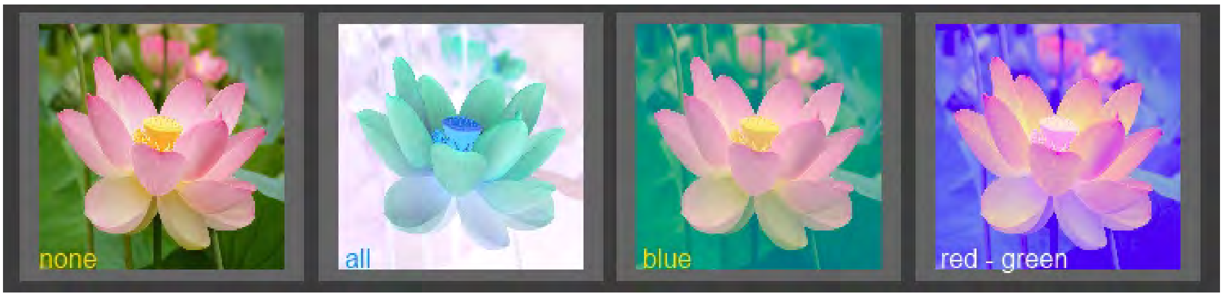


Figure 9-40: In the first texture, no complementary color is used. In the second one, all are complementary colors, in the third, instead of blue color, its complement (yellow) is used. At the last one, instead of red and green, we have their complements (cyan and magenta).

9.4.2.4 Delete Texture (Area G)

By pressing the Delete button, the selected texture from the cell in the grid is removed. If the other layers have bitmaps, they will remain in the grid, but the effect of the removed one, will disappear.

Figure 9-41: Delete Option removes selected Texture

Figure 9-42: The way the texture looks, after deleting two of its layers.

9.4.3 Texture Selectors (Area H)

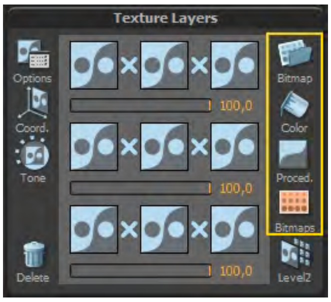


Figure 9-43: Texture Selectors

On the right side of the layers panel, we find all the buttons that can import a texture in the editor (see them in Figure 9-43). Thus, we can open a bitmap, create a color, or browse the bitmaps and procedurals already available in the scene.

Note that the available bitmaps and procedurals can also be browsed using the Textures tab (at the Scene panel) and d**ragged and dropped** inside the texture editor for efficiency.

9.4.3.1 Bitmap

The first option we meet at the Texture Selectors area is the Bitmap button. By pressing it, a “Browse Bitmap” window appears, as we see it in Figure 9-44. This window helps you locate the folder you want and the bitmap image you need to use as a texture. You can choose among *.jpg, *.jpeg, *.png, *.bmp, *.gif, *.tga, *.tif, *.hfr and *.exr file formats. Once you select it, the new image is appearing to the first empty cell of the first row or to the cell you have selected.

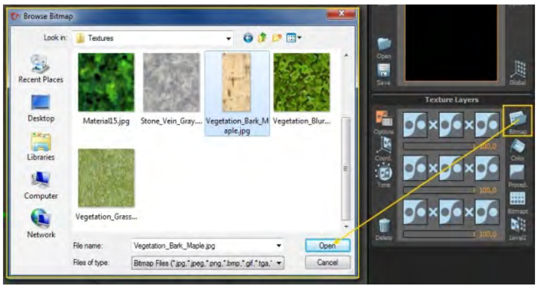


Figure 9-44: Browse Bitmap Window

9.4.3.2 Color

The second option that we see at the Texture Selectors area is the Color button. By pressing this button, the Thea Color Lab appears (see it in Figure 9-45). In this lab, you can select a specific color to use it as a texture or as a texture layer. Many options appear in this lab, such as choosing a color from the Tristimulus, Spectrum or Blackbody panel, save and edit a color palette and preview the way the color will be perceived under different lighting conditions. More details on the Color Lab can be found at the corresponding chapter.

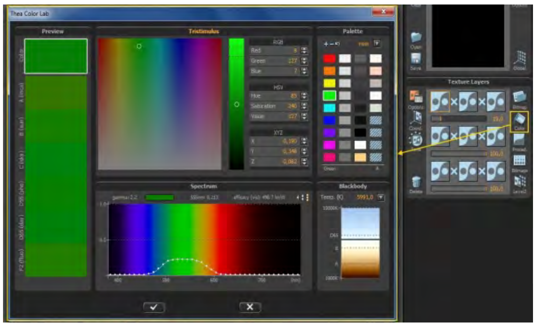


Figure 9-45: Thea Color Lab

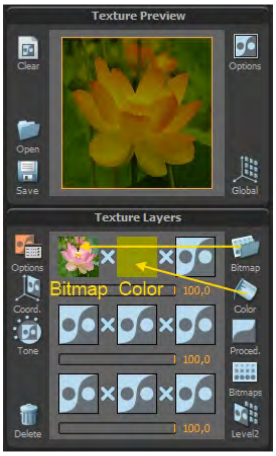


Figure 9-46: Bitmap and Color layers

As we see in Figure 9-46, we can choose for different cells of the grid, bitmaps and colors in the combination we want.

Remember that we can **double click on the cells** to browse for another bitmap or color if we wish to change it.

9.4.3.3 Procedurals

A separate category of textures, are the procedurals. These pre-installed textures are not applied to your models as the bitmaps, but instead, they are applied according to an internal function they follow, in a specific way (see them in Figure 9-47). Each procedural has some specific options, which appear at the panel at the bottom, once the button Options is pressed.

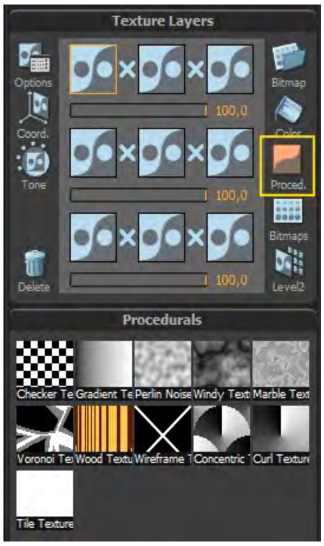


Figure 9-47: Procedurals Panel

Note: in the next tables, we see a brief description of each procedural along with its available options. At the example figures, we add the procedural to a cell of the grid, to see the way it affects an example bitmap image of a flower.

In most of the next examples we have used another row of the grid for the procedural (as seen in Figure 9-48), meaning we have used a normalized addition. We could have also used a multiplication or a synthesis as well.

Please note that Procedural Textures currently do not work with Presto engine.

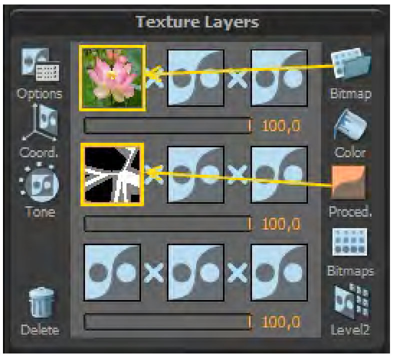
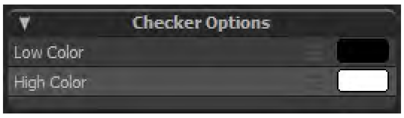
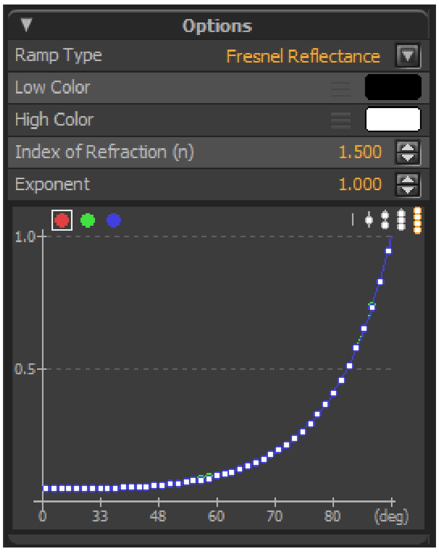


Figure 9-48: Bitmap and Procedural on

the Grid

Procedural	Description	Available Options
 Figure 9-49: Checker Texture	Checker texture, is applying a square grid on its layered texture, where in black squares, a dark transparency is added, while in white ones, a white transparency is added. From its options panel, user can edit these colors, from the default black and white, to those preferred.	 Figure 9-50: Checker Options
	Below (Figure 9-51), we see some example textures, of how the checker procedural affects a layered bitmap. In the first image, we have set the Low -High colors (as default) to Black-White. In the second one, we have changed them to Red-Blue. In the 3rd one, we have changed the Scale option of the checker procedural (at the Coordinates panel).  Figure 9-51: Checker Procedural example images – Changing the Low-High Colors and the Scale of the procedural	

Procedural	Description	Available Options
 Figure 9-52: Fresnel Ramp Texture	Fresnel Ramp is a new procedural that has been added to the Material Editor. It is an enhancement for our Fresnel reflectance curve which allows for more artistic freedom. Similar to our Fresnel curve, the Fresnel Ramp main purpose is to alter the reflectance with respect to the viewing angle but with more options and the possibility to use it for nearly all components (such as Diffuse, Reflectance and Translucency).	 Figure 9-53: Checker Options

To better see how the settings affect the reflectance, we are going to use the new Fresnel Ramp in the Diffuse channel. To see the Fresnel Ramp settings, we click on the Options icon inside the Texture Lab.
Fresnel Reflectance curve is the default Ramp Type and the related options are Low Color, High Color, Index of Refraction (n) and Exponent. Under those settings, we can see a window where the resulting curves are shown, based on our current selected ramp type. We can alter the curve through the Index of Refraction and Exponent setting and assign colors to the Low and High colors. With this we can already create some cloth materials, like velvet (Figure 9-54).

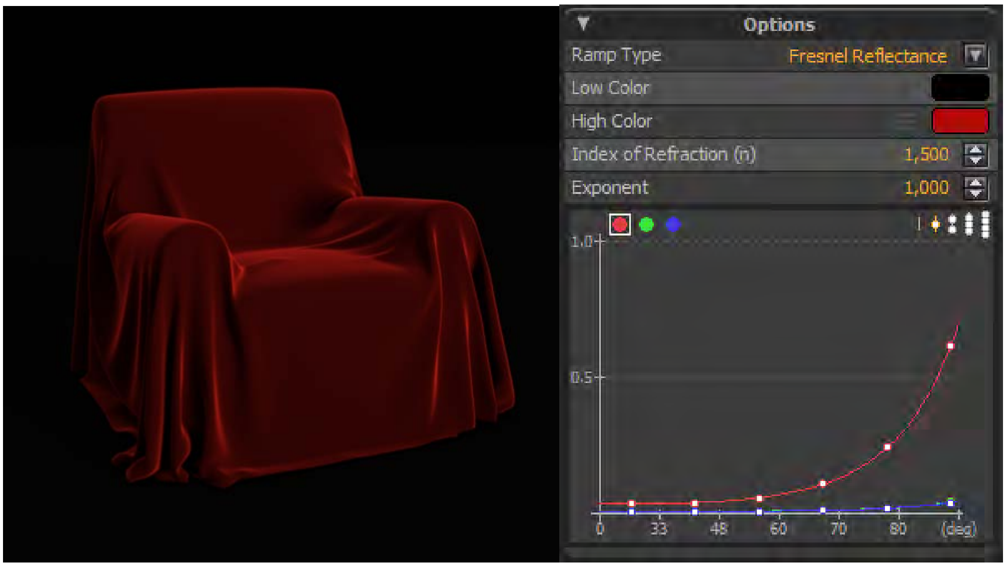


Figure 9-54: Velvet Material with use of Fresnel Reflectance

Fresnel Transmittance curve produces the reverse curve, compared to Fresnel Reflectance option, and can also be adjusted through the Index of Refraction and Exponent settings. In this case, we will produce a dark color at shallow angle and a bright color at the center. If we invert the low and high colors we will have a similar curve as if we were using Fresnel Reflectance ramp type (Figure 9-55).

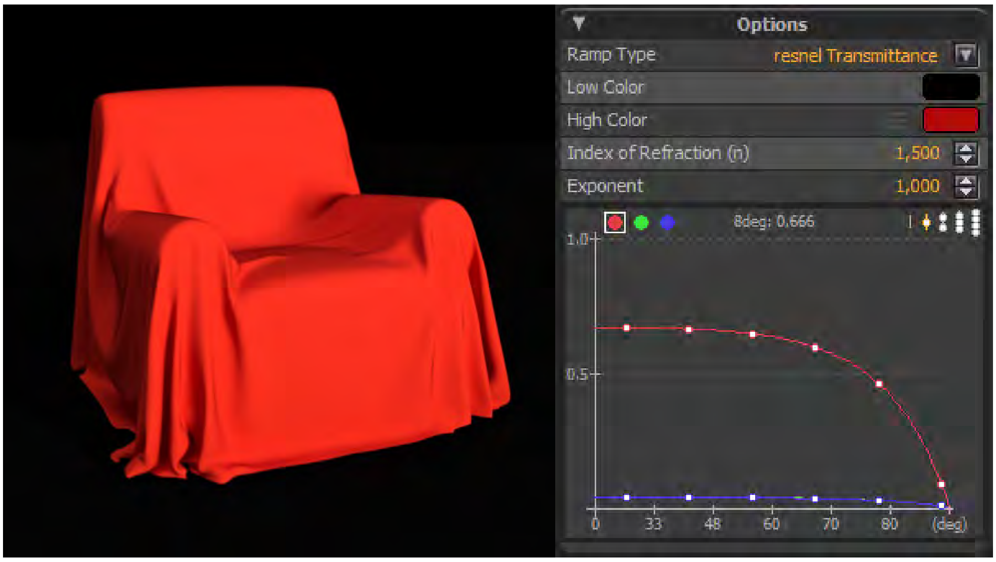


Figure 9-55: Fresnel Transmittance curve

Linear Increasing ramp type is similar to the Fresnel Reflectance curve but here we have only the Exponent settings to alter the curve. Notice that it produces a linear gradient that linearly interpolates between the low and high color. Increasing the Exponent settings we can control very easy the ramp gradient. When using very high

Exponent values, it is good practice to give the low color a value bigger than 0 (around 2). This will avoid an unnatural sudden ending of the gradient (Figure 9-56).

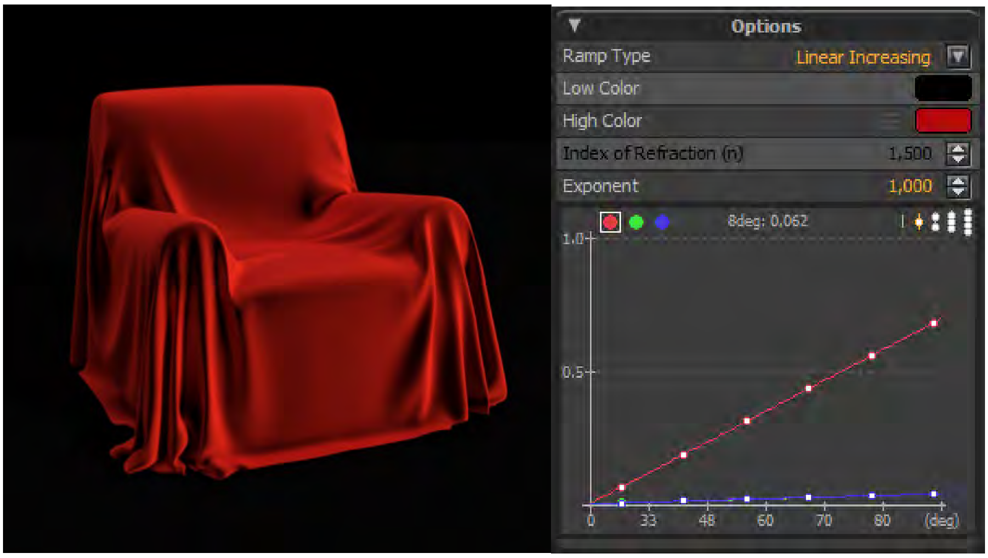


Figure 9-56: Linear Increasing Ramp Type

Linear Decreasing ramp type gives the opposite result of the Linear Increasing ramp type. The gradient produced will interpolate from the high color in the center to the low color at shallow angle. With the Exponent value we can control the falloff of the curve (Figure 9-57).

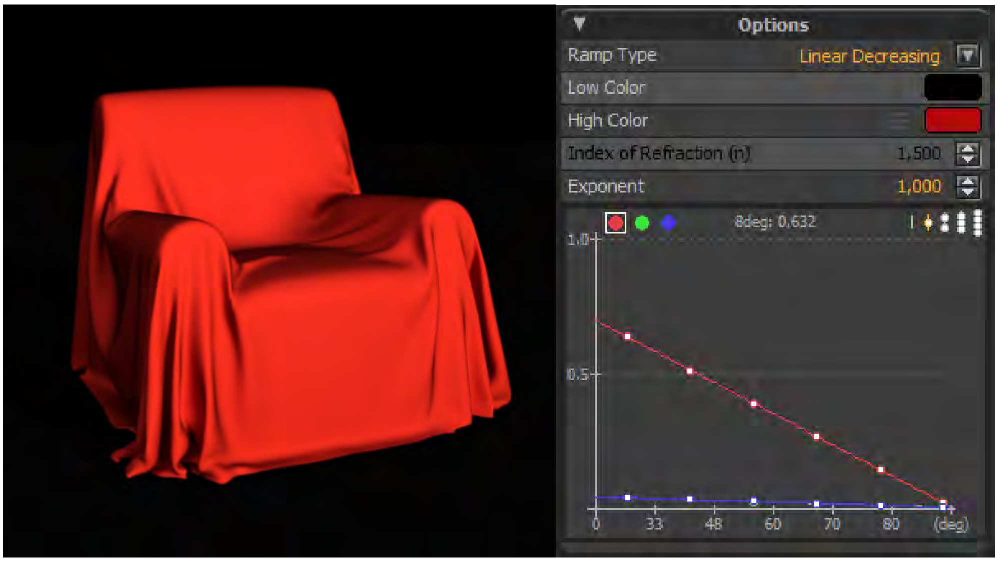


Figure 9-57: Linear Decreasing Ramp Type

Gray Curve is one of the most versatile ramp type as it allows direct editing of the curve, giving near absolute freedom on how the reflectance changes. The Index of Refraction and Exponent settings are disabled with this option. To modify the curve, we can click inside the curve editor window or draw a curve directly. We can also change the curve editing resolution which is located at the top-right corner of the curve editor window. It is good practice to start with a low resolution and increase the resolution if more fine control is needed. For materials like velvet an "S" shaped curve can produce the best results, as shown in Figure 9-58.

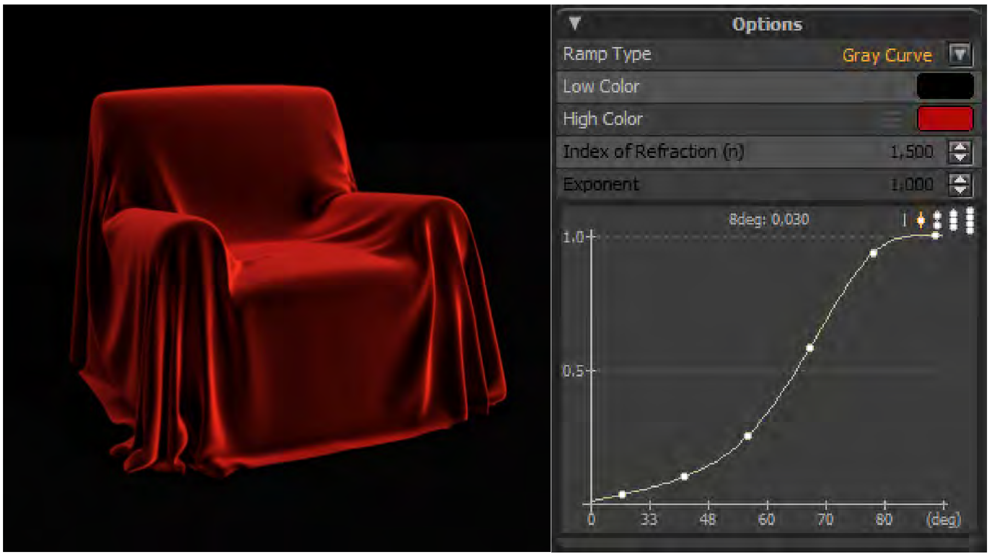


Figure 9-58: Gray Curve Ramp Type

RGB Curves is the most versatile option for creating colored ramp gradients, where we have control over all three curves. Similar to the Gray Curve, we can directly edit the curve shape inside the curve editor but with the difference that we edit separately the red, green and blue curves. The RGB Curves can be used to create pearl like materials or psychedelic results (Figure 9-59).

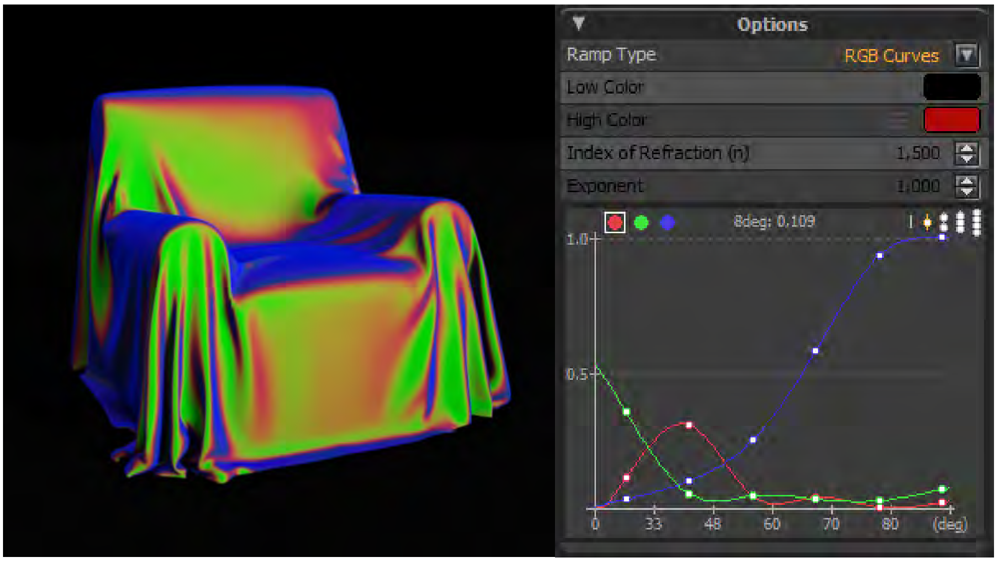


Figure 9-59: RGB Curves Ramp Type

Interesting materials can be created using the RGB Curves. Figure 9-60 shows a few material examples produced with this option for Reflectance, Diffuse and Translucency components.

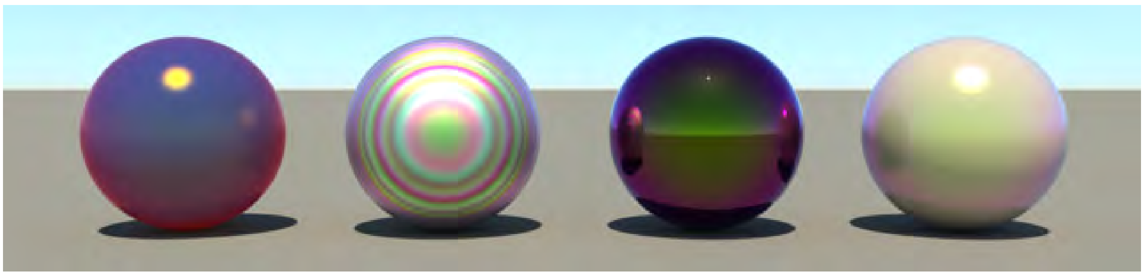


Figure 9-60: Several Materials created with the use of RGB Curves Ramp Type

In case an image texture is needed to be used together with the Fresnel Ramp, we can follow the setup as seen in Figure 9-61. We can use one texture or if we need more control we can even use two textures, one for the High Color and the other for the Low Color. Making use of the texture tone mapping, we can adjust the brightness and saturation to achieve the desired results.

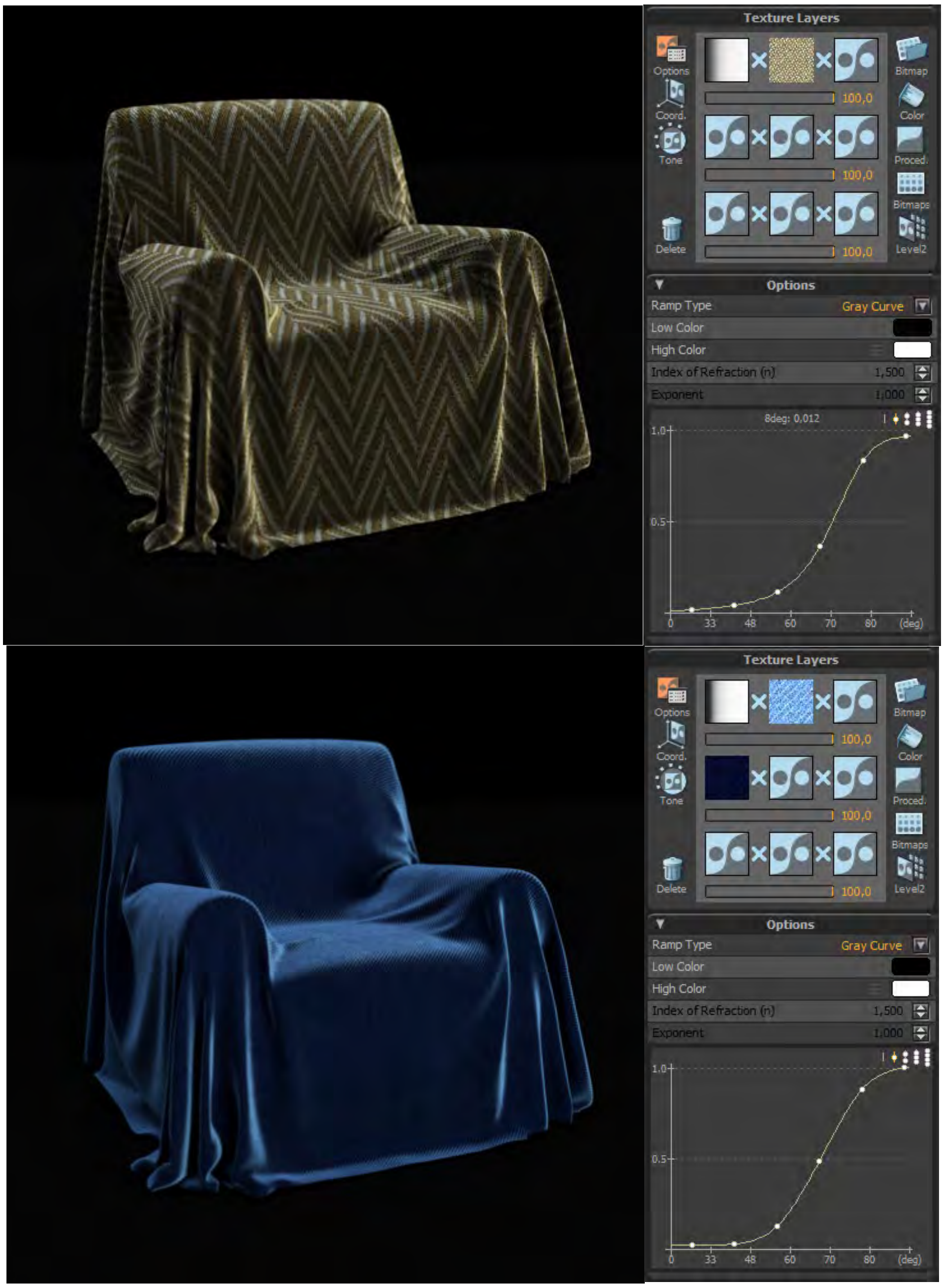


Figure 9-61: Using Fresnel Ramp together with an image texture

Figure 9-62: Gradient

Gradient procedural, is applying a gradient effect to the layered bitmap. From its options panel, user can change the low and high colors and also the X, Y, Z directions (see these options in Figure 9-63).

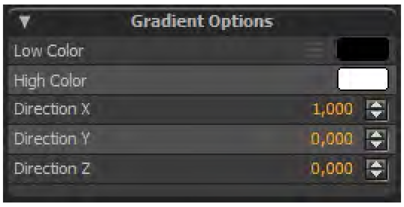


Figure 9-63: Gradient Options

Texture

In the next figure (Figure 9-64), we see some examples of the different settings that we see for gradient procedural. In the first image, we have applied the gradient procedural on the flower bitmap, by setting Low Color as Blue and High Color, Red. In the second one, we have set them back to their default colors (Black and White). In both first and second image, the procedural has Direction X=1, Y=0 and Z=0. In the 3rd image, we have changed these directions to X=0, Y=1 and Z=0 and we see that the direction of the gradiance has changed. For the last example image, we have set X=0, Y=0 and Z=1. Note that the Z-direction effect is not seen on the texture lab preview which is two dimensional.

Figure 9-64: Gradient Procedural example images – Changing the Low-High Colors and the X, Y, Z Directions

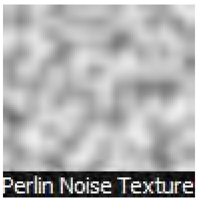


Figure 9-65: Perlin Noise Texture

Perlin noise is a procedural texture, a type of gradient noise used mainly to increase the appearance of realism in computer graphics. It is creating an effect like noise on the layered texture, while it can also been used for bump map or roughness etc. At its options panel, apart from the low and high color, user can set the number of Octaves (0 to 10) and Omega (0 to 1) and also add or not Turbulence.

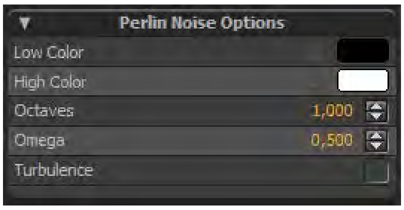


Figure 9-66: Perlin Noise Options

Figure 9-67: Changing the Low - High Colors

In

Figure 9-67, we have changed the Low-High Colors of the procedural from Black-White (default ones) to Red-Blue correspondingly and we see the way this affects the layered flower bitmap.

Figure 9-68: Enabling Turbulence

In

Figure 9-68, we have enabled the Turbulence option as well, so we see the way our texture looks like with and without the turbulence. In both these cases, the Octaves are set to 1 and the Omega to 0.5 (default values).

For these options (Octaves and Omega), we can see their effect on the final texture, by changing their values.
In Figure 9-69 we change the Octaves four times, while keeping Omega constant, at 0.5. The first image has value 0 (minimum value), the 2nd 1 (the default value), the 3rd 5 and the last one 10 (maximum value).

Figure 9-69: Different Values for Octaves

In Figure 9-70, we keep constant the Octaves of the procedural (set to 5) and we change the values of Omega. The first time, is set to 0 (minimum value), then to 0.5 (default value). The 3rd time is set to 0.75 and the last time to 1 (maximum value).

Figure 9-70: Different Values for Omega

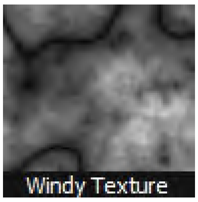


Figure 9-71: Windy Texture

Windy procedural, is adding a kind of wind effect on the layered texture. It can be applied also to materials slots for structure purposes. At its options panel, user can define the Low and High color, the Strength and Height Octaves (0 to 10), the Strength and Height Omega and the existence of Symmetry (0 to 1).

Figure 9-72: Windy Options

Figure 9-73: Changing Low-High Colors

In Figure 9-73, we see the way the Low-High colors affect the windy effect on a layered bitmap. Instead of the default Black-White, we have set these colors to Red-Blue accordingly.

Figure 9-74: Enabling Symmetric Option

In Figure 9-74, we have enabled the last option, Symmetric, and we see the way it affects the final texture.

In all these cases, the rest parameters stay constant, to the default values.
Strength Octaves: 3
Height Octaves: 3

		Strength Omega: 0.5 Height Omega: 0.5

In the next sets of figures, we keep Black and White as Low-High colors and have Symmetric option disabled. In each set, we change one only parameter to see the way it affects the final render.

In Figure 9-77, we test different values for the Strength Octaves. The first time, we set it to 0 (minimum value), then to 3 (default value) and then to 10 (maximum value). The rest parameters are kept in their default values, as described before.

In Figure 9-75, we give different value at Height Octaves, which are: 0 for the first case (minimum value), 6 at the middle image (default value) and 10 for the last one (maximum value). Again, rest parameters stay constant.

Figure 9-75: Different Values for Height Octaves

The next parameter that affects the windy effect is the Strength Omega. In Figure 9-76, we give to this parameter the next values: 0 (minimum value), 0.5 and then 1 (maximum value).

Figure 9-76: Different Values for Strength Omega

The last option, the Height Omega, is presented in Figure 9-78. By giving it different values (0, 0.5 and 1) we see the way it affects the final texture.

Figure 9-77: Different Values for Strength Octaves

Figure 9-78: Different Values for Height Omega

Figure 9-79: Marble Texture

Marble texture, is a procedural that creates an effect on surfaces similar to a marble material. In Figure 9-80, we see the available options that exist at the Marble Options panel.

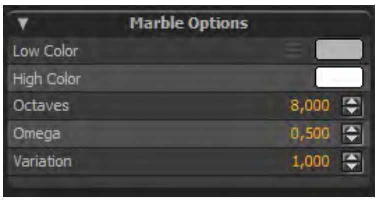


Figure 9-80: Marble Options

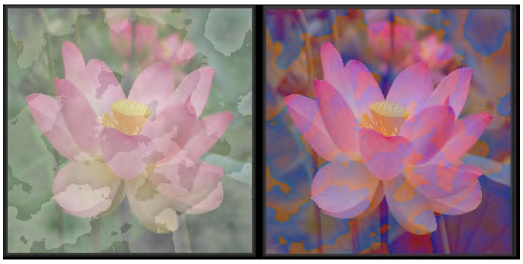


Figure 9-81: Changing the Low-High Colors

The first parameter that user can change for Marble Texture, is the Low and High colors. In Figure 9-81, instead of the Gray-White (default ones), we also see the effect with Red-Blue colors.

The rest options are set to their default values, which are:
Octaves: 8
Omega: 0.5
Variation: 1

The next option we see for the Marble procedural is the Octaves value. In Figure 9-82, we change these values and so in the first texture we have set it to 1, in the next one to 8 and then to 10. The rest parameters are set to their default values.

Figure 9-82: Different Values for Octaves

In Figure 9-83, we see the way the Omega values affect the final texture. We have given the next values: 0 (minimum) for the first texture, 0.5 for the second and 1(maximum value) for the last one.

Figure 9-83: Different Values for Omega

The last option we meet for the marble procedural is the Variation. In Figure 9-84, we have given several values for Variation and we see the different effects. The values we see are from left to right are: 0.5, 1, 2, 5 and 10 accordingly.

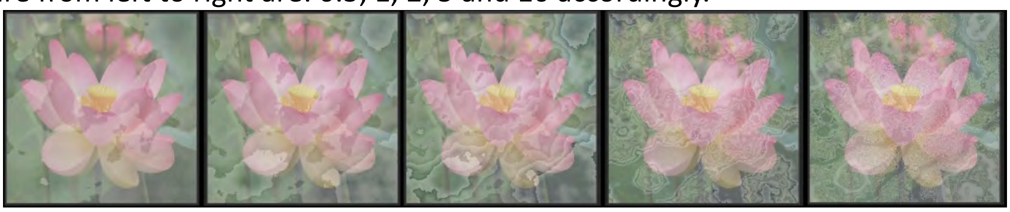


Figure 9-84: Changing the Variation Values

Figure 9-85: Voronoi Texture

A Voronoi diagram is a way of dividing space into a number of regions. A set of points (called seeds, sites, or generators) is specified beforehand and for each seed there will be a corresponding region consisting of all points closer to that seed than to any other. The regions are called Voronoi cells.

In Figure 9-86, we see the available options for Voronoi procedural. User can specify the Cell, Ridge and Plateau colors, along with the size of the Ridge and Plateau. In Figure 9-87, we see the areas of the Cell, Ridge and Plateau in the Voronoi diagram.

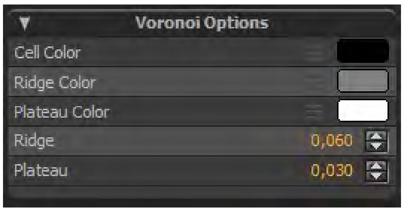


Figure 9-86: Voronoi Options

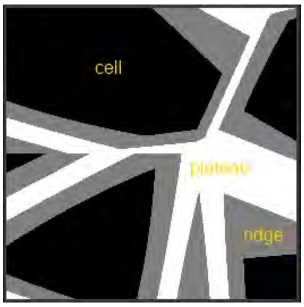


Figure 9-87: Cell, Ridge and Plateau Areas


Figure 9-88: Changing Voronoi Cell, Ridge and Plateau Colors

In Figure 9-88 we see the way the layered flower bitmap looks like, after changing the Cell, Ridge and Plateau colors of the Voronoi procedural, from the default Black, Gray and White to Red, Blue and Yellow accordingly. The rest options stay constant at their default values, which are 0.06 for the Ridge and 0.03 for the Plateau.

Below, we are changing the Ridge values at first (in Figure 9-89) and then the Plateau values (in Figure 9-90) in order to show the way the final texture changes.


Figure 9-89: Changing Ridge Value: 0 (minimum), 0.06 (default), 0.160 and 0.260

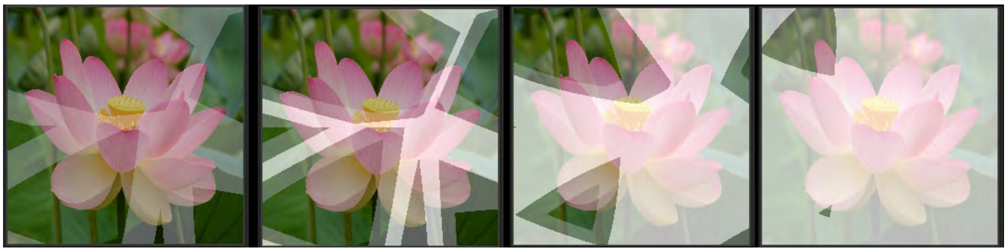


Figure 9-90: Changing Plateau Value: 0 (minimum), 0.03 (default), 0.130 and 0.230

Figure 9-91: Wood Texture

Wood texture is useful for creating wood surfaces, as it creates a realistic wood effect by selecting the two main colors of wood rings (see Wood Options in Figure 9-92).

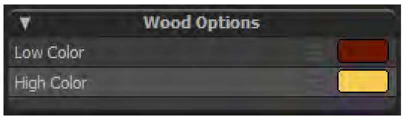


Figure 9-92: Wood Options

In Figure 9-93, we have changed the Low and High Wood Colors, from the default Brown and Yellow, to Orange and Black accordingly.

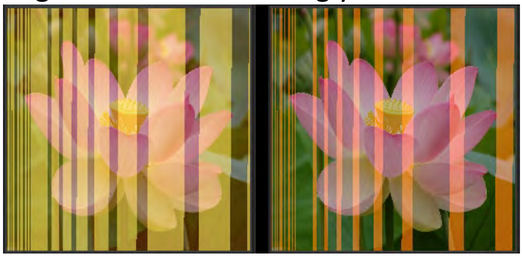


Figure 9-93: Changing Wood Texture Colors

Figure 9-94: Wireframe Texture

Wireframe procedural, is used in order to create a wireframe effect on a surface. Along with the many parameters that are presented at the Options panel (see Figure 9-95), user can create several effects, as we will also analyze with the following examples. As we see, we have placed the procedural at the same row with the flower bitmap, just to see how the procedurals act in multiplication mode (we can also add it though to another row).

The default values for the Wireframe procedural are the following:
Wire Color: White
Inner Color: Black
Thickness: 0.01
Fadeout: 0.01
Hard Edge Threshold: 45
All Edges: Enabled
Silhouette Edges, Open Edges, Soft Edges, Hard Inner Edges, Hard Outer Edges: Disabled.

In the next examples, we change each time one parameter, while keeping the rest to their default settings.

Figure 9-95: Wireframe Options

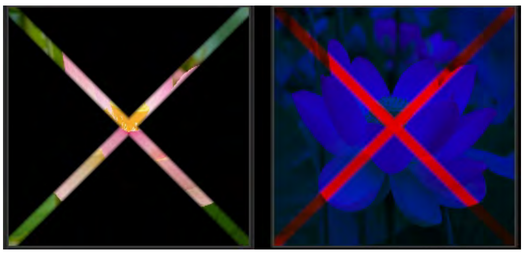


Figure 9-96: Changing the Wire and Inner

The first two options at Wireframe settings are the Wire and Inner colors. As we see in Figure 9-96, we have changed the Wire color from white to red and the Inner Color from black to blue.

<table>
<tr><td></td><td>Colors</td><td></td></tr>
<tr><td></td><td colspan="2">In the next figure (Figure 9-97), we are changing the Thickness value, in order to see the way the Wireframe procedural changes. The values we have given are from left to right are: 0 (minimum) for the 1st example, 0.01 (default value) for the 2nd, 0.11 for the 3rd and 0.21 for the last one.

Figure 9-97: Changing the Thickness value</td></tr>
<tr><td></td><td colspan="2">In Figure 9-98, we are changing the Fadeout value. At first we have set it to 0 and as we see, there is no fading around the wire. Then, we see the default value (0.01) and then we increase it to 0.11 and 0.21 correspondingly.

Figure 9-98: Changing the Fadeout value

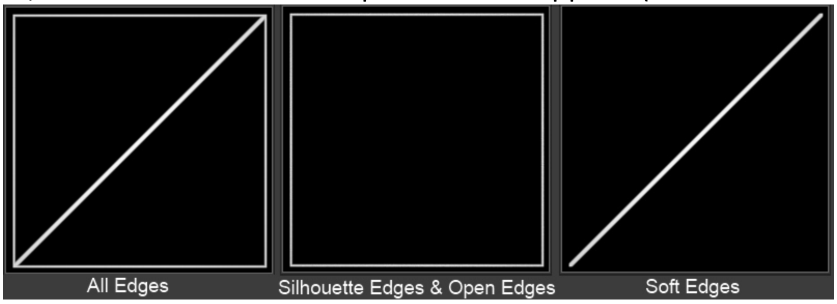
The rest of the options, are not directly visible on the selected texture, as they are depending on the geometry, though are applicable once the wireframe is applied on a model.</td></tr>
<tr><td></td><td colspan="2">Note: we can disable the All Edges option, and then enable one by one the rest edges options, in order to see what each one represents. In Figure 9-99, we see the edges of a square model, on which the wireframe procedural is applied (at the Diffuse channel).


Figure 9-99: Different Type of Edges</td></tr>
<tr><td>

Figure 9-100: Concentric Texture</td><td>Concentric texture, is specially designed to been applied on metallic surfaces, at the anisotropic slot. We see the way a metallic surface looks like, when Concentric texture is used for its Anisotropy in Figure 9-101.</td><td>There are no special options for this texture. This is the way the texture affects a layered flower bitmap (see Figure 9-102).</td></tr>
</table>

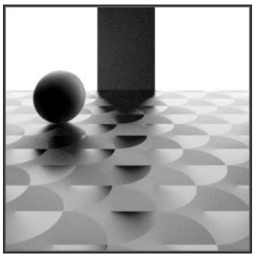


Figure 9-101: Concentric Procedural used at Anisotropy slot

Figure 9-102: Concentric Procedural on a bitmap

Figure 9-103: Curl Texture

Curl texture, as concentric one, is specially designed to been applied on metallic surfaces, at the anisotropic slot. We see the way a metallic surface looks like, when Curl texture is used for its Anisotropy in Figure 9-104.

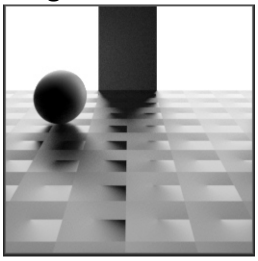


Figure 9-104: Curl Procedural used at Anisotropy slot

There are no special options for this texture. This is the way the texture affects a layered flower bitmap (see Figure 9-105).

Figure 9-105: Curl Procedural on a bitmap

Figure 9-106: Tile Texture

Tile texture, is useful for creating a mask on a selected texture. In order to see it working properly, we can add it on the same row with a bitmap and use multiplication. By editing its options (see Figure 9-107) you can define the Low and High colors, the U and V Repetitions, the Projection and the UV channel.

Figure 9-107: Tile Options

Below, in Figure 9-108, we see the way the Tile procedural changes a bitmap texture. The first time, we have the default values (Low Color: Black, High Color: White, U, V Repetitions: 1, Projection: UV and Channel: Default). Then, we decrease both the repetitions, so we see the texture to be “clipped”. In the 3rd example, apart from the repetitions (U: 0.3 and V: 1) we have set as Low color the White and as High the Blue.

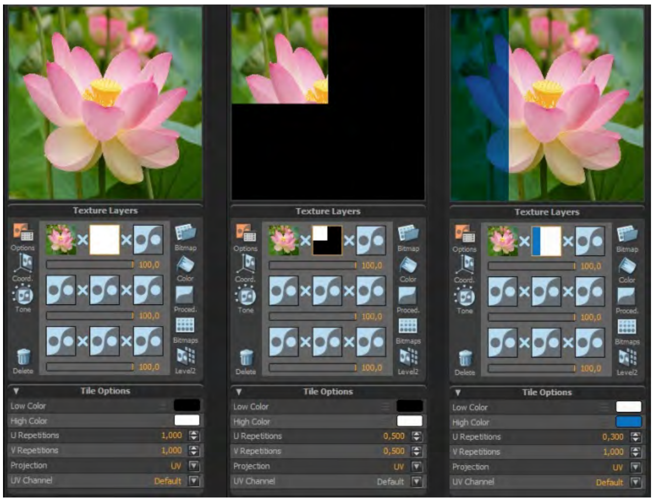


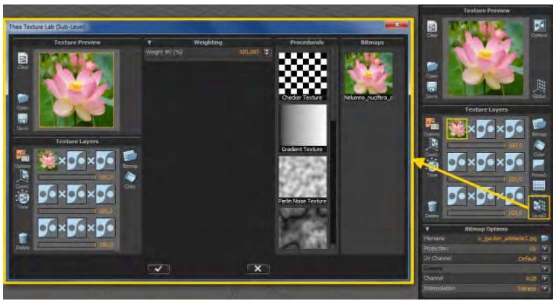
Figure 9-108: Changing Tile Texture Options

9.4.4 Bitmaps

The last option that we see at the Texture Selectors area is the Bitmaps button. By pressing it, a new panel appears at the bottom of the Texture Layers panel – in area J- (see it in Figure 9-109). This panel shows the bitmaps that have been recently opened.
These bitmaps may not be in use now by any material. In order to clean up unused textures and not see them here anymore, you can use the Clean Up Bitmaps button, at the Textures tab (is located at the Scene panel). By this way, only the bitmaps that are currently in use will be seen here.

Figure 9-109: Show Open Bitmaps Panel

9.4.5 Texture Level 2 (Area I)



The last option that we meet at the right side of the Texture Layers panel is the Level 2 button. By pressing it, a new panel appears as a pop up window, that is identical to the Texture lab, but this time helps you to edit the selected texture or layer and then use it in this way, at its initial position (see Figure 9-110). Assuming we have the flower bitmap at the first cell of the grid (see Figure 9-111)

Figure 9-110: Thea Texture Lab (Sub-Level)

and we want to edit this bitmap. By selecting it and press the Level 2 button, we can edit this bitmap at the new Texture Lab that appears. Once we are satisfied with the result, we can press OK and then, see the changes of the selected bitmap, applied to it, at its initial grid position.

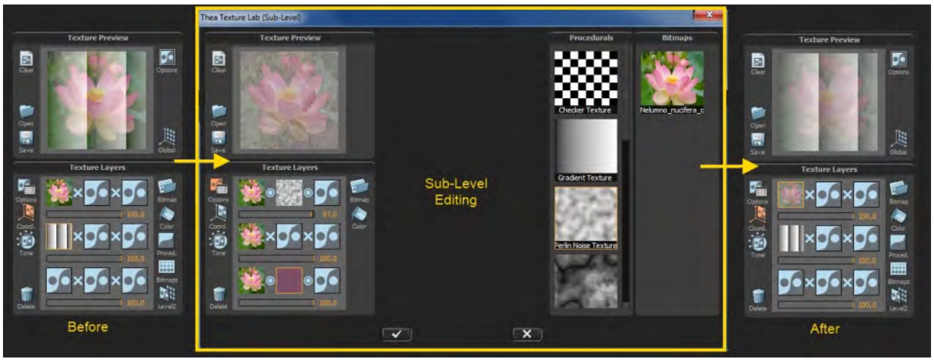


Figure 9-111: Editing a bitmap at Sub-Level Texture Lab

9.5 Properties Panel - Properties of Active Selection

9.5.1 Properties of Active Selection (Area J)

Figure 9-112: Properties of Active Selection Panel

The last panel that we see at the bottom of the Texture Lab (see it in Figure 9-112), is changing each time, according to the selected button from the previous panels, as we have already described.

So, we can see each time the following panel:

Texture Preview → Weighting Panel
Global → Global Operation Panel
Options → Bitmap or Procedural Options Panel
Coordinates → Coordinates Panel
Tone → Tone Mapping Panel
Bitmaps → Bitmaps Panel

Chapter 10: Environment Settings


Image by Sandro Sorce

10. Environment Settings

10.1 Introduction

As we have already mentioned the Settings panel consists of several important tabs. The second tab we see is the Environment (see it in Figure 10-1). The environment settings describe environmental lighting additional to any point and area light sources the user may define in his scene. Also, the global medium settings can be found here. As we see, we have three tabs: Sky, IBL and Medium, each one consisting of several options, which we analyze at this chapter.

Tip: as we have explained at the Browser chapter, we can save these settings as a new sky to re-use them later at another scene.

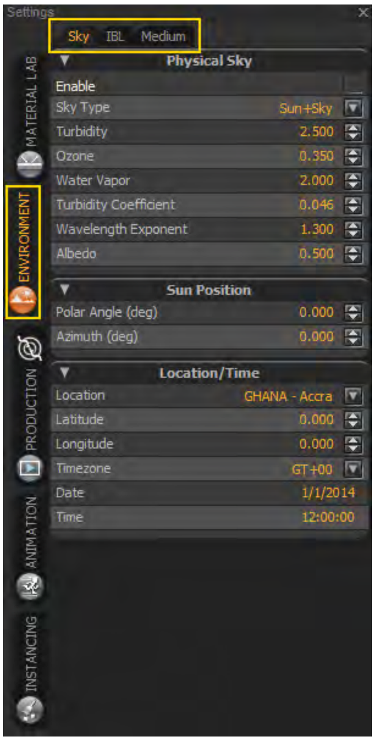


Figure 10-1: Environment and its tabs

10.2 Sky

Figure 10-2: Sky Panels

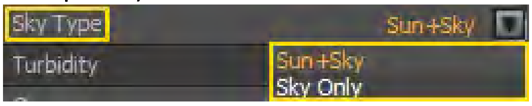
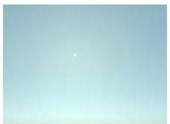
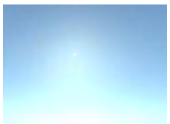
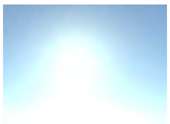
In Figure 10-2, we can see that the Sky tab consists of three panels which help user adjust the Sky and Sun in the Scene.

10.2.1 Physical Sky

Figure 10-3: Physical Sky Options

The physical sky settings contain all the parameters needed for setting the sky (see Figure 10-3). These options are physically-based parameters of the sky model used inside Thea Render.

Note that whenever the user enables the physical sky there are two more actions transparently taking place; first, image-based lighting (IBL) is disabled and second, sun is also generated (this can be seen in your scene Tree view under point lights).

Enable	By enabling the physical sun on our scene, a sun is generated and IBL is disabled.
Sky Type	From this drop-down list user can select to have both Sun and Sky enabled in the scene or just the Sky (see Figure 10-4). By selecting the Sky Only option, sun is automatically disabled (you can see the flag icon at the Tree View tab of the Scene panel).  Figure 10-4: Sky Type Selection
Turbidity	Turbidity is a term used to describe the scattering of the atmosphere that is caused by haze. The term haze refers to an atmosphere that scatters more than molecules alone, but less than fog. Haze is often referred to as a haze aerosol because the extra scattering is due to particles suspended in the molecular gas. Because the haze particles typically scatter more uniformly than molecules for all wavelengths, haze causes a whitening of the sky. The actual particles come from many sources such as volcanic eruptions, forest fires, cosmic bombardment, the oceans etc. A default value of this parameter is 2.5 as seen in Figure 10-6. Values should be kept under 10 for realistic results.
	 Figure 10-5: Turbidity set to 0.5  Figure 10-6: Turbidity set to 2.5  Figure 10-7: Turbidity set to 3.5  Figure 10-8: Turbidity set to 6.0 Figure 10-9: Turbidity set to 8.0
Ozone	This parameter defines the amount of ozone gas in the atmosphere. The standard way to determine the amount of total ozone is by measuring the amount of ozone gas in a column of air and is expressed in Dobson units. One Dobson unit indicates 0.01 millimeter thickness of ozone gas in a column. The default value in Thea is 0.350 cm. Higher values give the sky and the scene a blue color.
Water Vapor	User can define here the amount of water vapor in the atmosphere. In the same way as ozone, it is measured in centimeters. Default value is set to 2.0.
Turbidity Coefficient	Turbidity coefficient is the power for exponential transmittance for atmospheric aerosol.
Wavelength Exponent	At this point the wavelength exponent can be defined. The default value is set to 1.3. This number shows the average size of the particles in the atmosphere.
Albedo	Albedo option can influence the overall appearance of the sky. High albedo values can occur for example in winter scenes by the snow reflectance while small values occur at environment with grass. Especially in cases with high turbidity settings, changing the albedo value changes the overall brightness of the sky.

10.2.2 Sun Position

Figure 10-10: Sun Position Options

As we see in Figure 10-10, at this panel we can define the parameters for sun position. These are the degrees of Polar angle and the degrees of Azimuth.
Note that these values are changing every time you move your sun in the Viewport and when another location/time is chosen.

Polar Angle (deg)	This parameter defines the angle between the sun and the z-axis. Polar angle gets values from 0 (sun is perpendicular to the horizontal plane as at noon) to 90 (sun is parallel to the horizontal plane as during sunset or sunrise).
Azimuth (deg)	This parameter defines the angle measured from the x-axis in the xy-plane and gets values between -180 and 180 degrees. In the next figures we see our sun position by changing these values.

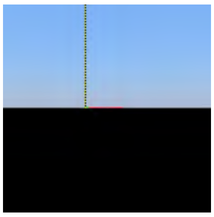


Figure 10-11: Polar angle: 0 Azimuth: 0

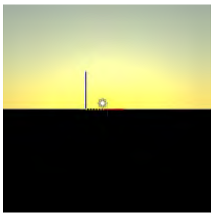


Figure 10-12: Polar angle: 90 Azimuth: 0

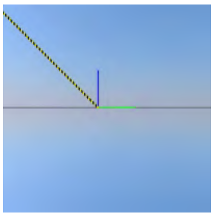


Figure 10-13: Polar angle: 45 Azimuth: -180

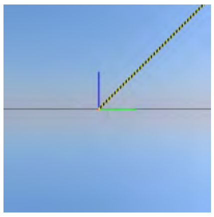


Figure 10-14: Polar angle: 45 Azimuth: 0

10.2.3 Location/Time

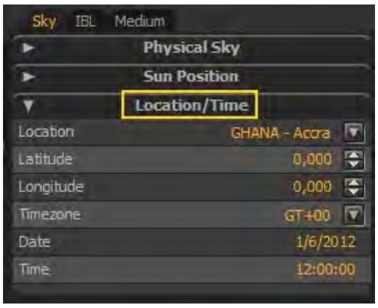


Figure 10-15: Location/Time Parameters

At this panel, with the location and time, we can specify the exact details of our scene environment: its location and the time.

Location	By pressing the arrow button, a drop down list appears with a list of several countries and big cities, for choosing the one you want. You can add more cities if you wish by editing the Locations.txt file at Thea Data folder.
Latitude	Latitude is a geographic coordinate that specifies the north-south position of a point on the Earth surface. Latitude is an angle which ranges from 0° at the Equator to 90° (North or South) at the poles.
Longitude	Longitude is the geographic coordinate that specifies the east-west position

	of a point on the Earth's surface. The longitude is measured as an angle east or west from the Prime Meridian, ranging from 0° at the Prime Meridian to +180° eastward and −180° westward.
Timezone	By the dropdown list that appears here, you can set the GT (Global Time) offset (from GT-12 to GT+12).
Date	At tis editable area, you can specify the day, the month and the year. The input should be dd/mm/yyyy.
Time	At this last parameter, you can define the exact time of your scene sky.

10.3 IBL

Figure 10-16: IBL tab

Image-based lighting (IBL) is a convenient way to add illumination to your scene, coming from captured photos of the surrounding environment. Since a photo of a real scene can be used, the lighting is highly convincing and enhances the realism of your renders. In most cases, the images used for this kind of lighting need to be of high dynamic range (hdr) in order to provide enough lighting for a scene.

As we will see at the next tables, in the IBL panel, we can use an image for illuminating the scene but we can also setup different images for background, reflections and refractions. This makes possible to use different source for lighting and for reflections/background, which in most cases adds more detail in the image. This is actually a usual render optimization, where the illumination source is relatively low-detailed texture in order for the image to quickly converge, while background and reflections use a detailed map for visually enhanced results.

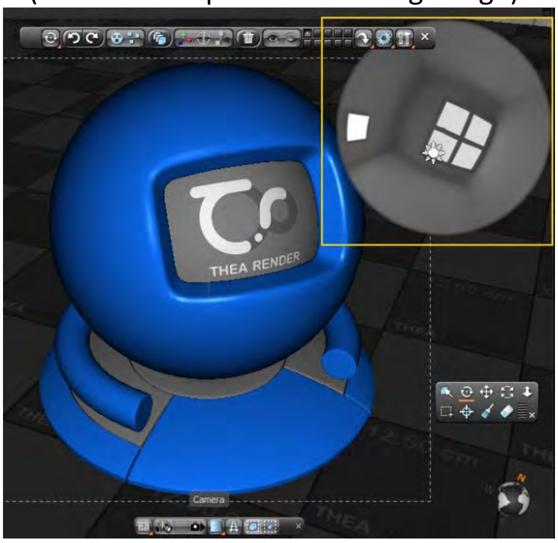
10.3.1 Image Based Lighting

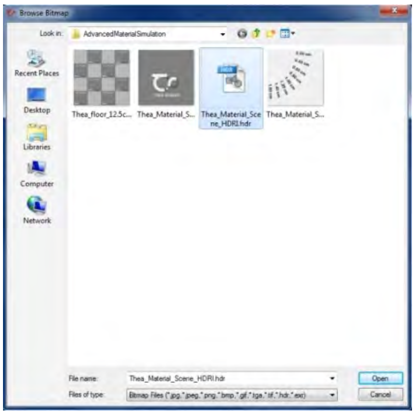
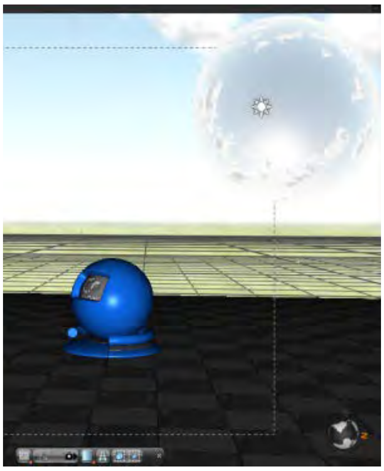
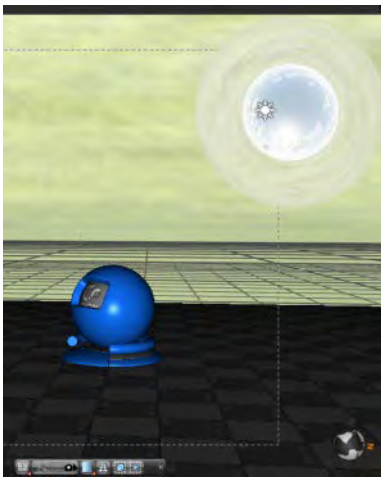
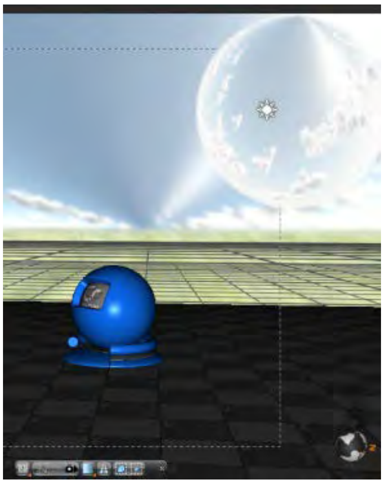
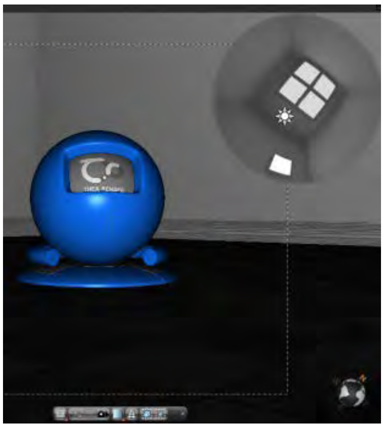
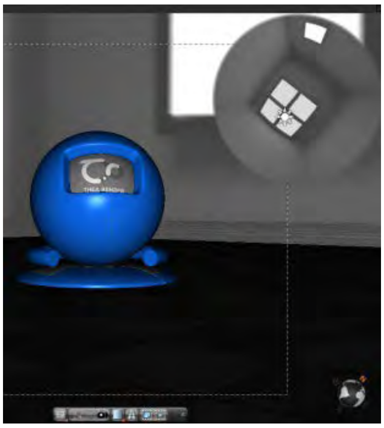
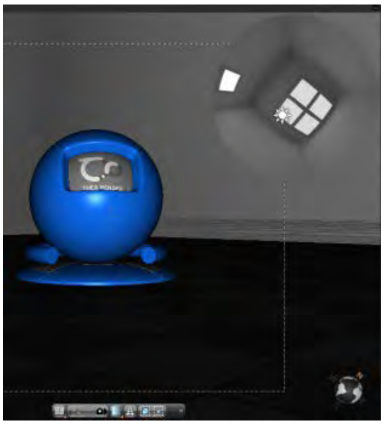
As we have said, at this panel, we can add an image for the illumination of the scene.
Note that once we add an image here (by clicking on the folder icon) and enable this feature, if we had a sun in the scene it is automatically disabled.

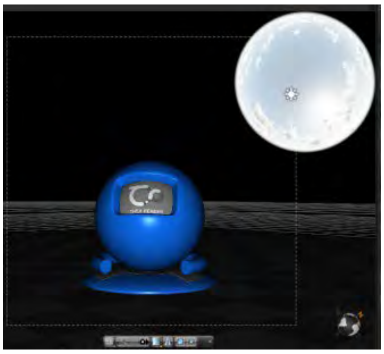
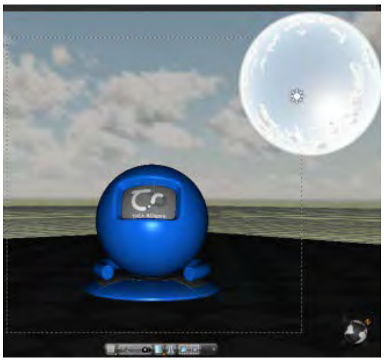
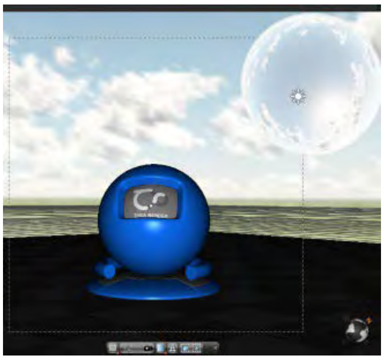
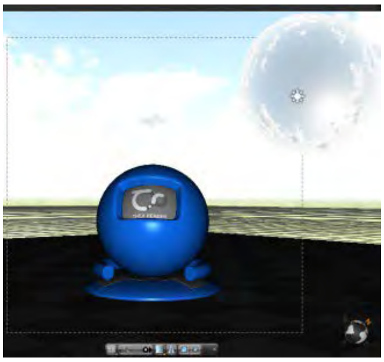
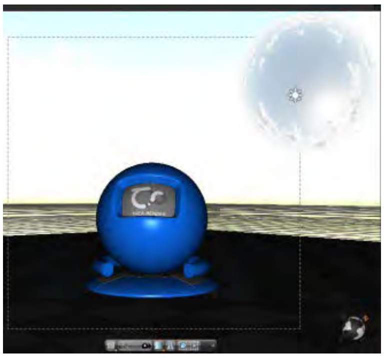
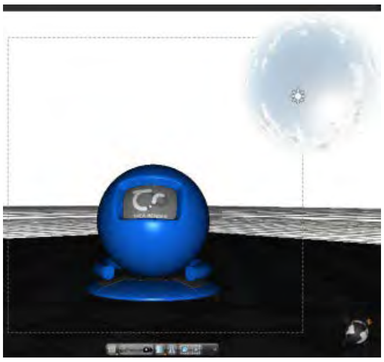
Tip: by doing a right click on the names of the options, you can see a drop down list for Copy, Paste, Delete or Revert the selections.

Figure 10-17: Image Based Lighting Options

As we see in Figure 10-18, when we enable the image based illumination for the scene, the preview of the sky we see at the top right of the Viewport (once we select the sun at the Tree View list), is now presenting the preview of the inserted image and the relevant position of the sun to it.
At the next table, we see what each of the available options of IBL panel do.

Enable	As we said, by choosing to enable Image Based Lighting, the sun of the scene is disabled and illumination is based on the image that is added at the next option.
IBL Type	The options available here let the user decide to have either Image Based Lighting in the scene or add additionally a Sun. By clicking on the sun (at the Tree View List) we can see the preview of the inserted image and its relative position to the sun (see for example the following image).  Figure 10-18: Enabling IBL and a sun for a scene

<table>
<tr><td>Filename</td><td>Here you can specify the image you want to use for illumination. You can press on the blue folder and a “Browse Bitmap” window opens, as seen in the next figure.
The available file types are: *.jpg, *.jpeg, *.png, *.bmp, *.gif, *.tga, *.tif, *.hdr and *.exr.</td><td>
Figure 10-19: Browse Bitmap for IBL</td></tr>
<tr><td>Wrapping</td><td colspan="2">From this Drop-Down list, user can select the wrapping of the inserted image. It can be Spherical, Hemispherical or Angular Probe.
Below we see these three cases for the same image.</td></tr>
<tr><td>
Figure 10-20: Spherical Wrapping</td><td>
Figure 10-21: Hemispherical Wrapping</td><td>
Figure 10-22: Angular Pole Wrapping</td></tr>
<tr><td>Rotation (deg)</td><td colspan="2">Apart from specifying the wrapping of the image, we can also set its rotation, so that according to the camera view we want, have the desired illumination, or align the sun of the image with the sun of our scene.
At the examples images below, we have rotated the image and see the way it changes according to our view frame. By increasing the rotation degrees the image is rotated anti-clockwise (in the preview circle).</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td>Figure 10-23: Image is not rotated (0 degrees)</td><td>Figure 10-24: Image is now rotated by 180 degrees - we see that the background window is visible</td><td>Figure 10-25: Image is rotated by 270 degrees.</td></tr>
<tr><td>Intensity</td><td colspan="2">The last parameter that we can edit for an inserted image is its intensity. We can see some examples at the next figures. We see that for increasing the Intensity of the map we increase its contribution to scene illumination, background, reflection and refraction.</td></tr>
<tr><td>
Figure 10-26: Zero Intensity considers that no point of the image is illuminating the scene</td><td>
Figure 10-27: By increasing Intensity to 0.250, the contribution of the image is higher</td><td>
Figure 10-28: Intensity is set to 0.500. Low values are used for generally very bright initial images.</td></tr>
<tr><td>
Figure 10-29: Intensity is at 0.750</td><td>
Figure 10-30: Intensity is at the default value 1.000</td><td>
Figure 10-31: Intensity is set to 2.000. Larger values are better to be used for initially darker images</td></tr>
</table>

10.3.2 Background Mapping

At the second panel that we see in Figure 10-32, we can specify the background mapping of our scene. This means that even if we have used already an image for illumination (which is also used as a background), we can now specify another one for background and overwrite the one that was used.
In the next figures we see some examples of these options.
Concerning the available options at this panel, we see that they are the same to IBL panel and perform the same actions as described before, by affecting this time this map only.

Figure 10-32: Background Mapping

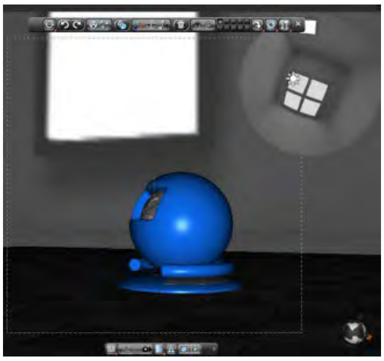


Figure 10-33: An image of a room is selected at the IBL tab, while no image for Background mapping is specified.

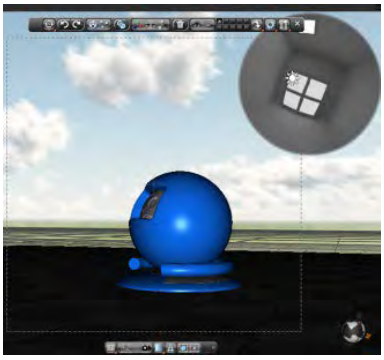


Figure 10-34: By adding an image of an exterior at the Background, we see that the new background is now visible

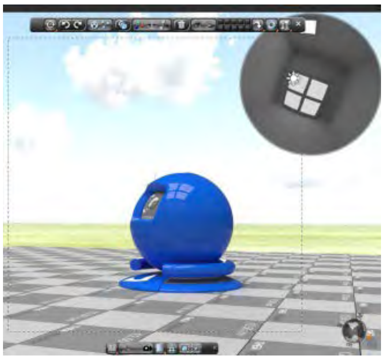


Figure 10-35: In the rendered image, the background is specified by the Background mapping image, while reflection and refraction are based on the IBL image.

10.3.3 Reflection Mapping

Figure 10-36: Reflection Mapping Options

At this point, as seen in Figure 10-36, user can specify the reflection mapping. If we do not enable this option, reflections are according to the map inserted at the IBL panel.

In the next examples, we see the way reflection changes if we insert a different image at this slot.

The rest options (Enable, Filename, Wrapping, Rotation and Intensity perform the same actions as described at the IBL panel, but they only affect the reflection map).

Note: for materials that their roughness is close to zero (or zero), the reflection is based totally on the Reflection Mapping. Though, for higher values, there is an interpolation between this image and the IBL image.

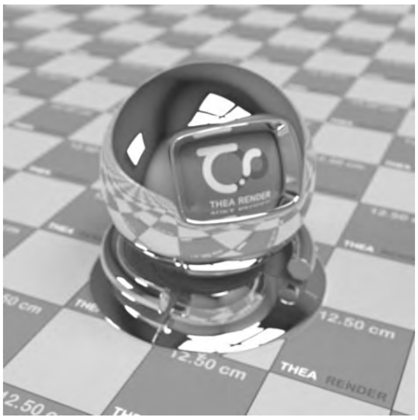


Figure 10-37: Reflections on the model (mirror material with roughness equal to zero) are specified by the room image of the IBL panel

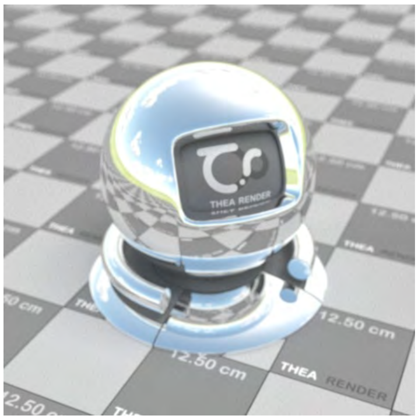


Figure 10-38: By enabling a new Reflection Mapping image, of a sky for example, the reflections on the model are according to the new image.

10.3.4 Refraction Mapping

Figure 10-39: Refraction Mapping Parameters

The exact same things that we described at the Reflection Mapping are valid for the Refraction Mapping panel.
In the next figures we see the way the refraction component of a material (e.g. clear glass) is following either the IBL image or the Refraction Mapping if the latter is enabled.

Figure 10-40: Refraction is based on the IBL image (room image).

Figure 10-41: Refraction on the material is according to the Refraction Mapping image (sky).

10.4 Global Medium

Figure 10-42: Global Medium Settings

The third tab that we see at the Environment settings is the Global Medium panel. Global medium is the medium surrounding of the scene and the one that is used whenever there is a surface-light interaction. The index of refraction found here, is the index of refraction of the global space (more accurately the space where camera is inside). The rest of the parameters are the same like in the Medium properties (see Material Editor section in page 171).

Enable	Enable or disable the use of Global Medium.
Index of Refraction (n)	This index specifies the index of refraction of the global space of the scene.
Absorption Color	Absorption Color defines the transmittance color – this is actually the color visualized after a distance of 1 meter (assuming unit density and no scattering). When the distance is less than 1 meter, the color shifts towards white and when the distance gets bigger the transmittance shifts towards black. The color change along to distance is strongly nonlinear and thus it is recommended to avoid highly saturated colors.
Scatter Color	Scatter Color defines the scattering color – this is the color that bounced particles (in the medium) have. The sum of absorption and scatter color (multiplied by their corresponding densities) defines the extinction coefficient of a medium which is used to calculate the total absorption at a distance. The scatter color may be applied numerous times for particles that bounce inside the medium (especially for highly scattering medium) and so, it is also recommended here to avoid highly saturated colors.
Absorption Density	Absorption Density defines the density of absorption in 1/m units. The higher this density the higher the absorption. This option gives easy control to the magnitude of absorption and it is possible to set a procedural texture in order to define spatially varying absorption (heterogeneous medium).
Scatter Density	Scatter Density is the density of scattering in 1/m units. The higher this density the higher the scattering. This option gives easy control to the magnitude of scattering and it is possible to set a procedural texture in order to define spatially varying scattering (heterogeneous medium).
Coefficient File	Coefficient File: Absorption and Scatter colors can also be described by numerical data. The file that includes this data has similar format to the ior files (or .nk files as sometimes are mentioned) and you can enable this option and select the desired file from the list.
Phase Function	Phase Function: a phase function defines the variation of outgoing radiance over the sphere of directions and it is the medium analog of a bi-directional scattering distribution function (which is used for surface). The available functions are the Isotropic, Rayleigh, Mie Hazy, Mie Murky, Mie Retro or Henyey Greenstein (you can also set the asymmetry value below it). Most used phase functions are isotropic and Henyey-Greenstein.
Asymmetry	This parameter defines the asymmetry parameter of Henyey-Greenstein phase function. This parameter is unitless and takes values from –1 (totally back scattering) to 1 (totally front scattering). Obviously the extreme values of –1 and 1 do not actually scatter light outside the particle direction and they are not of practical use. A value of 0 is balanced scattering between back and forth directions and it is the same like using an isotropic phase function.

Chapter 11: Thea Render Engines

11. Thea Render Engines

11.1 Introduction

Thea Render is a physically-based global illumination renderer, uniquely featuring multiple state-of-the-art biased, unbiased and GPU photo-realistic render engines.
Although, one could say that a renderer featuring multiple render engines would only give average results, this is not true for Thea Render; all render engines are proprietary one with complex algorithms and techniques, developed in house, surpassing other renderers in each category (unbiased and biased). Even more, the availability of these engines under the same framework, makes the transition between ultra-high quality still images (typically using unbiased engine) and quality animations (typically using biased engine), completely transparent, since the materials and lighting stay the same and no "heuristic" conversion of any kind is required.
At the next table we see the existing engines, their category and the mode in which they can be used (Interactive/Production).

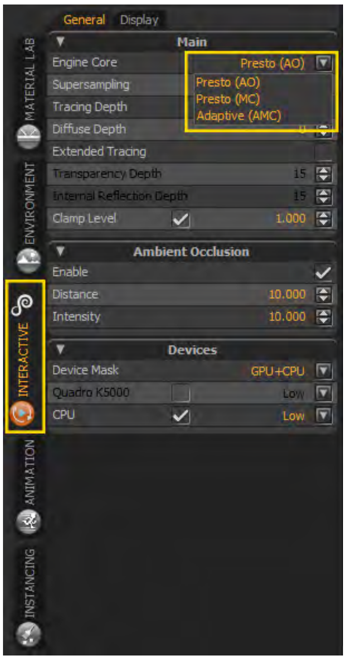


Figure 11-1: Interactive Mode

Engine	Mode
Adaptive (BSD)	Production
Unbiased TR1	Production
Unbiased TR2	
Adaptive (AMC)	Interactive and Production
Presto (AO)	Interactive and Production
Presto (MC)	

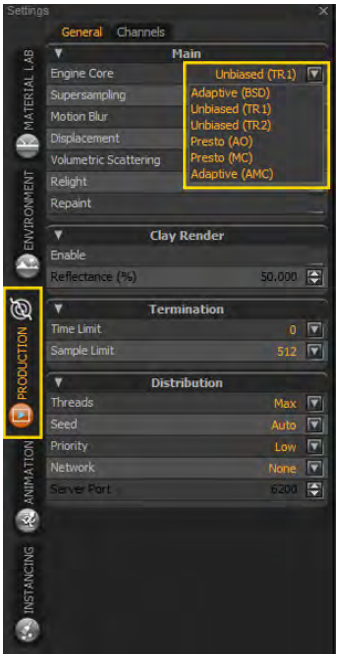


Figure 11-2: Production Mode

At the Settings panel, just after the Material Lab and Environment tabs, we see the tab that hosts all needed settings for render engines (see Figure 11-1 and Figure 11-2).
For seeing the settings of each engine, it is just needed to be selected from the list.

During Viewport navigation this tab shows the Interactive Render engines and their settings while at Darkroom, the Production ones are seen. By double clicking on the tab you can switch between the two modes.

Note: Progressive (AO) and Progressive (MC) will not be directly available after edition 1.4. Due to the rise of Presto (AO) and Presto (MC), which is the analog of Progressive (AO) and Progressive (MC), these engines have been removed from the main engine selection list - for better clarity and less future maintenance work. One will still be able to use them through presets though.

Note 1: by having a quick look at the next figures, we notice several settings which are common between engines, such as channels, distribution, motion blur etc. These options are **common** between the engines and once a change is made at one engine, it is automatically applied to the other engine corresponding option.

Note 2: in the next figures, the settings available correspond to the normal user mode. At the preferences window, you can switch to the **Advanced User Mode** and you will then see more options at the render settings. All these options are described in more detail at the following chapters.

11.2 Main characteristics

At the following tables we see briefly some main characteristics of each category and their available engines.
At the following chapters we have categorized the engines in three main categories: Biased, Unbiased and Presto.

11.2.1 Biased Engine (Adaptive BSD)

The Adaptive BSD biased engine, based on field mapping and final gathering techniques, gives to the user the absolute control of what features should be rendered (at the expense of setup time).
When it comes to high-quality fast photorealistic rendering or walkthrough animations, the biased engine is the real deal.
This engine can be used for Production Mode only so it can be seen at Production Engine Core list.
Biased engine and its settings are described in detail at Chapter 12.

Figure 11-3: Biased Engine Settings

11.2.2 Unbiased Engine (TR1/TR2)

With the term "unbiased" we mean that rendering, seen as a simulation process, converges always to the ground truth, computing all ways of lighting transfer without any artifacts. Unbiased TR1 or TR2 can be selected from the Engine Core list of the Production panel (see Figure 11-4).

The unbiased engines have essentially no parameters, thus rendering can start right away without worrying about render setup. Unbiased engine TR1 should be preferred in exterior renders and interiors where direct lighting is the most dominant in the scene while unbiased engine TR2 should be preferred in cases of ultra-difficult lighting. In practice, TR1 can handle very difficult indirect lighting scenes and even "sun pool caustics", thus TR2 should be actually used in extremely difficult light transfer situations (like in the case of caustics lighting a scene).

Unbiased engines are analytically described in Chapter 13.

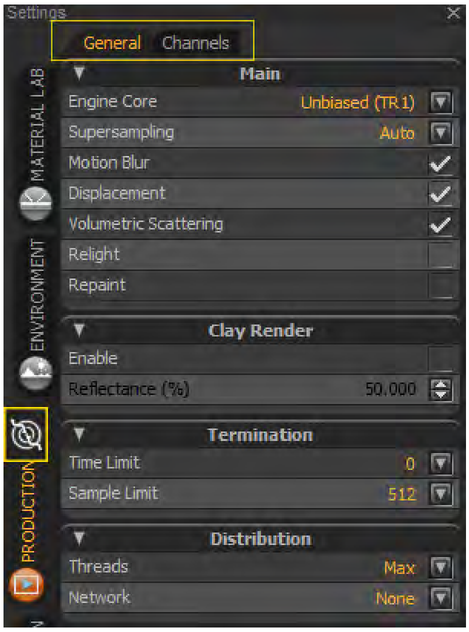


Figure 11-4: Unbiased Engine Settings

11.2.3 Presto

Presto engine runs on both the GPU+CPU and it can be used for Interactive and Production Rendering (see Figure 11-5). Presto comes with 2 different render modes, both progressive; one for very fast preview which accounts mostly for direct lighting and uses also ambient occlusion (Presto (AO)) and a second one, truly photorealistic, unbiased-like mode (Presto (MC)).

Presto engines and their settings are described in detail in Chapter 14.

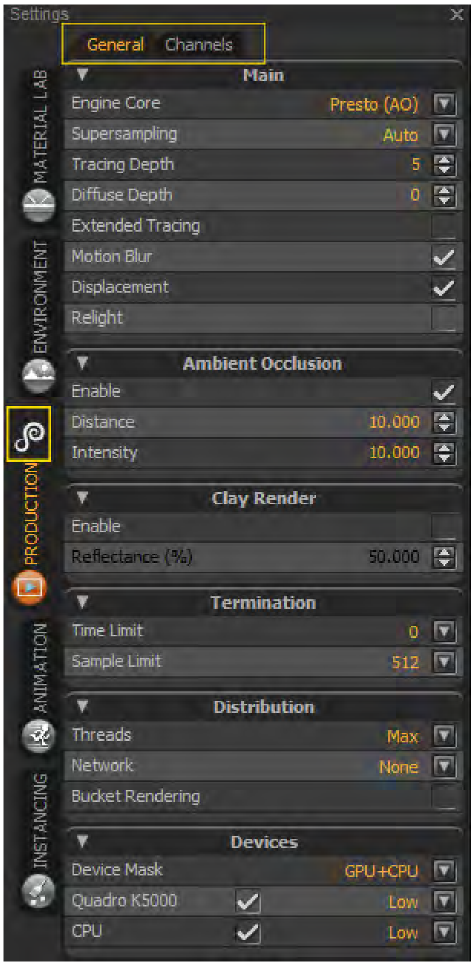


Figure 11-5: Presto Engine Settings

11.2.4 Other Progressive Engines – Adaptive (AMC)

As we have already mentioned, some extra Progressive engines exist:
Progressive (AO), Progressive (MC) and Adaptive (AMC), used for both Interactive and Production rendering.
These engines are a separate category of progressive engines, which use the logic of an unbiased engine, but with some extra tuning which reduces render time but also adds a bias in the final result.
Progressive (AO) engine, is very simplified and does not take into account many settings, so it is very fast, although adds much noise (the use of Ambient occlusion which is enabled for this engine helps reducing this noise).
Progressive (MC) and Adaptive (AMC) let the user specify the tracing depth of the scene (in unbiased methods, this goes indefinitely).
Note: Progressive (AO) and Progressive (MC) have been deprecated after version 1.4 and are only available via the Presets.

The settings of Adaptive (AMC) engine can be seen in Figure 11-6.

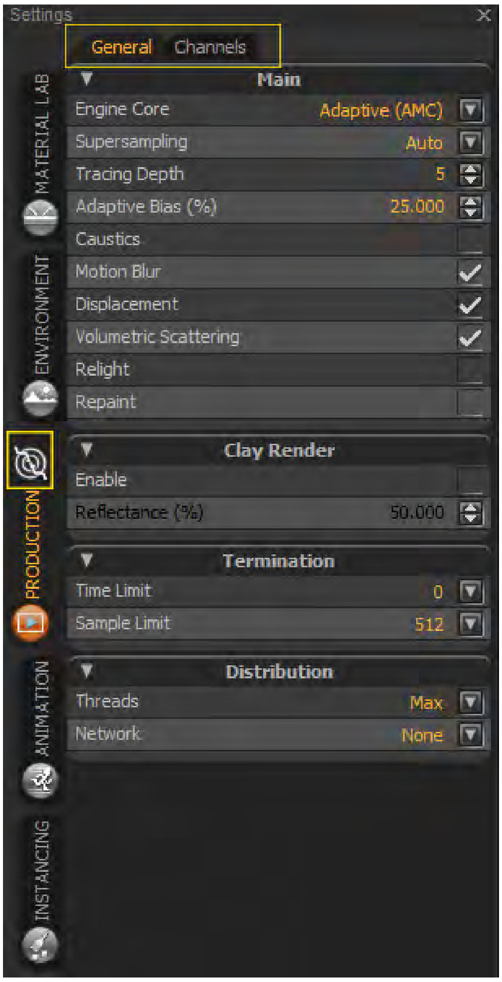


Figure 11-6: Adaptive (AMC) Production Mode Settings

THEA RENDER

phyisically-based unbiased, biased & gpu render engine

Chapter 12: Biased Engine

Image by Eduardo Câmara

12. Biased Engine

12.1 General

Adaptive BSD engine stands for the biased engine of Thea. The abbreviation "BSD" comes from the word "biased" and we use this term here as an identifier of this engine that uses interpolation schemes (like irradiance cache) to render in shorter times. The word "Adaptive" on the other hand means that we implemented the engine so that more effort is put where it is needed most. Furthermore, this effort is driven by perceptual criteria in order to arrive to a high quality result according to the human perception.
Biased engine settings consist of three tabs: General, Biased RT (Ray Tracing) and Biased GI (Global Illumination).

12.1.1 General Settings

Figure 12-1: Main, Clay Render and Distribution panels at the General tab of Biased engine settings

At the first tab, the General, we see the panels Main, Clay Render and Distribution, where some generic settings can be specified. Note once again that these settings (that are common to other engines as well) change for all engines. If you disable for example Motion Blur here, it will be disabled also at Unbiased and Presto panels too.

At the Main panel, you can see the biased engine (Adaptive BSD) selected from the Engine Core list and enable/disable the Motion Blur and Displacement.
Supersampling: this corresponds to the supersampling used for the image output, i.e. internal resolution multiplier for antialiasing enhancement. Value None corresponds to no supersampling at all, Normal to 2x2 and High to 3x3. Auto corresponds to no supersampling for the biased engine (it is by default disabled). Setting supersampling to a higher level will generally improve antialiasing of the output but will increase memory demands for storing the image (4 times in Normal level and 9 times in High level). The time needed to render the scene will also be increased for biased engine.
Motion blur (if enabled) will show up for all visible animated objects. The actual blur amount depends on camera shutter speed and animation properties of the objects.
By enabling Displacement, materials that have a displacement will be normally rendered; otherwise, they will be rendered as if they had no displacement.

At Clay Render panel user has the possibility to render a scene by the use of Clay Render. Before rendering you need to enable it here. By enabling this option, all materials in the scene will be rendered as diffuse gray, giving the final image a clay effect.
By changing the Reflectance percentage you can decrease/increase the diffuse material reflectance (from black to white).

At the Distribution panel we can specify the threads that will be used during rendering (not all applications process threads). Max corresponds to the maximum number of logical cores on your machine. Exceeding this value (shown explicitly as the last value in the drop-down list) will have no benefit and actually an impact on performance. Network parameter sets render engine in single workstation (None) or acting as Server, in network rendering.

12.1.2 Advanced User Mode Additional General Settings for Biased engine

Apart from the existing settings that we described, advanced users can find more settings for the biased engine. You need at first enable the Advanced user mode from the Preferences window.

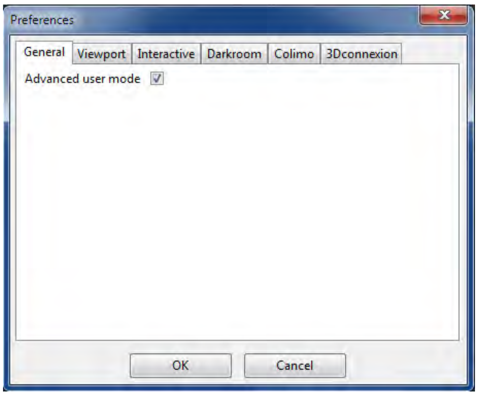


Figure 12-2: Enabling Advanced user mode

Figure 12-3: General panels in advanced user mode

As we see in Figure 12-3, when switching to Advanced user mode, some extra options appear at the Main and Distribution panels.

Seed: this parameter specifies the initial (input) number for the random numbers generator engine. User can edit this value by writing the wanted integer number, though is recommended to let this value to auto and let the engine choose the needed seed.

Priority: this parameter corresponds to the priority assigned to render threads by the operating system. Setting to Normal will make rendering faster, but it is not recommended when you plan to use the machine in parallel, or there are other somewhat demanding processes running.

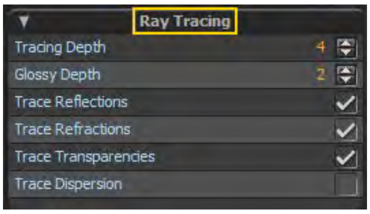
Server Port: this value corresponds to the server port used by the application during network rendering. It is recommended to leave it at the suggested value 6200.

12.1.3 Biased RT Settings

Figure 12-4: Biased RT panels

At this tab, we see all the panels that affect the Ray Tracing for the biased engine (for normal user mode).
At the next tables we give a detailed description of each panel and its options.

12.1.3.1 Ray Tracing

 Figure 12-5: Ray Tracing existing options	The ray tracing panel contains the basic parameters in order to trace reflecting and refracting objects and evaluate direct lighting. As we see in Figure 12-5, the Ray Tracing panel, consists of the following options.
Tracing Depth	This is the main parameter influencing tracing depth for biased engine. Increasing this parameter may be needed for certain cases where there are a lot of mirrors or dielectrics in the scene, but it has a direct impact on render time
Glossy Depth	This is a separate value to control tracing depth for blurred reflections/refractions. Keeping this value low will save evaluations on rough materials that in many cases contribute little to the overall image.
Trace Reflections	This parameter enables tracing of perfect reflections (glass reflection and glossy/coating zero roughness reflection).
Trace Refractions	This parameter enables tracing of perfect refractions (glossy/coating zero roughness refraction).
Trace Transparencies	This parameter enables tracing of glass and alpha mapping transparencies.
Trace Dispersion	This parameter enables dispersion for biased engine. Dispersion will raise render times considerably for the objects that exhibit this property, so having this option disabled for quick test renders is preferred.

12.1.3.2 Antialiasing

At this panel of the Biased RT tab, we see the available options for Antialiasing (see Figure 12-6).

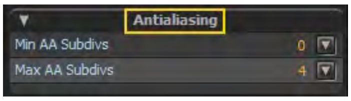


Figure 12-6: Antialiasing Options

Min AA Subdivs	This parameter sets the minimum subdivisions for the antialiasing process, i.e. it corresponds to minimum samples per pixel (in a power-of-two relation). Increasing this value increases render times directly, but it may be necessary in order to capture small details and thin lines.
Max AA Subdivs	This parameter sets the maximum subdivisions for the antialiasing process, i.e. it corresponds to maximum samples per pixel (in a power-of-two relation). These samples will be taken when contrast between neighbor pixels exceeds Max Contrast value.

12.1.3.3 Direct Lighting

Figure 12-7: Direct Lighting parameters

This parameter enables/disables the direct lighting component of the biased engine.

12.1.3.4 Blurred Reflections

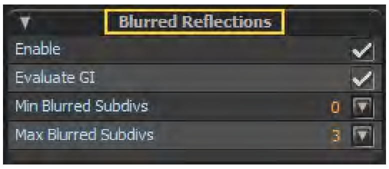


Figure 12-8: Blurred Reflections Options

As we also see in Figure 12-8, concerning Blurred Reflections, we have the following options:

Enable	If enabled, blurred reflections and refractions will be traced in the scene. The maximum tracing depth is set by the ray tracing Glossy Depth parameter.
Evaluate GI	This parameter defines if Global Illumination will be evaluated or not.
Min Blurred Subdivs (0-7)	This parameter controls the minimum number samples (in a power-of-two relation) taken on a blurred reflection/refraction.
Max Blurred Subdivs (0-7)	This parameter controls the maximum number samples (in a power-of-two relation) taken on a blurred reflection/refraction.

12.1.3.5 Ambient Occlusion

The next panel that we see at the Biased RT tab is the Ambient Occlusion panel with its available options seen in Figure 12-9. Note that setting affecting Ambient Occlusion are affecting this engine only.

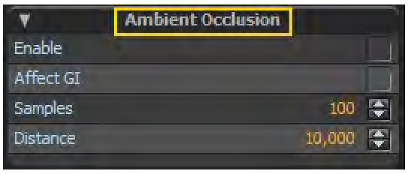


Figure 12-9: Ambient Occlusion Options

Enable	The first step is to enable/disable the Ambient Occlusion for biased engine.
Affect GI	If this parameter is enabled then the ambient occlusion result will be used as a damping factor (multiplied) for irradiance computation result. Otherwise, the two results will be added independently (this will lead to brighter images).
Samples	The stochastic samples taken on the hemisphere to estimate ambient occlusion. The more samples the better the accuracy but it will also take more time for the computation.
Distance	This is the maximum distance that the sample may be evaluated to an intermediate (gray) color. After that distance, the sample is evaluated to white color. Note that these colors can also be modified in advanced user settings but the default gray scale mimics better the global illumination effect.

12.1.4 Advanced User Mode Additional Biased RT Settings

Figure 12-10: Biased RT panels in advanced user mode

Here we see the way the Biased RT panel looks like for an advanced user. We can see a new panel to appear here: the Termination panel. Additionally, for the rest panels, some new options are also appearing.

At the Termination panel you can specify two termination criteria: the Russian roulette and termination Brightness.

Figure 12-11: Termination panel

Russian Roulette is used for terminating a ray faster in the expense of making the evaluation noisier. It is a necessary means though when dealing with high tracing depths (for example, when one needs to trace glasses and raises the tracing depth considerably). The value is the minimum depth where Russian Roulette will start to take effect.

Terminating Brightness: when the weight of a tracing ray is too low, we can use this parameter to prune it and gain render time. Please note though that sometimes even rays with low weights can bring in significant amount of lighting. In general, this parameter should be used with a quite low value to avoid any discontinuity artifacts.

Max Contrast percentage controls the antialiasing process fired on neighbor pixels based on their contrast. A very low value will trigger the process more often resulting in higher render times but improved quality.

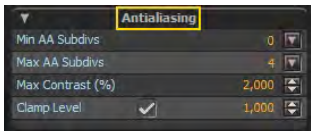


Figure 12-12: Antialiasing panel extra settings

Then we can enable/disable the Clamp Level. This parameter is used to clamp the evaluation of a pixel, improving antialiasing. The number corresponds to the clamping limit. Higher than 1, clamping becomes less effective for antialiasing while less than 1 it becomes more effective but also lowering the brightness of the image more aggressively.

At the Direct Lighting panel we have the following additional options: Adaptive sampling is preferred to be enabled to make automatically a balanced evaluation of all lights depending on their relative significance, keeping the evaluation noise at a minimum level and render times short.
Max Direct Error (%) parameter controls the evaluation error of the direct lighting component. In most cases, an error of 2% will produce high quality renders.

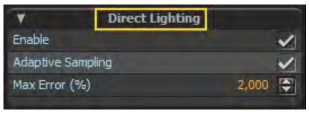


Figure 12-13: Direct Lighting panel extra settings

Some extra parameters for ambient Occlusion exist for advanced users that are described below.

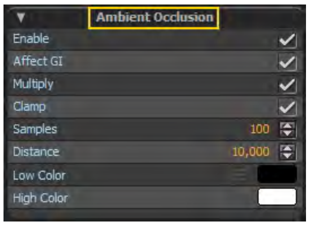


Figure 12-14: Ambient Occlusion panel extra settings

Ambient Multiply: if enabled, the ambient occlusion result will act as a damping factor for direct lighting, showing like a dirt effect (corners will be receiving less direct lighting).
Ambient Clamp: if enabled, then the distance for all rays will be clamped to the distance of the shortest ray. This will result in darker ambient occlusion (assuming gray scale colors).
Low / High Colors: these colors define the evaluation of an ambient occlusion ray based on the distance. A ray with zero distance will be evaluated to Low color; a ray with distance equal to or greater than Ambient Occlusion Distance will be evaluated to High color. Rays with intermediate distances will be evaluated with intermediate color.

12.1.5 Biased GI

Figure 12-15: Biased Global Illumination tab

The third tab that we see for the Biased engine is the Biased Global Illumination. As we see in Figure 12-15, it consists of four panels, which we are going to analyze at the next tables. For this tab too, there is the possibility to have more settings by enabling the Advanced user mode.

Tip: Please note the existence of open, save and lock cache icons for the Caustics and Irradiance Cache panels. These options give you the possibility to compute once these maps and reuse them again for the same scene. The lock and save commands should be issued after the initial computation of Field mapping or Irradiance Cache.

12.1.5.1 Field Mapping

Field mapping is a new proprietary technique that evaluates consistently the lighting than cannot reach easily the viewer. It is combined with Final Gathering to give high accuracy consistent irradiance evaluation.

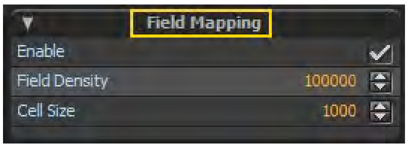


Figure 12-16: Field Mapping options

Enable	The first step is to enable/disable the Field Mapping.
Field Density	This parameter defines the resolution (cells) of the field map. The higher the value the higher the resolution of the map, leading to more detailed evaluation. A higher value is typically needed for big complex scenes but it also requires more memory. This value typically ranges from 100000 to 1000000 cells.
Cell Size	This parameter corresponds to the number of cells used for evaluation. Lowering this value can improve computations significantly, but too low values may result in artifacts particularly near corners. This value typically ranges between 1/100 and 1/1000 of the value used in field density (usually a value between 300 and 1000).

12.1.5.2 Caustics

Below the Field Mapping options, we see the available options for the Caustics (see Figure 12-17). Caustics are the photons that have been reflected or transmitted via at least one specular surface (like water or glass) before hitting a diffuse surface.

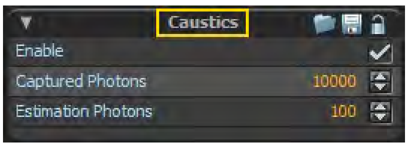


Figure 12-17: Caustics panel

Enable	This parameter enables or disables caustic photon maps. As we said, caustic photon maps are formed by light particles hitting diffuse surfaces after bouncing on a shiny reflector/refractor. These maps are directly visualized and should be populated by a lot of photons to yield an accurate visual result. Note that caustics can also be formed by final gathering; caustics estimated by field mapping are usually more accurate when the light source is small (or a point light) - on the other hand, final gathering can estimate much

	better caustics from large area lights or the sky.
Captured Photons	This parameter corresponds to caustic photons captured in the map by all emitters. Usually, caustics need to be quite detailed and this value should be as high as possible. To avoid excessive memory demands, user should also control the lights emitting caustic photons and surfaces capturing caustics, to keep them as few as possible.
Estimation Photons	This is the number of caustic photons used for irradiance estimation. The higher the value the more blurry the results. Note that increasing this value will also have an impact on render times.

12.1.5.3 Final Gathering

The third panel we see is the Final Gathering. At the non-advanced user mode it consists of the following parameters.

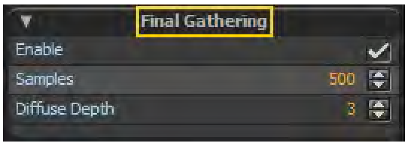


Figure 12-18: Final Gathering panel

Enable	Final gathering is another global illumination solution that can be used in conjunction with field mapping or alone. Using it along with field mapping is preferred whenever light is relatively easy to find its way to the scene; diffuse depth in that case may be very small (even only 1 leading to fastest results). In cases where lighting is easier to evaluate based on rays starting from the viewer, for example in sun-sky interiors, using final gathering alone should be preferred; in such a case, diffuse depth should be increased (to a value 3 or more).
Samples	These are the rays used for final gathering estimation. The higher the value the more accurate the results but it will take longer to trace them. Values are typically ranging from 100 to 1000, but it may be necessary to increase them whenever there is big lighting variation.
Diffuse Depth	This is the maximum diffuse bounces of the final gathering random walk.

12.1.5.4 Irradiance Cache

As we see in Figure 12-19, apart from enabling/disabling Irradiance Cache, some other parameters also exist. As we will see later, for advanced user mode, these options are even more.

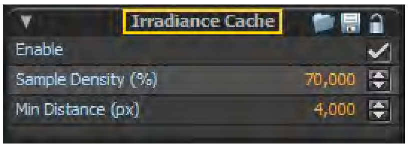


Figure 12-19: Irradiance Cache panel

Enable	Irradiance cache is a technique that is used almost always together with final gathering, in order to accelerate rendering. Irradiance samples computed by final gathering are reused based on a world-space interpolation scheme.
Sample Density (%)	This parameter corresponds to the density of irradiance samples taken on the image. The higher the denisty, the more the samples will be, resulting in a smoother irradiance interpolation over the image. Nevertheless, there is a trade-off here since more samples

	means also higher render times and more memory needed to keep them. Typical range for this value is between 70% and 90% - it is recommended to not go lower than 60% or higher than 95%.
Min Distance (px)	Irradiance cache density in world space is usually higher on curved or occluded objects (for example, near corners). This parameter influences the density of irradiance samples when visualized on the image plane. Setting a minimum distance (in px) will force reusing samples in nearby corners, without overpopulating irradiance cache in these places. Increasing this value too much though, will lead to light leaks since distant samples will be taken into account in potentially occluded areas.

12.1.6 Advanced User Mode Additional Biased GI Settings

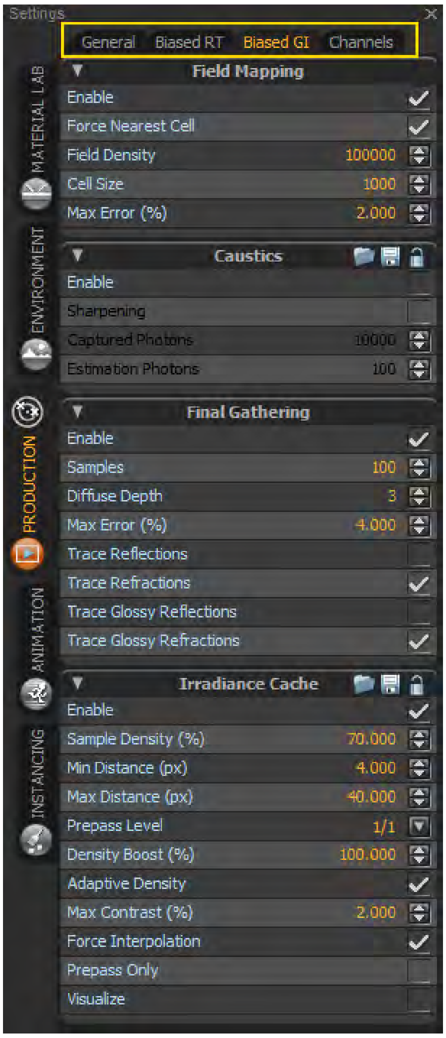


Figure 12-20: Biased GI panels in advanced user mode

Here we see the way the Biased GI panel looks like for an advanced user. As we see, for all the panels, many extra options exist. At the next tables, we see these panels once again, with the extra options being analyzed.

At first we locate some extra options at the Field Mapping panel.

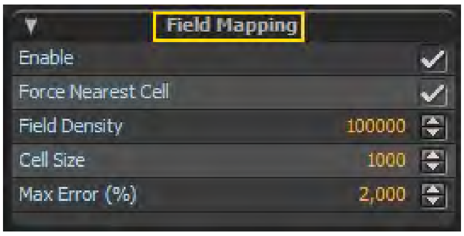


Figure 12-21: Field Mapping in advanced user mode

Force Nearest Cell: with this parameter the field map will be evaluated using the nearest cell found. This can improve computation times and, unless the field map is too sparse, should be enabled.

Max Error (%): this is the maximum error used during adaptive computation of the field map. The default value 2% should work fine in most cases.

Figure 12-22: Caustics in advanced user mode

Sharpening: this is a simple parameter to turn on sharpening filter on the caustics, leading to more pronounced caustic pattern edges.

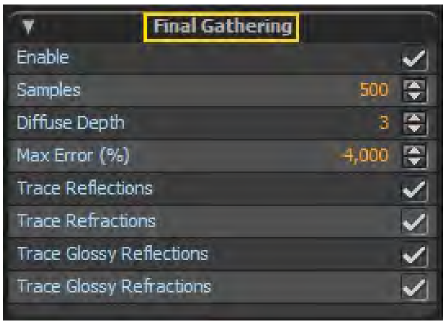


Figure 12-23: Final Gathering in advanced user mode

Max Error (%): this is the maximum error used during adaptive computation of the final gathering. The default value 4% should work fine in most cases.

Trace Reflections: allow or not to Final gathering to trace reflections.

Trace Refractions: allow or not to Final gathering to trace refractions.

Trace Glossy Reflections: this parameter enables evaluation of glossy reflections during final gathering walk.

Trace Glossy Refractions: this parameter enables evaluation of glossy refractions during final gathering walk.

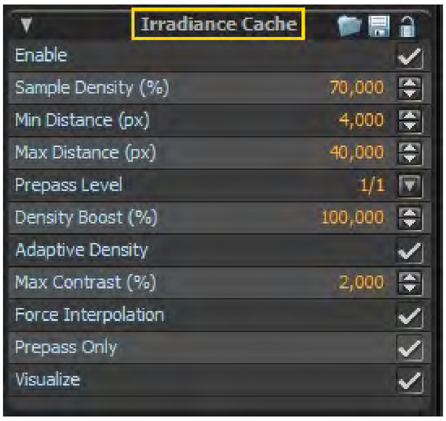


Figure 12-24: Irradiance cache in advanced user mode

Max Distance (px): irradiance cache density in world space is usually higher on curved or occluded objects (for example, near corners). It may be the case that in very flat areas, samples are very sparse. This parameter influences the density of irradiance samples when visualized on the image plane. Setting a maximum distance (in pixels) will force generating samples more often in flat areas, avoiding undersampling these places.

One problem with irradiance cache is that since it uses interpolation of samples generated on-the-fly, visible discontinuity artifacts may appear due to the problem that these samples can be used for interpolation only after they have been generated. To avoid these artifacts, a usual workaround is to make an irradiance pass on the scene before making the actual render. Thus, the irradiance samples will be already there, when interpolation will takes place. A value None in the prepass, will skip the irradiance pass; this may be handy when making test renders. Prepass values correspond to the resolution of the irradiance pass (1/1 correspond to every pixel, 1/2 to every two pixels, and so on). Values of 1/1 or 1/2 are recommended for final renders.

Density Boost (%): this parameter is used to increase the sample density during the irradiance precomputation pass. This way, during the final render pass, more samples can be used for interpolation resulting in smoother irradiance and better render. Typical range for this parameter is between 50% and 100%, although higher values than 100% may also be used.
Adaptive Density: this parameter when enabled will locally increase the sample density and is controlled by the maximum contrast percentage.
Max Contrast (%): this parameter corresponds to the maximum error when adaptively adding more samples to irradiance computation. Adaptive density should be enabled in this case; adaptive density will locally increase the sample density whenever the contrast is higher than this parameter. The default value 2% should work fine in most cases.
Force Interpolation: By enabling this parameter, no more final gathering samples will be taken during normal render pass, but the ones already in irradiance cache will be always forced to be used (even if interpolation error is higher than wanted accuracy). This parameter should never be enabled with prepass set to None, since this will lead to no irradiance samples at all used for interpolation (instead,

prepass values of 1/1 or 1/2 are recommended when this parameter is enabled). If disabled, samples may be added in irradiance cache even during normal render pass, which may slightly increase render times.
Prepass Only: This parameter can be used if only the irradiance computation pass is needed, without the final render pass.
Visualize: When enabled, the locations of final gathering samples (the samples that will populate irradiance cache) are visualized during irradiance pass. They are presented in red color, and user may get a quick idea of irradiance cache density in order to fine tune its control parameters.

12.1.7 Channels

The last tab for the Adaptive (BSD) engine is the Channels.
At the Channels panel, the list with all the available channels is presented, so that we are able to enable those that we want to be rendered (in addition to the default Color channel).

Figure 12-25: Irradiance Cache panel

THEA RENDER
phyisically-based unbiased, biased & gpu render engine

Chapter 13: Unbiased Engine


Image by Jakob Winter

13. Unbiased Engine

13.1 Unbiased Engine

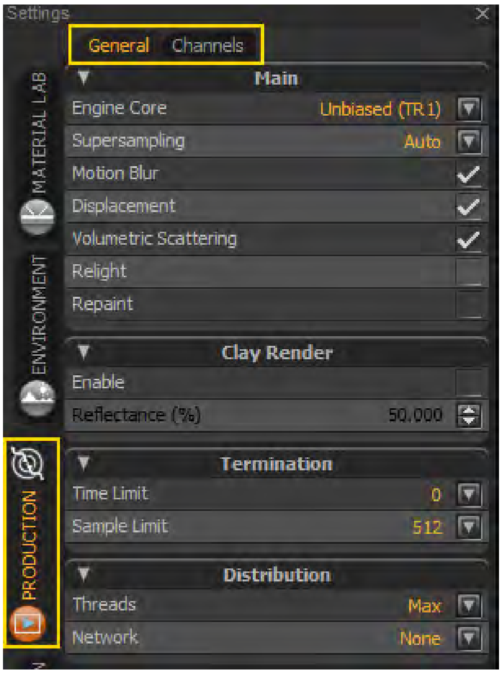


Figure 13-1: Unbiased engine tab

Unbiased engines are the render engines, that in comparison to biased ones, they introduce no bias in the computation. Unbiased rendering takes typically longer to finish since it really has to compute all amounts of lighting transfer with the benefit of more accurate results. The unbiased engines should be preferred when one seeks maximum accuracy with the least possible effort in tuning the render engine (actually none). In Thea there are two differently fine-tuned unbiased engines: TR1 and TR2. TR1 engine core should be preferred over TR2 for exteriors and general situations where direct lighting is dominant in the scene. TR2 should be preferred on the other hand for difficult indirect lighting situations, such as indirect caustics.
At the next tables we describe the existing options found at this tab along with the extra ones appearing in advanced user mode.

13.2 General tab for Unbiased engine

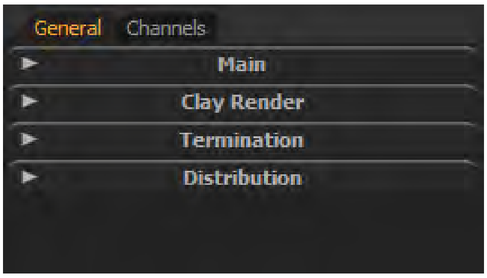


Figure 13-2: General panel

Unbiased rendering has typically only a few parameters to tune, something that makes setup easier. As we see we have four panels available here.

13.2.1 Main

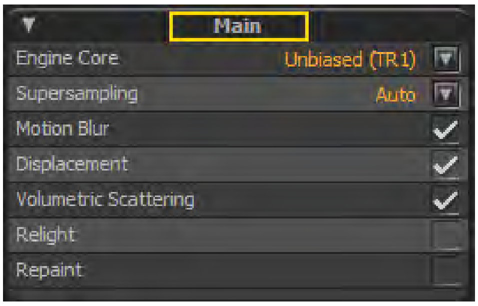


Figure 13-3: Unbiased engines main settings

At this point, we can select among the existing unbiased engines, TR1 and TR2, by clicking on the down-arrow icon (see Figure 13-3). As we have said, TR1 engine core should be preferred over TR2 for exteriors and general situations where direct lighting is dominant in the scene. TR2 should be preferred on the other hand for difficult indirect lighting situations, such as indirect caustics.

Supersampling: this (as we have already explained at biased engine settings) corresponds to the supersampling used for the image output, i.e. internal resolution multiplier for antialiasing enhancement. Value None corresponds to no supersampling at all, Normal to 2x2 and High to 3x3. Auto corresponds to 2x2 for unbiased engines. Setting supersampling to a higher level will generally improve antialiasing of the output but will increase memory demands for storing the image (4 times in Normal level and 9 times in High level). For the unbiased engines, the extra time needed to render the higher resolution image is usually amortized by the reduced noise visible in the visualized (downsampled) image. It is usually suggested, for unbiased rendering, to change supersampling to None for high resolution output and to High when there is persisting noise.

Motion Blur: if enabled, motion blur will show up for all visible animated objects. The actual blur amount depends on camera shutter speed and animation properties of the objects.

Displacement: by enabling this option, materials that have a displacement will be rendered by the unbiased engines normally, while if it is disabled they will not.

Volumetric Scattering: it corresponds to rendering participating media. If disabled, volumetric (Medium) and sub-surface (SSS) scattering won't be rendered by unbiased engines.

Relight: this parameter corresponds to rendering light groups in separate image buffers for relighting post-process. Due to the allocation of an image buffer per light, the number of lights has a direct impact on memory demands and rendering high resolution images with a lot of lights may require a lot of Gb Ram. Please note that clearing all image buffers separately takes more time than clearing one merged buffer, although this is easily amortized by reusing the render output in a relight animation.

Repaint: this parameter is useful once someone wants to use (after rendering) the Colimo application (by Motiva). By enabling this option, Thea Render can calculate the extra information needed for user selected materials during the course of a single render. For these materials you should be at first enable the Repaintable option that can be found at the Material Lab, at General Properties. The additional channels computed are exported as a single Colimo project with high quality of the original render being preserved. Then, by using Colimo, the color and texture of the pre-selected materials can be changed in real-time.

13.2.2 **Clay Render**

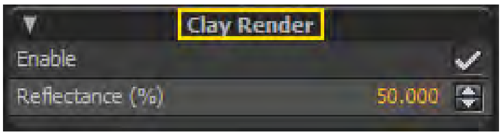


Figure 13-4: Termination settings for unbiased engines

At Clay Render panel user has the possibility to render a scene by the use of Clay Render. Before rendering you need to enable it here. By enabling this option, all materials in the scene will be rendered as diffuse gray, giving the final image a clay effect.

By changing the Reflectance percentage you can decrease/increase the diffuse material reflectance (from black to white).

13.2.3 Termination

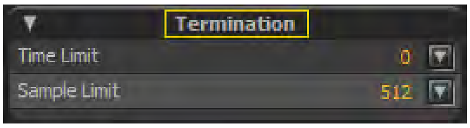


Figure 13-5: Termination settings for unbiased engines

As unbiased engines can be used to render for as time as is needed (user can manually stop the render once results are satisfying), some other ways also exist to define the time the rendering will stop.

Time Limit (min): this is a parameter used to terminate the unbiased render process by specifying the render time. It is given in minutes and 0 is a special value corresponding to no time limit at all.

Max Samples: this parameter too, is used to terminate the unbiased render by defining the maximum amount of samples. It is given in number of samples and 0 is a special value corresponding to no samples limit at all.

13.2.4 Distribution

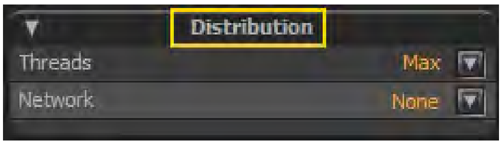


Figure 13-6: Distribution for unbiased engines

As we have also described for biased engine, distribution panel controls the maximum threads used during rendering and the network role.

Threads: they define the threads that will be used during rendering (not all applications process threads). Max corresponds to the maximum number of logical cores on your machine. Exceeding this value (shown explicitly as the last value in the drop-down list) will have no benefit and actually an impact on performance.

Network: this parameter sets render engine in single workstation (None) or acting as Server, in network rendering.

13.3 Advanced user mode additional settings for Unbiased engines

Figure 13-7: Unbiased engine settings for advanced users mode

As we see in Figure 13-7, when switching to Advanced user mode (from the Preferences window), some extra options appear at the Distribution panel, which we analyze here.

Seed: this parameter specifies the initial (input) number for the random numbers generator engine. User can edit this value by writing the wanted integer number, though is recommended to let this value to auto and let the engine choose the needed seed.

Priority: this parameter corresponds to the priority assigned to render threads by the operating system. Setting to Normal will make rendering faster, but it is not recommended when you plan to use the machine in parallel, or there are other somewhat demanding processes running.

Server Port: this value corresponds to the server port used by the application during network rendering. It is recommended to leave it at the suggested value 6200.

13.4 Channels

Figure 13-8: Channels for unbiased engines

The second tab for Unbiased engines is the Channels from where we can enable the channels we need to be rendered along with default, Color, channel. As we see in Figure 13-8, the available channels to choose from are: Normal, Position, UV, Depth, Alpha, Object Id, Material Id Mask and Inverted Mask channels.

Channels have been analytically described at the Darkroom Chapter.

phyisically-based unbiased, biased & gpu render engine

Chapter 14: Presto GPU+CPU

14. Presto GPU+CPU

14.1 GPU engine

Figure 14-1: Presto (AO) Settings for Production Mode

Thea Presto is a render engine that has been written bottom-up and is running on both GPU and CPU simultaneously, harvesting all your computer raw power. The engine has been especially tuned for fast interactive rendering and pushes GPU+CPU computing to the limits, while keeping the high photorealistic quality of Thea Render. Take a Tour and see benchmarks for Presto here.

Thea Presto is an engine that makes it possible to compare GPUs and CPUs under the same render framework with performance maxed out for both architectures, in a systematic way. It is a photorealistic render engine that supports many features (for a detailed list of supported features check the feature comparison table at Appendix, page 303). Presto is excellent for interactive purposes due to the fast refresh rate and it supports multiple graphic cards and CPU cores in both Interactive and Production modes.
Thea Presto is using every GPU (Nvidia CUDA architecture) and CPU (Intel's Embree library) core.

14.2 Presto Settings at Production Mode - General

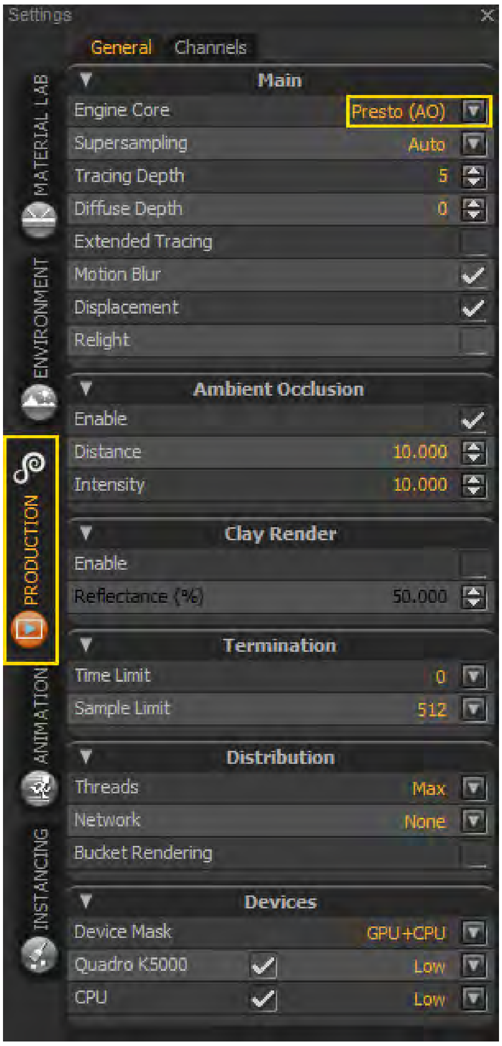


Figure 14-2: Presto (AO) Settings for Production Mode

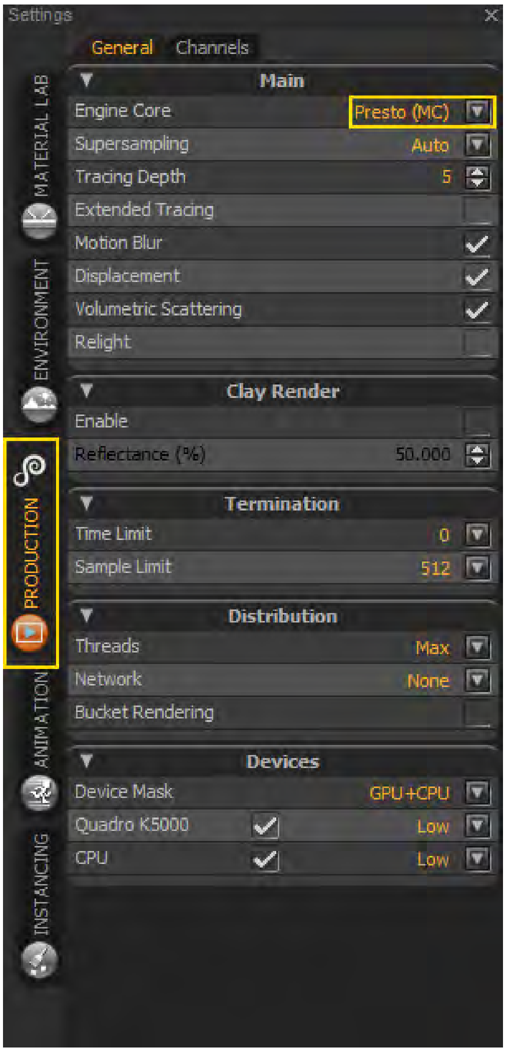


Figure 14-3: Presto (MC) Settings for Production Mode

As we already mentioned Presto engines can be used for both Interactive and Production rendering. For each case the needed settings appear at the Settings panel. Additionally, as we have two different Presto engines, according to our selection, different engine-specific settings also appear (see Figure 14-2 and Figure 14-3).

Presto (AO) makes use of ambient occlusion computation in order to mimic a part of global illumination. The diffuse and glossy depth can also be limited. All these result in a very fast interactive engine that, in many cases, can also be used for convincing final renders. It is very similar to Progressive (AO) engine running on the CPU.
Presto (MC) is an engine that performs unbiased-like computation of paths starting from the viewer with only the tracing depth as limiting factor. It will compute the right value for global illumination, although the result will be noisier than the BSD version and thus, will take longer to clear. It is very similar to Progressive (MC) engine running on the CPU.

Here we give some details over the existing settings (although some of them have been also covered to previous chapters).

Engine core: from the existing drop-down list, user can select at first the desired engine core for rendering. For our case, for using a Presto engine we can select among Presto (AO) and Presto (MC).

Supersampling: we have already explained supersampling at the previous engines. Supersampling is also set in Auto here.
For Presto engines, Auto corresponds to None Supersampling for Interactive Mode and 2x2 for Production mode.

Tracing Depth: it is an important parameter for Progressive engines. Increasing this parameter may be needed for certain cases where there are a lot of mirrors or dielectrics in the scene but it has a direct impact on render times.

Diffuse Depth: is a separate value to control tracing depth for diffused surfaces.

Extended Tracing: By enabling Extended Tracing Depth we can efficiently render scenes with transparent objects or materials with Subsurface Scattering, with lower Tracing Depth
values and better render times.

Motion Blur: if enabled will show up for all visible animated objects. The actual blur amount depends on camera shutter speed and animation properties of the objects.

Displacement: by enabling Displacement, materials that have a displacement will be normally rendered; otherwise, they will be rendered as if they had no displacement.

Relight: this parameter corresponds to rendering light groups in separate image buffers for relighting post-process. Due to the allocation of an image buffer per light, the number of lights has a direct impact on memory demands and rendering high resolution images with a lot of lights may require a lot of Gb Ram. Please note that clearing all image buffers separately takes more time than clearing one merged buffer, although this is easily amortized by reusing the render output in a relight animation.

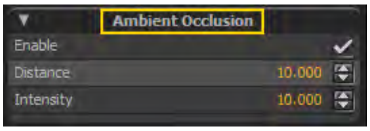


Figure 14-4: Ambient Occlusion for interactive engine

At this panel, user can enable/disable the Ambient Occlusion and specify the Distance and color/intensity for the Presto (AO) engine.
Distance: this is the maximum distance that the sample may be evaluated to an intermediate (gray) color. After that distance, the sample is evaluated to white color.
Intensity: this value defines the intensity of the Ambient Occlusion used.

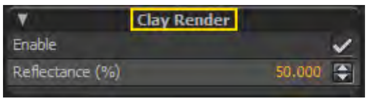


Figure 14-5: Termination settings for unbiased engines

At Clay Render panel user has the possibility to render a scene by the use of Clay Render. Before rendering you need to enable it here. By enabling this option, all materials in the scene will be rendered as diffuse gray, giving the final image a clay effect.
By changing the Reflectance percentage you can decrease/increase the diffuse material reflectance (from black to white).

14.2.1 Termination

Figure 14-6: Termination settings for unbiased engines

As Progressive engines can be used to render for as time as is needed (user can manually stop the render once results are satisfying), some other ways also exist to define the time the rendering will stop.

Time Limit (min): this is a parameter used to terminate the render process by specifying the render time. It is given in minutes and 0 is a special value corresponding to no time limit at all.
Sample Limit: this parameter too, is used to terminate the render by defining the maximum amount of samples. It is given in number of samples and 0 is a special value corresponding to no samples limit at all.

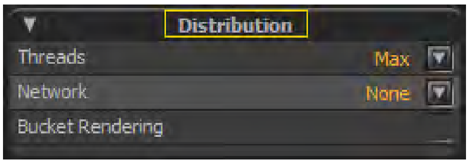


Figure 14-7: Distribution panel

Distribution panel controls the maximum threads used during rendering and the network role.

Threads: they define the threads that will be used during rendering (not all applications process threads). Max corresponds to the maximum number of logical cores on your machine. Exceeding this value (shown explicitly as the last value in the drop-down list) will have no benefit and actually an impact on performance.
Network: this parameter sets render engine in single workstation (None) or acting as Server, in network rendering.
Bucket Rendering: rendering high resolution images with multiple channels is usually an issue for GPUs but with the use of Bucket Rendering implementation, we are able to overcome this limiting factor and improve scalability as well.
Note: enabling Bucket Rendering option uses as Termination Criteria the Sample Limit.

Figure 14-8: Devices panel

At Devices panel user can select the Device Mask among the options GPU+CPU, GPU and CPU and in this way define if only GPU, CPU or both of these engines will be used for Darkroom rendering. By choosing the GPU+CPU options, all the cores from CUDA cards (GPU) and those from Intel Embree (CPU) will be used. Additionally. Below this menu the available devices of your machine can be seen and you can define Priorities for them.
CPU Threads allows the control of CPU logical core allocation for enhanced Thea Presto performance in both Interactive Render and Darkroom. Further to extensive tests performed on high-end workstations and servers where high number of CPU(s)/GPU(s) were available, this feature enabled optimal performance output from system resources. CPU Threads control mechanism is available when Advanced user mode option is enabled in Thea Render Studio.
For checking the available devices, assign priorities, enable/disable devices and see more details for them you can also open the Devices options from Customize menu (see next figure).

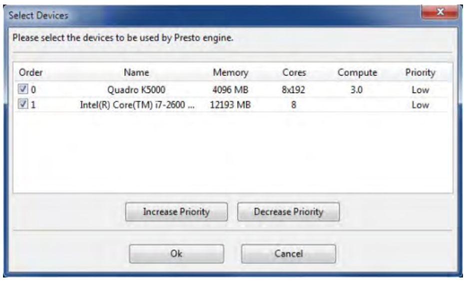


Figure 14-9: Select Devices window

Option	Description
Auto	Default mode. CPU Core control stratagem is handled automatically by Thea Presto.
Max (-1) (-2)	All logical CPU cores are utilized for maximum CPU performance output. User can opt to remove either one logical core (-1) or two logical cores (-2) from the logical core pool.
Max - GPUs (-1) (-2)	Total number of logical cores utilized equals to the maximum number of logical cores minus the number of actively selected GPUs. Additional logical cores can be deducted from the thread pool with (-1), (-2).
1 … x	Bottom section of the CPU Threads dropdown menu offers manual selection to the number of logical CPU cores used. This section is populated based on the type of CPU model available and values are populated according to the number of Cores/Threads available.

14.3 Presto Settings at Production Mode - Channels

Figure 14-10: Presto engine Channels

By switching to Channels tab a list with all available channels for Presto engines are presented. You can specify the channels you need to be rendered (before start rendering) and then find them listed at the Channels list of Darkroom.

Tip: for multiple channels and big scenes/resolutions, Bucket Rendering is an optimal solution for avoiding any memory issues.

14.4 Presto Settings at Production Mode – Advanced user mode

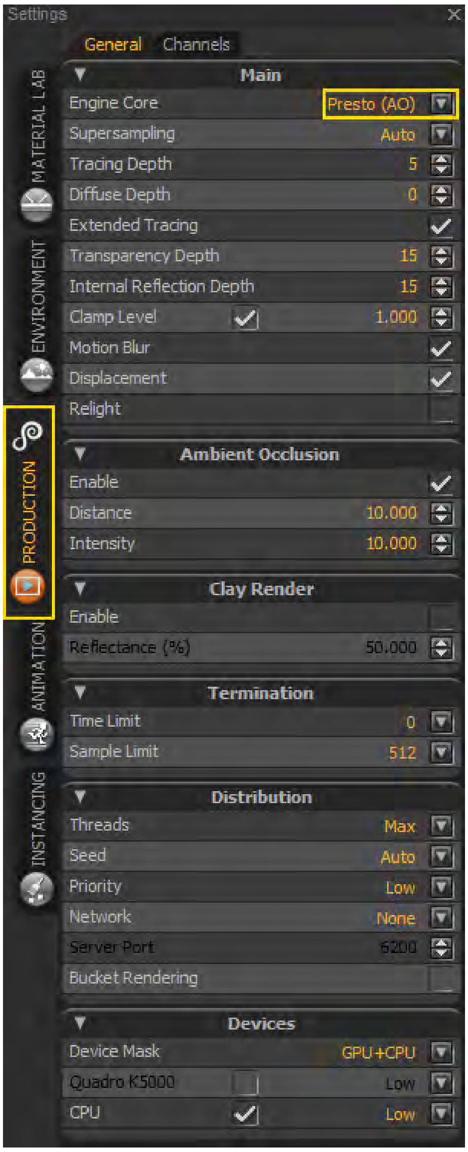


Figure 14-11: Presto (AO) Settings for Production Mode (Advanced User Settings)

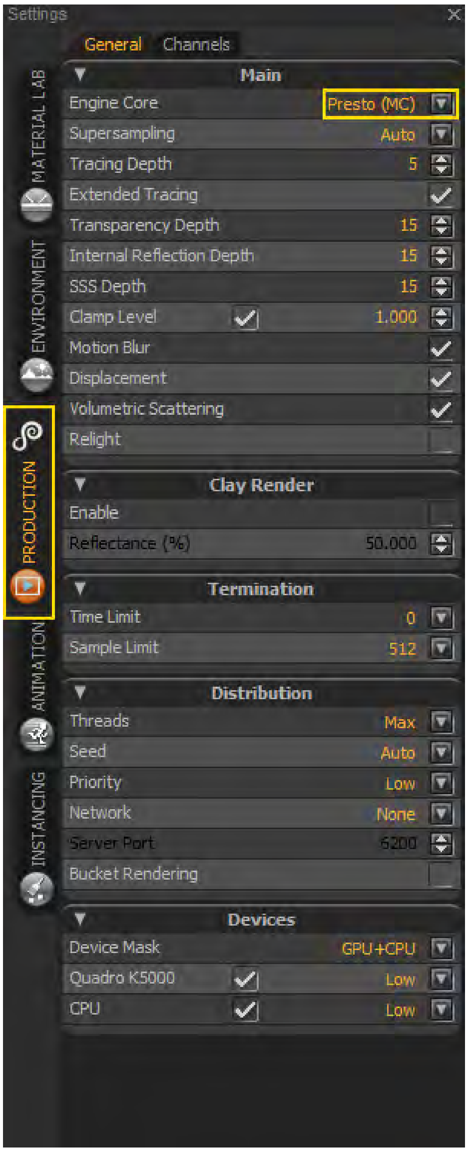


Figure 14-12: Presto (MC) Settings for Production Mode (Advanced User Settings)

Once again, by enabling the Advanced User Modesom extra settings appear at the Presto engines in Production Mode panels.

These are the following:

Transparency Depth: determines the Extended Tracing Depth for all transparent materials like Thin Film, Glossy Glass and Clip Map. It only affects transparency.

Map. It only affects transparency.

Internal Reflection Depth: Depth determines the Extended Tracing Depth for transparent materials that have refraction and total internal reflection. These materials are created with the use of Thea Glossy material (for example solid glass or water). If you notice that you get dark areas on solid glass, the cause is often because of too low Internal Reflection Depth and not due to the Transparency Depth.

SSS Depth (for Presto (MC)): determines the Extended Tracing Depth for Subsurface Scattering (SSS) materials. In some cases increasing this value is needed to increase the brightness of bright colored dense SSS materials.

Clamp Level: this parameter is used to clamp the evaluation of a pixel, improving antialiasing. The number corresponds to the clamping limit. Higher than 1, clamping becomes less effective for antialiasing while less than 1 it becomes more effective but also lowering the brightness of the image more aggressively.

Seed: this parameter specifies the initial (input) number for the random numbers generator engine. User can edit this value by writing the wanted integer number, though is recommended to let this value to auto and let the engine choose the needed seed.
Priority: this parameter corresponds to the priority assigned to render threads by the operating system. Setting to Normal will make rendering faster, but it is not recommended when you plan to use the machine in parallel, or there are other somewhat demanding processes running.
Server Port: this value corresponds to the server port used by the application during network rendering. It is recommended to leave it at the suggested value 6200.

14.5 Presto Settings at Interactive Mode - General

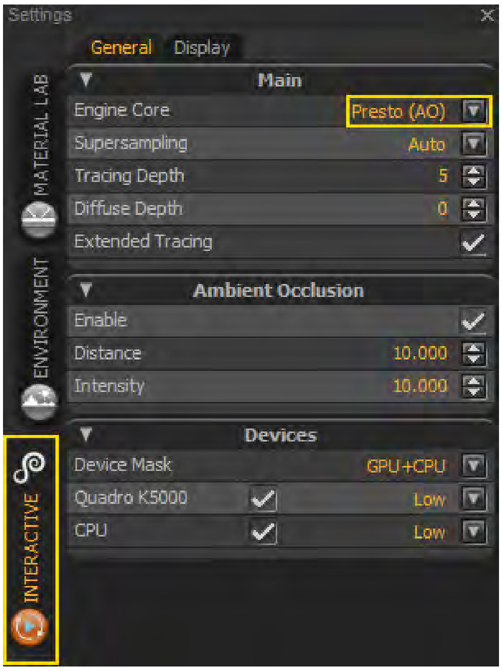


Figure 14-13: Presto (AO) Settings for Production Mode

Figure 14-14: Presto (MC) Settings for Production Mode

By switching to Viewport (or double click on engines tab) you can see the settings for Interactive Rendering. In Figure 14-3 and Figure 14-14 we see these settings for Presto (AO) and Presto (MC).
All of these settings have been covered to the Production Mode settings of the previous paragraphs.
Tip: during Interactive Rendering with Presto engines, you can see at the bottom left corner of the Vieport the info of the devices used (see Figure 14-15).

Figure 14-15: Display of Presto information during interactive render.

14.6 Presto Settings at Interactive Mode - Display

Figure 14-16: Display Settings for Presto engine

In the same way as for rest Interactive Render engines, the Display panel hosts all needed settings for the Display of the rendered image at the Viewport.
Display options are the same as seen in the Darkroom Display tab and changing one value at one panel affects the corresponding value at the other.

For analytical description of the Display Settings please check out the Darkroom Chapter.

14.7 Presto Settings at Interactive Mode – Advanced user mode

Figure 14-17: Presto (AO) Settings for Interactive Mode (Advanced User Settings)

Figure 14-18: Presto (MC) Settings for Interactive Mode (Advanced User Settings)

Once again, by enabling the Advanced User Mode some extra settings appear at the Presto engines in Interactive Mode panels, at General tab.
We have already explained these advanced settings at the Production mode of the previous paragraphs.
Note: For Supersampling, Auto corresponds to None Supersampling for Interactive Mode and 2x2 for Production mode.

14.8 Thea Presto Optimization Tips

14.8.1 Device not recognized

Presto GPU is currently based on Nvidia CUDA, which means that a compatible graphic card is needed to run it. In case an Nvidia card is available it should be listed to the Select Devices window. In case you are not able to see your card listed there please check the following:
- Make sure your Card is CUDA-Enabled. A list with all CUDA-Enabled cards can be found here. Note that NVidia Graphic cards of compute capability 1.x are not supported anymore due to shifting to CUDA 6.5, so you will need a card of compute capability 2.x, 3.x or 5.x.

- Check out to see if your NVidia graphics adapter has the latest reference drivers installed. If not please make the needed driver update.
(Presto GPU will need CUDA 6.5 compatible driver.)

14.8.2 Performance Issues - Run Presto at max effectiveness

In case Presto is not able to render a scene (black scene appears) or when an error appears, some devices customizations may be needed (these have not to do with the engine overall stability). Two factors that may need tweaking to optimize the Presto engine performance are the following:
- Altering the priority of your devices. In cases of heavy rendering jobs, lowering your devices priority is a workaround for making the device respond faster.

- Performance Improvement: Presto CPU should not be configured with Normal or High priority when Presto GPU is also enabled it order to achieve better synchronization and overall results.

- Configure Windows Watchdog (Windows only). Windows runs a service, called "watchdog" that monitors the graphic driver. If the driver does not respond within 2 seconds, it decides that there is a kind of instability so it terminates and restarts the driver process. The driver is the process responsible for handling all Presto commands to the GPU and - unfortunately - Presto is responsible for keeping the driver super-busy when there is a heavy rendering job.
You can actually configure watchdog service. And this is the recommendation to stay in the safe side, in all cases. In that situation, you can even set your device priorities to Highest (which means fastest Presto - at the expense of a less responsive graphic system).
Read here about watchdog service.
Recommendation: Do not disable watchdog driver completely, but set timeout between 30s and 1m.
Note: Disabling/Altering watchdog service is needed even for a graphic card that is not used for display.

- Power Supply and Ventilation. Presto should be used with proper hardware, this means proper PSU (Power Supply), cooling and ventilation. Please make sure that there is enough power supply for your card (you can see the hardware specifications for each card at Nvidia site) and that your machine has been configured appropriately. Adequate ventilation of the devices and chipset plays also a significant role, especially when both CPU and GPU are used for rendering.

- GUI Responsiveness. In case your machine is built with more than one graphic card it is recommended to use one of them (any card) for display and use the other (an Nvidia CUDA-Enabled card) for rendering. In this way the whole User Interface responsiveness will be better. In case a sole card exists, you can decrease the card priority at Thea Render Devices Selection window to achieve a more responsive graphic system.

THEA RENDER
phyisically-based unbiased, biased & gpu render engine

Chapter 15: Animation

15. Animation

15.1 Animation

Figure 15-1: Animation Panel

At the Settings panel, after the available engines, we can see the Animation tab, that help us use Thea for making animations. As we see in Figure 15-1, there are three panels with settings that let us specify the main features for making the animation.

This panel works together with the animation toolbar that we can find at the Viewport (see details in Chapter 3).

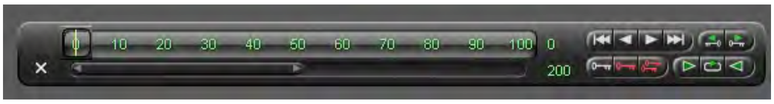


Figure 15-2: Animation Toolbar

15.1.1 Frames

Figure 15-3: Frames Parameters

At the Frames panel, user can define the basic parameters for making an animation and render it (see
Figure 15-3).

End Frame: this is the last frame that will be used during rendering an animation sequence and actually specifies the total frames of the animation.

Frame Rate: is the rate of frames per second for the animation sequence. It is used to compute the total time by the whole animation sequence (and taking number of frames into account).

Current Frame: you can see here at which frame you currently are (its number). It is the same as at the animation toolbar and changes as animation is played back.

Render Frames: you can select from the drop-down list the frames that need to be rendered (current, all or selected).

Selected Frames: enter here the exact frames to be rendered. This parameter will be used when Render Frames is set to Selected value. You can write for example: 3, 4-8, 12. The frames that will be finally rendered will be the 3, 4, 5, 6, 7, 8 and 12.

Network Cooperation: this parameter defines how cooperative rendering will take place for an animation being rendered over the network. There are two options; Frame, which is the default one, means that each node will take care of a whole frame on its own. Bucket|Pixel option means that all nodes will work and contribute on the same frame. When the power of the machines is relatively the same or the render time per frame is relatively quick compared to transferring results and data over the network, Frame cooperation is ideal. Bucket|Pixel option is recommended only for shorter sequences with longer render times per frame.

15.1.2 Walkthrough

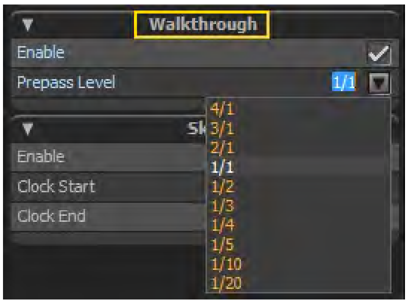


Figure 15-4: Walkthrough Animation

At this panel you can edit the necessary settings for making a walkthrough animation. If you have used a camera to move around your scene and no other animations is active, you can enable walkthrough animation for locking irradiance cache and make render times faster.

Prepass Level: from this drop-down list you can specify the desired Prepass Level for the walkthrough animation, meaning the irradiance computation per frame. For many computations per frame (4/1 for example) times are bigger but final result is smoother. As we go down the list (after 1/1) we can skip the irradiance computations for some frames and decrease render times.

15.1.3 Sky

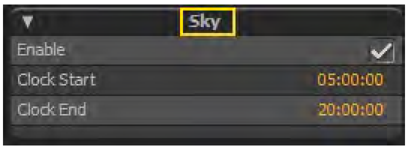


Figure 15-5: Sky Options

At this panel you can enable/disable Sky animation. You may have an animated object moving around your scene and with this option you can change the sun position the same time. But you can also use this option to render a scene without any other animation, but just the sun moving.

Enable: by choosing to enable this option, you can make an animation where sun position will change.

Clock Start: here you can define the time of the day that will be at the first frame.

Clock End: here you specify the time of the day that will correspond to the last frame of the animation.

Chapter 16: Instancing

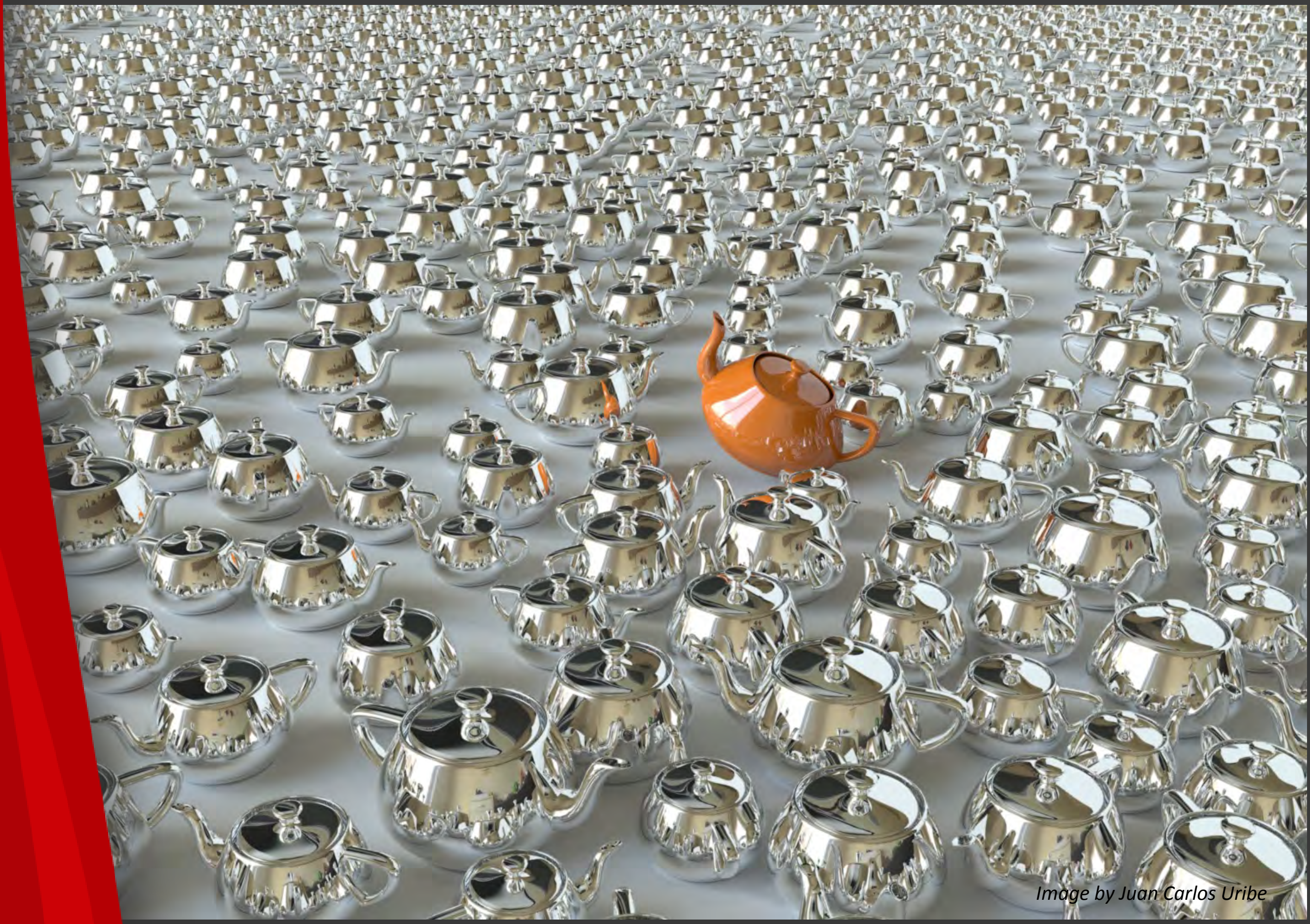


Image by Juan Carlos Uribe

16. Instancing

16.1 Introduction

In computer graphics, geometry instancing is the practice of rendering multiple copies of the same object in a scene at once.
This technique is primarily used for objects such as trees, grass or other models which can be represented as repeated geometry without appearing unduly repetitive. So, whenever there is a need to render the same object in many copies, the instancing method can be used.

16.2 Instancing and Thea Render

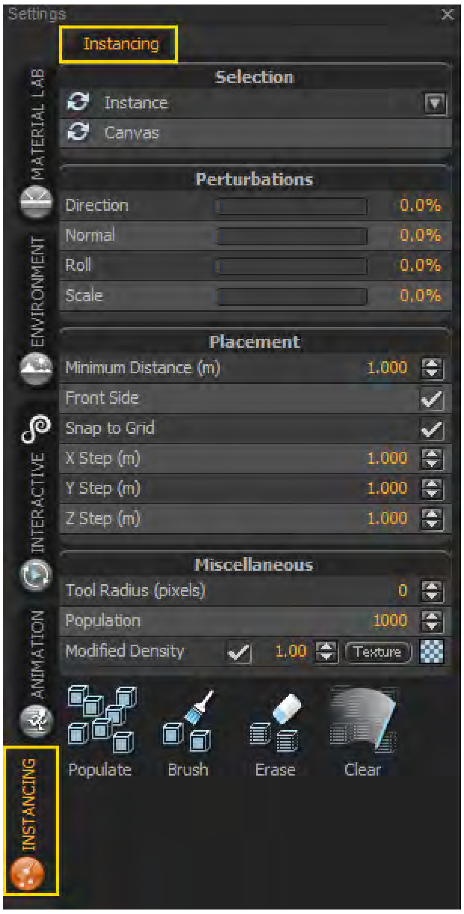


Figure 16-1: Instancing Panel

Thea Render is a render engine that allows users to render multiple copies of selected objects, with the use of its embedded instancing brush. You can find this tool along with its options at the Settings panel (see Figure 16-1).

As it is seen in Figure 16-1, the user can choose the desired instance -object- to generate and the canvas -surface- on which the copies will be placed. Apart from these basic selections, a lot of other options allow the user to create more effects for fulfilling specific needs, such as different sizes, directions or angles of the new copies. Your created instances will be saved in a Package and you will be able to see it at the Tree View.

For deeper understanding of each parameter, an analytic description is following, along with some visual examples that will help to distinguish the results and the effects that each option can lead to.

16.3 Options Analysis & Case Study Example

16.3.1 Selection – Instance and Canvas

Figure 16-2: Selection of Instance

Instance: this option helps the user to specify the object that will be generated by the program (initial object). After selecting the desired object by clicking on it at the Viewport or at the Tree View, just click at the rotating arrows button at the left side of the instance selection, in order to apply your object to instancing tool (you will now see its name next to it

like in
Figure 16-2).

Canvas: this is the main surface where the instances will be placed. After selecting your desired object that will be used as a canvas, click at the rotating arrows next to canvas option to apply it (as you see in
Figure 16-3).

Figure 16-3: Selection of Canvas

Tip: instances are placed on the canvas according to their **Pivot Point**. Most of the times, it is more useful to place pivot point of the instance at the point that will be adapted to the canvas (for example at the bottom of a grass object). In order to change your pivot point, while having your object selected, press “p” key to enter in the pivot mode, change your axes accordingly and by pressing “p” again, exit pivot mode. You can also enter in the pivot mode, from the corresponding option of the toolbar at OpenGL Viewport (as you see in Figure 16-4).

Figure 16-4: Enter in Pivot Mode

In our case study that will complement the options explanation, we will try to cover with grass a surface with slopes and also “plant” some flowers on it. For that purpose, we will use a surface as a canvas (Figure 16-5), a grass patch as an instance (Figure 16-6) and a flower as instance too (Figure 16-7).

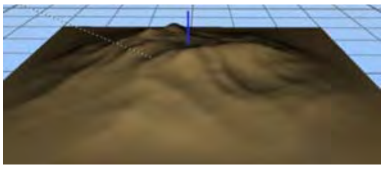


Figure 16-5: Sloped Surface for Canvas

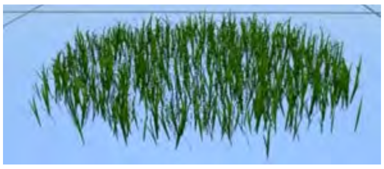


Figure 16-6: Grass Patch for Instance


Figure 16-7: Flower for Instance

Note: apart from instance and canvas selection, that user needs to define for using the instancing tool, the other four basic tool buttons for creating and erasing instances, are located at the bottom of the Instancing Tool window.

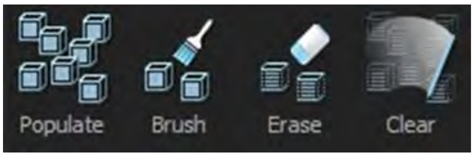


Figure 16-8: Basic Instancing Tools

Tip: In case your canvas is an infinite plane, populate button is not functional (automatic population cannot be carried out due to the surface infinity), so it is advised to use the brush tool.

- Populate: after selecting your desired settings, by clicking on the populate button, your instances will automatically be placed on the canvas according to your specifications.
- Brush: by clicking on the brush, the cursor becomes a brush and you can manually click and drag it on your canvas (at the Viewport) and create instances on the selected areas.
- Erase: by clicking on the erase button, the cursor becomes an erase tool, and by clicking and dragging it on the surface, you erase from these areas the generated instances.
- Clear: by hitting the clear button, you can erase all the instances that have been created at once.

16.3.2 Perturbations – Direction, Normal, Roll and Scale

Direction: this option defines if instances will be directed by canvas surface normal (0%), by global z-axis (100%) or somewhere in between. In Figure 16-9, by using a very simple example, we can see these options, for an inclined surface. Brown cubes have direction 0% and they are adapted to the surface while purple-blue cubes have direction 100% and they are parallel to z-axis, without taking under consideration the angle of the surface.

Tip: a normal to a surface at a point is the same as a normal to the tangent plane to that surface at that point (see Figure 16-10).

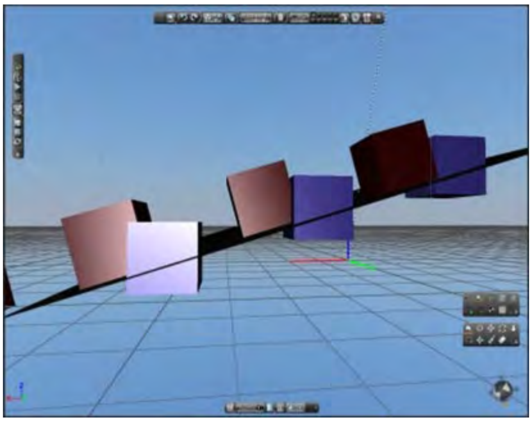


Figure 16-9: Different Directions

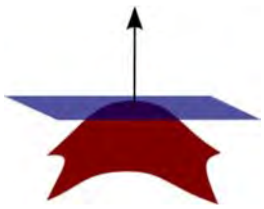


Figure 16-10: Normal to a Surface

In our case study example, when changing the direction percentage for generating grass on the selected surface, we have the following results.


Figure 16-11: Direction 0%

Direction: 0%
For zero direction the instance (grass) is placed exactly by surface's normal. This means that the instances are placed in such way to follow the curvature of the surface.


Figure 16-12: Direction 50%

Direction: 50%
For the half value in the direction percentage, the instances are oriented between the z-axis and the surface normal. Actually, for grass, a percentage around 10-20% would create a more realistic effect, as grass follows the surface curves, but it is also directed towards the sky.


Figure 16-13: Direction 100%

Direction: 100%
Full percentage of the direction value, makes the instances to be oriented along the global z-axis. As we see, the grass instances are totally horizontal (they just follow the height of the surface and not its normals) and in our case, with grass as an instance, the result is not very realistic. The final choice of the right value depends on the instance object that is used.

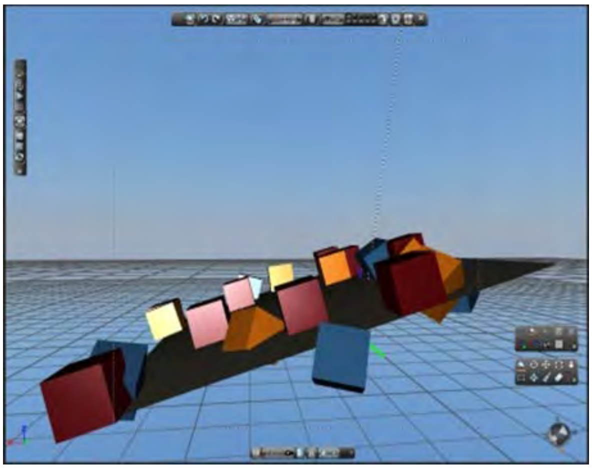


Figure 16-14: Different Normals

Normal: by changing this percentage, the instances will have random varying orientation related to the canvas normal. This time, by increasing the percentage, instances will use as fixed point their pivot point and they will rotate all around it, in all directions. Figure 16-14 shows the results of a simple example. Red squares have normal 0% and they are all at the same direction and tilt as the initial object, orange squares have 50% normal, so they are rotated somehow from their initial position, while blue squares that have 100% normal, are rotated completely differently.

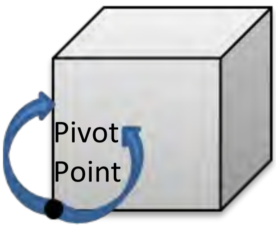


Figure 16-15: Rotation Around Pivot Point

In our case study, while changing the normal percentage, we have the following results.

Normal: 0%

For normal 0% (all other values are also zero), instances are generated at the same direction as the original initial grass patch.

Figure 16-16: Normal 0%

Normal: 50%

For half the percentage, instances are changing their directions and are placed randomly on the canvas (with their pivot point to stay pinned on the surface).

Figure 16-17: Normal 50%

Normal: 100%

For full percentage of the normal value, instances are rotated even more in all possible directions. For grass, large normal perturbations create a rather unrealistic effect, while for other instances, this may be useful.

Figure 16-18: Normal 100%

Roll: this option enables the user to roll the instances; rotate them around the z (longitudinal) axis. For 0% roll, all instances will be the same as the initial one (see brick squares at Figure 16-20) while for 100% roll, the objects are rolled around their z-axis (see wooden squares at Figure 16-20).

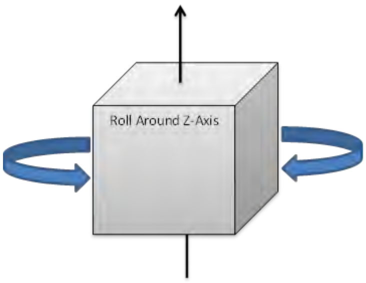


Figure 16-19: Roll around middle axis

Figure 16-20: Different Rolls

At our case study, we use this time as instance, the flower model, which is not symmetrical around its z-axis, to see better the roll perturbation while using the instancing brush.

Figure 16-21: Roll 0%

Roll: 0%
For zero roll, instances are generated exactly as the initial one.

Figure 16-22: Roll 100%

Roll: 100%
By increasing the roll percentage, the flowers are rolling by their z-axis as they are generated on the canvas.

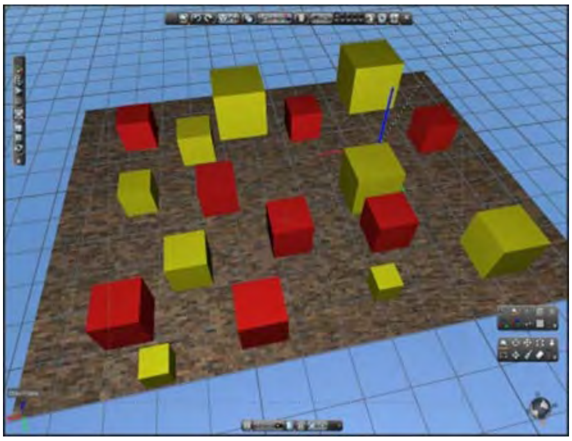


Figure 16-23: Different Scales

Scale: this option gives the possibility to the user to change the size of the generated instances. For scale 0%, the instances will be exactly the same as the initial one. By increasing this percentage though, the size of the new instances will be different. In Figure 16-23, we see that the red squares that have scale 0% are all the same to the initial one, while the yellow squares, that have 50% scale are smaller or bigger than the initial one. Higher percentage, leads to bigger difference between the smallest and the largest created instance.

By using again as instance the flower model, we can see the results by changing the scale value.

Scale: 0%
For zero scale percentage, all flowers have the exact same size as the initial instance.

Figure 16-24: Scale 0%

Scale: 50%
By increasing this percentage, instances start to have different sizes. The bigger the percentage, the bigger the difference between the smallest and the largest instance will be.

Figure 16-25: Scale 50%

Scale: 100%
With full scale percentage, the instances are having even bigger deviation from their initial size, as we also see in Figure 16-26.


Figure 16-26: Scale 100%

16.3.3 Placement – Minimum Distance, Front Side and Snap to Grid

Minimum Distance: this option defines the minimum distance that will exist between the generated instances. For creating grass for example you need a very small distance while for trees the distance should be bigger. It is totally dependent on the desired results and the scene.

In our case study, we will use different distances to show how the flowers are generated. Note that by choosing large minimum distances, even if you want to create more instances -large population value-, only a certain number of them will be placed as they need to follow the rule of distance that you have specified.


Figure 16-27: Minimum Distance 5 meters

Minimum Distance: 5 meters
In our example, by giving 5 meters as a minimum distance between new copies, the flowers will be placed in such way that there will be no other instance in radius of 5 meters around each one of them, as we can also see in Figure 16-27.


Figure 16-28: Minimum Distance 1 meter

Minimum Distance: 1 meter
If the minimum distance is smaller, instances come closer to each other as we can also see at Figure 16-28.


Figure 16-29: Minimum Distance 0.1 meters

Minimum Distance: 0.1 meters
The smaller the minimum distance is, the closer the instances come. For grass, very small minimum distance is desired, in order to assure better coverage, while for trees or flowers it depends on the result we need to create.

Front Side: this option, which is enabled by default, means that instances will be generated at the front side of the canvas object. When disabled, instances will be placed at the back side.

In our example, we use these two options for the flower instance and we see the results below.

Front Side: Enabled

For front side option enabled all the instances (flowers) are generated on the top side of the surface, as we can see in Figure 16-30.

Figure 16-30: Front Side

Front Side: Disabled

When disabling this option, the instances (flowers) are now placed at the opposite side of the surface, as we see in Figure 16-31.

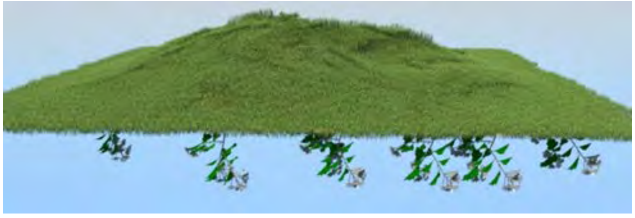


Figure 16-31: Back Side

Snap to Grid: this option allows the user to place the instances along to the selected axes at specific distances.

For a better understanding of this option we will use a simple example of small cubes with green, red and blue colors, which represent the colors of the axes as well (x-axis: red color, y-axis: green color and z-axis: blue color).

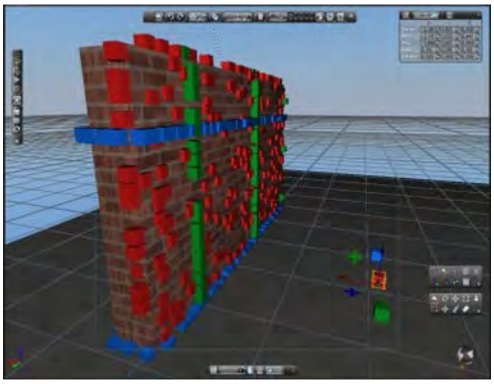


Figure 16-32: Step 2 meters

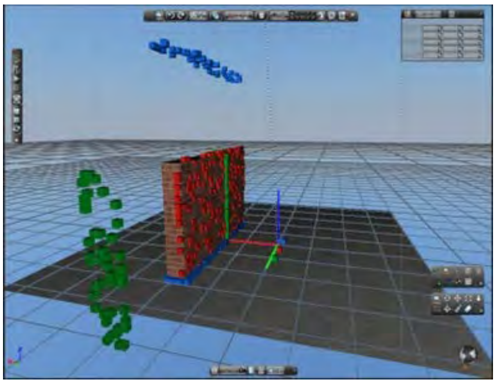


Figure 16-33: Step 5 meters

We are enabling the snap to grid option and we enter the following parameters, for each square that we use as an instance, thus, creating three packages:

For generating the green square, we use X step=0, Y step=2 and Z step=0.

For the red square, we have: X step=2, Y step=0 and Z step=0.

For the blue one, we set: X step=0, Y step=0 and Z step=2.

At Figure 16-32, we have the three instance packages, and we see that the green cubes are snapped along the Y axis (with step of 2 meters), the red cubes at X axis of the canvas (with step of 2 meters) and blue cubes along its Z axis (with step of 2 meters). Their distance from the axis center is defined by the step we have set. If we use a larger distance, for example 5 meters, we see at Figure 16-33 the way that instances are placed. They follow the dimensions of the canvas but they snap to the grid of it with the desired step.

16.3.4 Miscellaneous – Tool Radius, Population and Modified Density

Tool Radius (pixels): this option allows the user to change the size of the brush or erase tool. By increasing it, instances can be created in a larger area than the default one and correspondingly instances will be erased in larger areas by one click on the instances at the Viewport.

In our example we use the “Brush” to create some flowers and the “Erase” to delete some grass.

Tool Radius for Brush
By specifying the pixels of your tool, you can adjust the brush tool and generate instances to your desired areas by clicking and dragging your cursor. Instances will cover the area included in the red square (tool radius), like in Figure 16-34.

Figure 16-34: Brush Tool

Tool Radius for Erase
You can also erase specific areas of generated instances, by using the erase tool. By increasing the pixels of the tool radius, you are able to erase bigger surfaces. In the right figure we are erasing the grass by clicking and dragging the cursor on the instances.

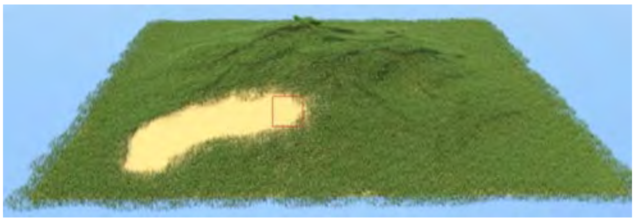


Figure 16-35: Erase Tool

Population: this is the amount of the desired instances the user wants to generate on the canvas. The population of instances can vary depending on the scene, the selected instance and the canvas size. For creating a grass or a carpet, large population promises wider coverage of the surface, while for trees or flowers for example, user may need just a small amount of them.

In our example, we will use the grass patch as an instance to fill our surface while using different populations of them. Tip: You need to use a small minimum distance as well, to allow your grass patches to come close enough and cover the surface.

Figure 16-36: Population 50

Population: 50
If we use as desired population the value 50, as we see in Figure 16-36, for this particular canvas and the desired effect, this amount is quite small.

Figure 16-37: Population 500

Population: 500
By increasing the number of instances, the surface is covered by more grass patches and starts to look more realistic.

Figure 16-38: Population 5000

Population: 5000
With the use of a very large population number, the whole surface is covered by grass, as it is seen in Figure 16-38.

Modified Density: this option, allows the user to create even more complex scenes, since there is the possibility to enter a pattern (by adding a texture image), which will define the areas that instances will be placed. In general, for a given texture, instances are placed only over the white areas, while black ones stay empty. For gray areas, the application will probabilistically decide whether to place instances or not, based on the brightness level. It is better to use gray-scale images, to be able to specify and control better the areas you want or not to place instances.

Apart from choosing the desired texture, there is also the option to set the desired texture scale, by changing the numerical value next to the modified density option (see Figure 16-39), for handling the gray parts of the image and increasing or decreasing the possibility to place an instance on them. At the next example, we use different values to experiment with this parameter. For easier observation we have applied the gradient texture on the canvas too.

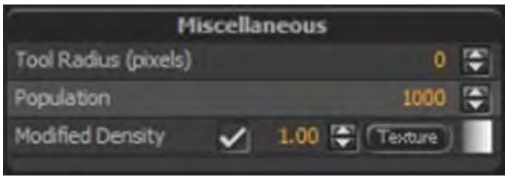


Figure 16-39: Modified Density

Modified Density: 0
For a zero value, the whole area is considered to be black and the possibility to add an instance is zero as well, so no single instance is created, as we see too in Figure 16-40.

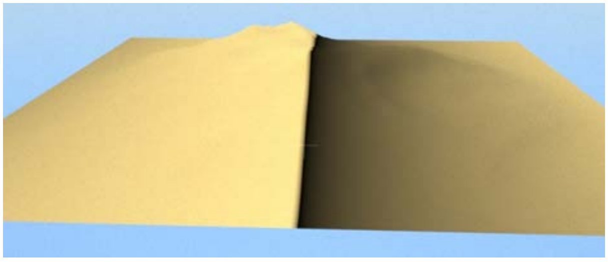


Figure 16-40: Zero Possibility

Modified Density: 0.2
By increasing this value, some lighter areas are now used for generating the instances, as we see in Figure 16-41.


Figure 16-41: 0.2x Possibility Scale

Modified Density: 2
As we are increasing more this value, the possibility for darker areas to start being used as active canvas is getting higher. For this value, as we see in Figure 16-42, almost only the very dark area is not covered by grass.


Figure 16-42: 2x Possibility Scale

Modified Density: 100
This is the maximum value that we can set, and is making even the most dark areas (except the pure black ones) to receive instances, as we can also see in Figure 16-43.


Figure 16-43: 100x Possibility Scale

By using our case study example again, we use another texture (it is black and white only, so there is no need to change the scalar value) with a specific pattern as you can see in Figure 16-44, to create some grass areas and place flowers in between them. At the following images we see the necessary settings along with the final results.


Figure 16-44: Grass Creation

After specifying the instance, the canvas, all the other perturbations etc., we can enter the population as well as the pattern, as seen in the image below. The result is shown in the Figure 16-44, where grass is only generated on the specific white areas of the texture.

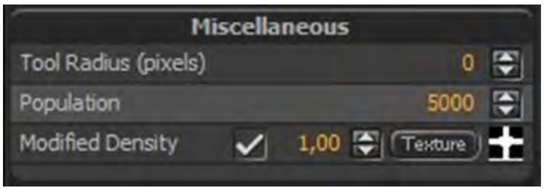


Figure 16-45: Grass Pattern


Figure 16-46: Flowers Creation

By inverting the colors of the previous texture (we could have used another texture as well) we can place instances to the empty areas, flowers for example. We see that the result is the creation of an exact pattern of combined grass and flowers that fills the whole canvas.

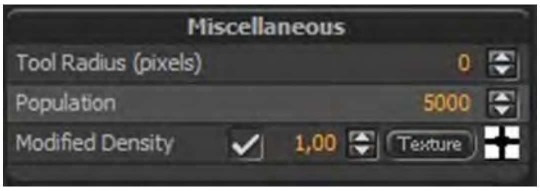


Figure 16-47: Flower Pattern

By this way you can create unique designs, like carpets for example (see Figure 16-48) by creating different instance packages each time and filling different areas of your canvas.


Figure 16-48: Example of a Carpet with the use of Modified Density map

Chapter 17: Network Rendering

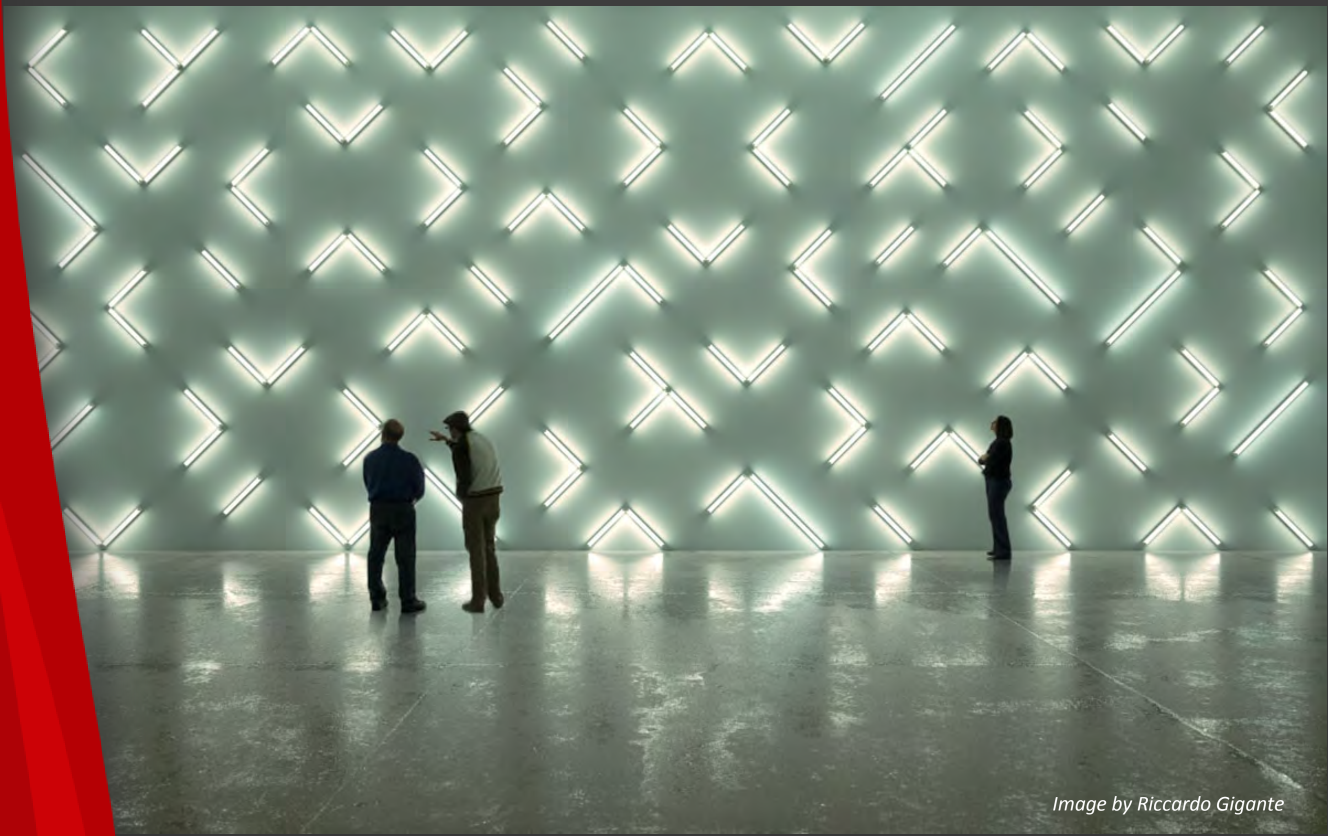


Image by Riccardo Gigante

17. Network Rendering

17.1 Introduction

As we have already described at the Darkroom chapter (see Chapter 5), the fourth tab that can be found there is the Network (see Figure 17-1).

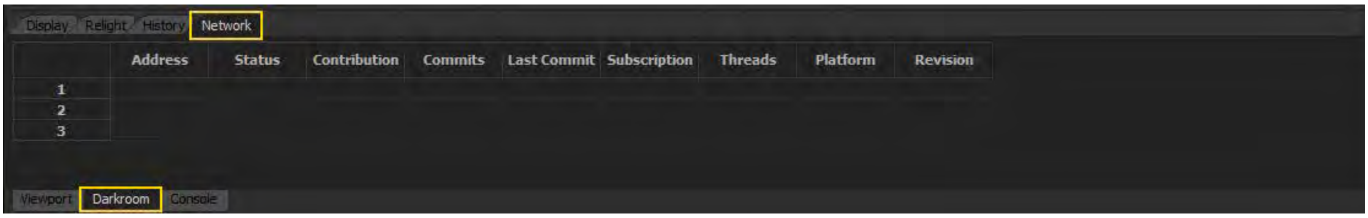


Figure 17-1: Network Tab at Darkroom

Network rendering is a way to remarkably improve render times by utilizing more machines to contribute in one or more renders. In our framework, there are two types of network rendering:

- Co-operating on the same frame. All machines contribute to the current frame by sending and merging their image buffers.
- Co-operating on different frames. In this case, each machine processes fully a frame that is part of an animation sequence.

In rendering, as in most network processing applications, the server-client scheme is used in order to distribute workload to several machines. In this scheme, one machine takes the role of splitting and distributing the work (the server) to other machines that receive these jobs, complete them and send back the results (the clients).

In Thea Render, there can be only one machine acting as server while there can be many client machines. The server machine can also act as a client, i.e. receiving and completing a render job itself. Because of this and the additional effort needed to communicate with client machines, the server machine is usually chosen to have high performance characteristics.

17.2 Network Rendering Setup

Let us see here how to setup the application in order to run in network rendering mode. As said in the previous paragraph, there can be many clients and one server, thus, we need to setup the application in more than one machines. Only a machine using the full application software license can run as a server. The machines that will be used as clients should have their corresponding client software licenses. Note here that if you have more than one full license, you can still choose one to become the server and the rest running in client mode.
The first thing generally done for network processing applications is for client machines to look up and find the server machine. In order to facilitate this process, Thea Render comes with a search mechanism that will show all server machines. Nevertheless, this will only work if all machines are members of the same local area network and connected on the same router. Let us see how the server in such case can be located.

First of all, we need to run Thea Render on the server machine (in either the studio or darkroom mode). Then, from the help menu, we select the Server Beacon option (Figure 17-2). This will popup a small window indicating that the machine is broadcasting its identity (Figure 17-3). There is nothing else needed to do on the server machine, so we keep the server broadcasting information and we move on now to client machines.

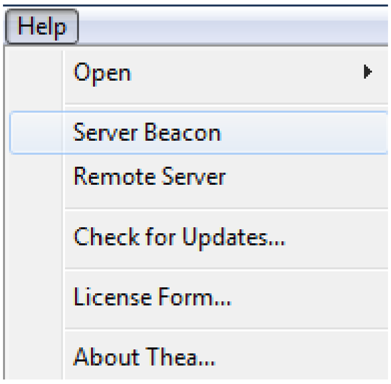


Figure 17-2: Employing Server Beacon help tool

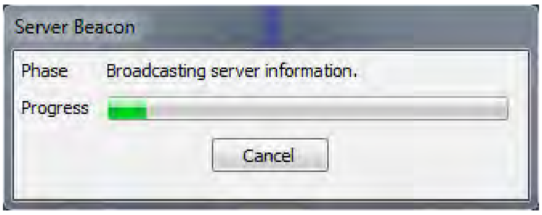


Figure 17-3: Broadcasting Server Information

Running Thea Render on client machines, will automatically show the client user interface (Figure 17-4). This can be also done by running Thea Render from command line, using the following syntax (without the quotes): "thea -client".
At this moment, the client is in startup mode and is not polling for any render jobs. We could click immediately the start button and make the client looking automatically for all servers broadcasting on the local area network. This way, assuming that your server and clients are on the same network, you can start immediately with network rendering without any further configuration.

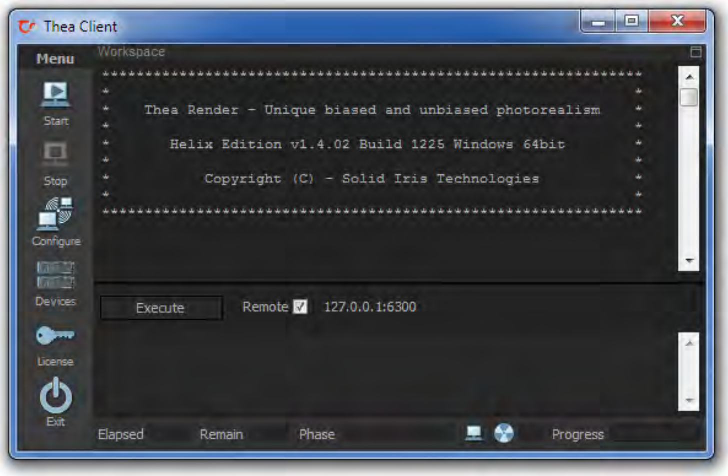


Figure 17-4: Running first time the client user interface

If on the other hand, you would like to select a particular server that your client should communicate with, you should click the Configure button. By clicking on that button, the client configuration menu pops up (Figure 17-5). The server port is a number used to allow simultaneous communication of several applications between machines. As long as two applications do not use the same port number there is no risk of data conflict. It is recommended to use the default value (6200) or in (a rare) case of conflict with another application to try a higher value (but this will also need setting up the server beacon using that port). The overriding of threads is necessary in order to utilize certain number of threads in the client machine, not necessarily the same with the settings that come in a scene. The default value (0) corresponds to maximum efficient threads for the machine.

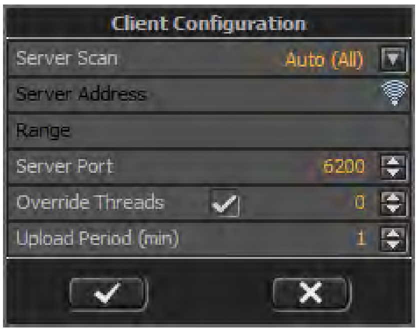


Figure 17-5: Client configuration menu

The upload period is the time period used to upload data to server (in minutes); for starting up, a low value may be used to verify everything is working properly but once you get accustomed to network rendering it is recommended to use a higher value (like 10-20 minutes) in order to minimize network traffic. Note that the upload period is only used by unbiased cooperative rendering, since in any other case, resulted data are uploaded as soon as the render job is finished.

With the Devices button, you are able to configure the devices of your system that will be used by Presto engine, as seen in the figure below.

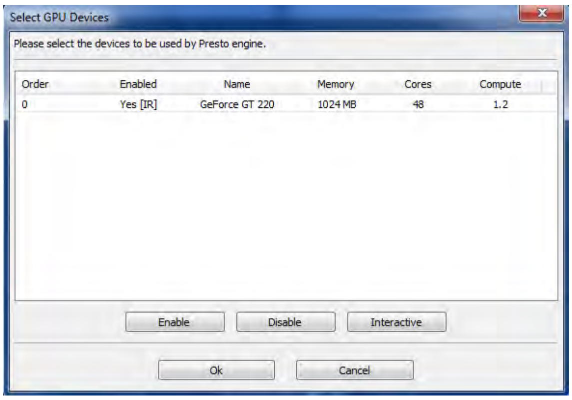


Figure 17-6: Select GPU Devices

We haven't discussed yet the Server Address entry - this is where the IPv4 (internet protocol version 4, for example 192.168.0.1) address should be entered. This address can be found from the network settings of the server machine but as we said before, we can locate the server easier. We already have the server machine broadcasting information at this point, so we can select “Manual” in the Server Scan entry and then click on the "sonar icon" found at the end of Server Address entry. This will bring up the server search list dialog (Figure 17-7); this is where the application checks the local area network for server beacons.

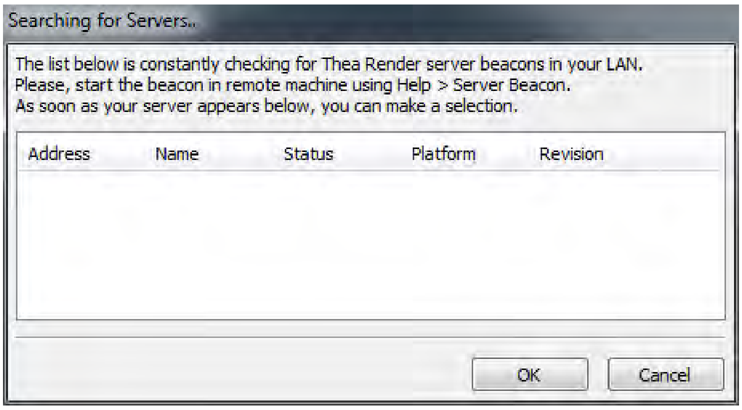


Figure 17-7: Searching for server beacons.

Note: If there is a firewall installed then you may be inquired to allow network access for the application.

Once the server is found, it is displayed in the list and we can click on the corresponding line and then OK to select it (Figure 17-8). It is important to note that automatic detection can take place only if the machines are connected on the same router. Also, installed firewall may not allow connection of the application, without even informing the user. In such case, the user should explicitly check the firewall, in case it forbids access.

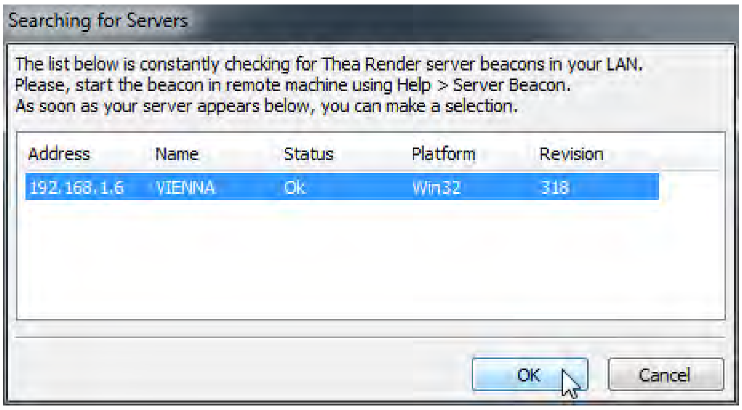


Figure 17-8: Selecting a server from the search list.

When the server is selected, we return to the client configuration dialog where the IP address has been setup and we can accept now the configuration by clicking the accept button. The application will remember our client configuration settings, so we can also exit the client application at this point.

17.3 Cooperative Rendering

As soon as all our clients have been setup, we can perform our first network render. The simpler network rendering mode is that of the same frame. This is typical for unbiased rendering, where many machines are working together contributing more and more passes on the same image.

There is no particular sequence in starting a network rendering, in the sense that server and clients can be started asynchronously and in any order. The easiest way to do this though, is to have the clients started and waiting for render jobs sent by the server. Even more, if you press the Start button on client interface, the application will automatically start next time the client runs. This is quite useful, since the whole procedure can be automated so that the application is launched once the operating system starts up.

Figure 17-9: Overriding network settings to act as a server.

Now, once the client machines have been started, they get essentially in a stand-by mode where they periodically check the server for any render jobs. As soon as the server starts running, the scene will be automatically sent to clients to be rendered. The easiest way to get a machine acting as a server is by overriding the network render settings, when the Start Render button has been pressed (Figure 17-9).

Note that for cases of animation you can also select a per frame or bucket/pixel cooperative network option, as described on Animation chapter, at page 281.

17.4 Pure Server

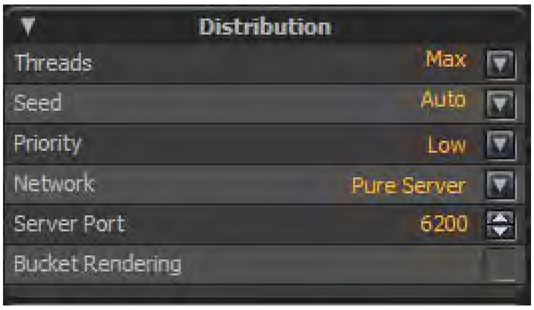


Figure 17-10: Pure Server Option

Pure Server network render mode allows you to offload your rendering task completely onto other networked systems whether they are on your local network or even outside your local network. Up until now when executing a network render task your local system is always included in the render process. However your local system may have low performance CPU+GPU. In such cases using Pure Server to offload your render task to other more powerful systems provides a more fluid UI response and allows you to focus on your modelling tasks locally while the rendering task is fully offloaded. This option is now available from the Network dropdown option within the Production tab - Distribution panel. Please note that if you are launching a network render task on your local area network, you do not need to make any changes to your IP configuration settings within Thea Render Client. However if you wish to execute a network render project where Thea Clients are residing outside your LAN IP range, you will need to configure your remote Thea Clients to use the Internet IP address/Port of your Thea Studio and configure also your DSL modem router NAT table so that packets are routed correctly. Please note this feature is available for all engine modes except Adaptive BSD.

THEA RENDER

phyisically-based unbiased, biased & gpu render engine

Chapter 19 - 21: Appendix

18. Appendix A

18.1 Table of Supported Features

At the next table we can see a list with several features and which Thea engines support them.

Feature/Engine/ Support	Adaptive BSD	Unbiased TR1/TR2	Adaptive AMC	Presto AO	Presto MC
Full Spectral Resolution		+	+	+	+
Supersampling	+	+	+	+	+
Clip Mapping	+	+	+	+	+
Alpha Mapping	+	+	+	+	+
Bump Mapping	+	+	+	+	+
Normal Mapping	+	+	+	+	+
Displacement Mapping	+	+	+	+	+
Motion Blur	+	+	+	+	+
Sub Surface Scattering (SSS)		+	+		+
Volumetric Scattering (Medium)		+	+		+
Blurred Reflections	+	+	+	+	+
Clay Render	+	+	+	+	+
Depth of Field	+	+	+	+	+
Material Layering	+	+	+	+	+
Max Coatings Limitation	-	-	-	2	2
Max Substrates Limitation	-	-	-	3	3
Thin Film Coating	+	+	+		
Dispersion	+	+	+	+	+
Anisotropy	+	+	+	+	+
Thin Film Interference	+	+	+	+	+
Complex IOR Files	+	+	+		
Coating Thickness Absorption	+	+	+		
Custom Reflectance 90	+	+	+		
Custom Fresnel Curve	+	+	+		
Sigma Texture	+	+	+		
Sun-Pool Caustics	+	+	+		
Terminator Artifact Solver	+	+	+	+	+
Ambient Occlusion	+			+	

Feature/Engine/ Support	**Adaptive BSD**	**Unbiased TR1/TR2**	**Adaptive AMC**	**Presto AO**	**Presto MC**
Lens Shift	+	+	+	+	+
Camera Projections	+	+	+	+	+
Diaphragm Circular/Polygonal	+	+	+	Circular	Circular
Per-Model Texture Coordinates	+	+	+	+	+
Texture Projection Modes	+	+	+	+	+
Front/Camera Mapping	+	+	+	+	+
Multiple UV Channels	+	+	+		
Texture Tone Mapping	+	+	+	+	+
Procedural Textures	+	+	+		
Texture Layering	+	+	+	+	+
Synthesis Texture Layering	+	+	+		
Point Lighting	+	+	+	+	+
Mesh Lighting	+	+	+	+	+
Image-based Lighting	+	+	+	+	+
Reflection/Refraction Mapping	+	+	+	+	+
Physical Sun/Sky	+	+	+	+	+
HDRI Support	+	+	+	+	+
IES Support	+	+	+	+	+
Instance Support	+	+	+	+	+
Relight Support		+	+	+	+
Repaint Support (COLIMO)		+	+		
Luminance Analysis	+	+	+	+	+
Illuminance Analysis	+				
Resume/Merge Render		+	+	+	+
Basic Render Passes	+	+	+	+	+
Advanced Render Passes	+			+	+
Shadow/Raw Passes				+	+
Interactive Render			+	+	+
Vignetting / Bloom / Glare (Post)	+	+	+	+	+
Camera Response CRF (Post)	+	+	+	+	+
Color Balance (Post)	+	+	+	+	+
Multithreading	+	+	+	+	+

Feature/Engine/ Support	Adaptive BSD	Unbiased TR1/TR2	Adaptive AMC	Presto AO	Presto MC
Network Rendering	+	+	+	+	+
Region Rendering	+	+	+	+	+
GPU Support				+	+
Passive Emitter	+	+	+	+	+
Z Clipping	+	+	+	+	+
Micro Roughness	+	+	+	+	+
Invisible Emitter	+	+	+	+	+
Invisible Model	+	+	+	+	+
Shadowless Model	+	+	+	+	+
Shadowless Point Lights	+				
Bucket Rendering	+			+	+
Extended Ray Tracing				+	+

19. Appendix B

19.1 Console Tab

Figure 19-1: Console tab

Just after the Viewport and Darkroom tabs we can see the Console tab (see it in Figure 19-1). Here we can find on top information of Thea Render (Edition, Copyright etc.) and see the installed libraries, the application, the config, the data and plugin folders destinations.
Then a list with all the actions taking place in Viewport and Darkroom (such as open a scene, render it etc.) exist. Below we can see a command window with an Execute button that is useful for the remote access feature.

20. Appendix C

20.1 List of Figures

At the next list we see a list with all the figures and their description that have been used in this manual.

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Image by Patrick Nieborg

Find further information at www.thearender.com