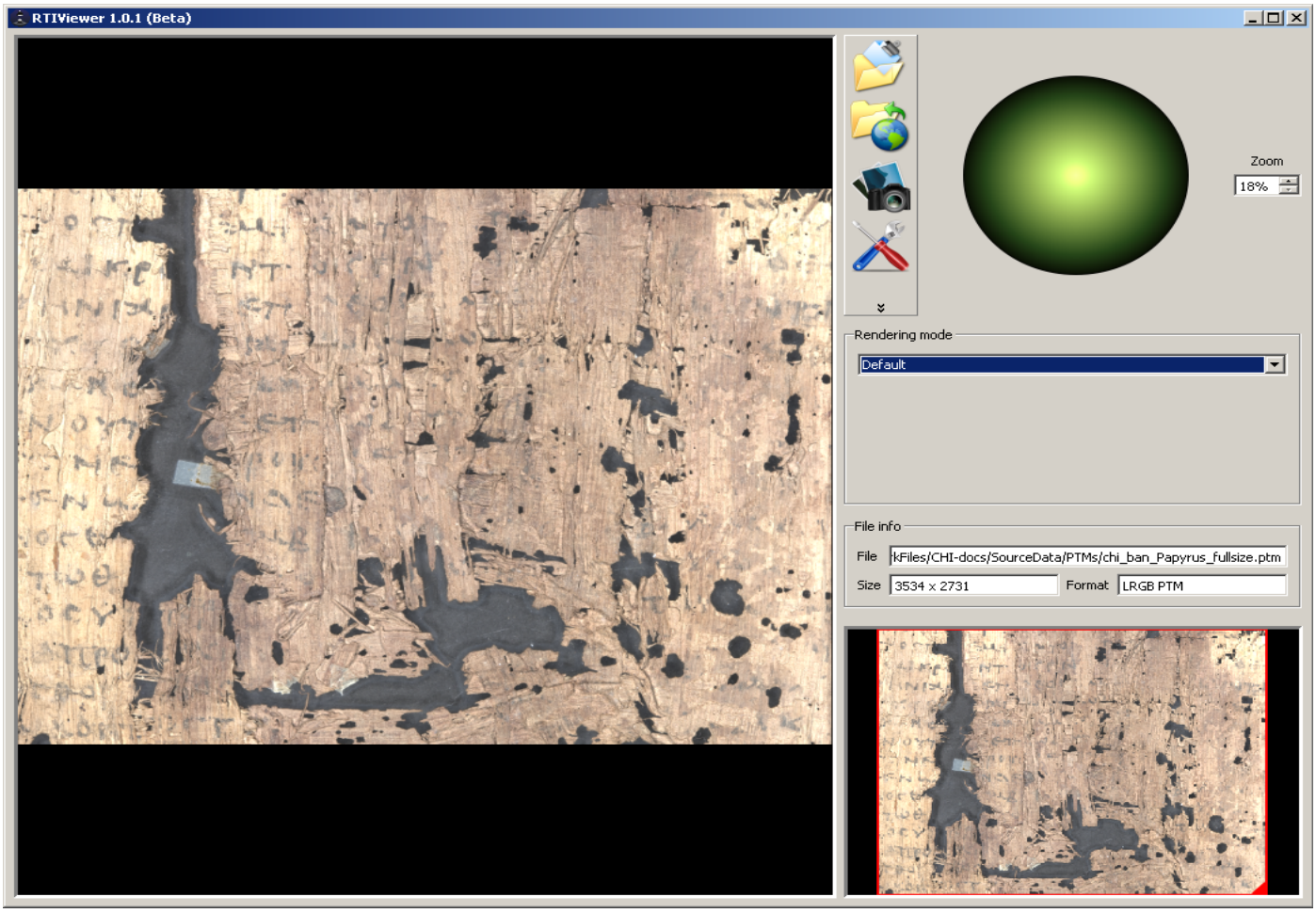
GUIDE TO RTIVIEWER

Document version 2.0

Find updates and related materials at http://CulturalHeritageImaging.org/Learn/



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Cultural Heritage Imaging *A California Nonprofit Corporation*

www.c-h-i.org

Guide to RTIViewer v1.0

Using RTIViewer

RTIViewer allows you to load and examine images created with relectance transformation techniques. This tool supports these formats, collectively called RTI files:

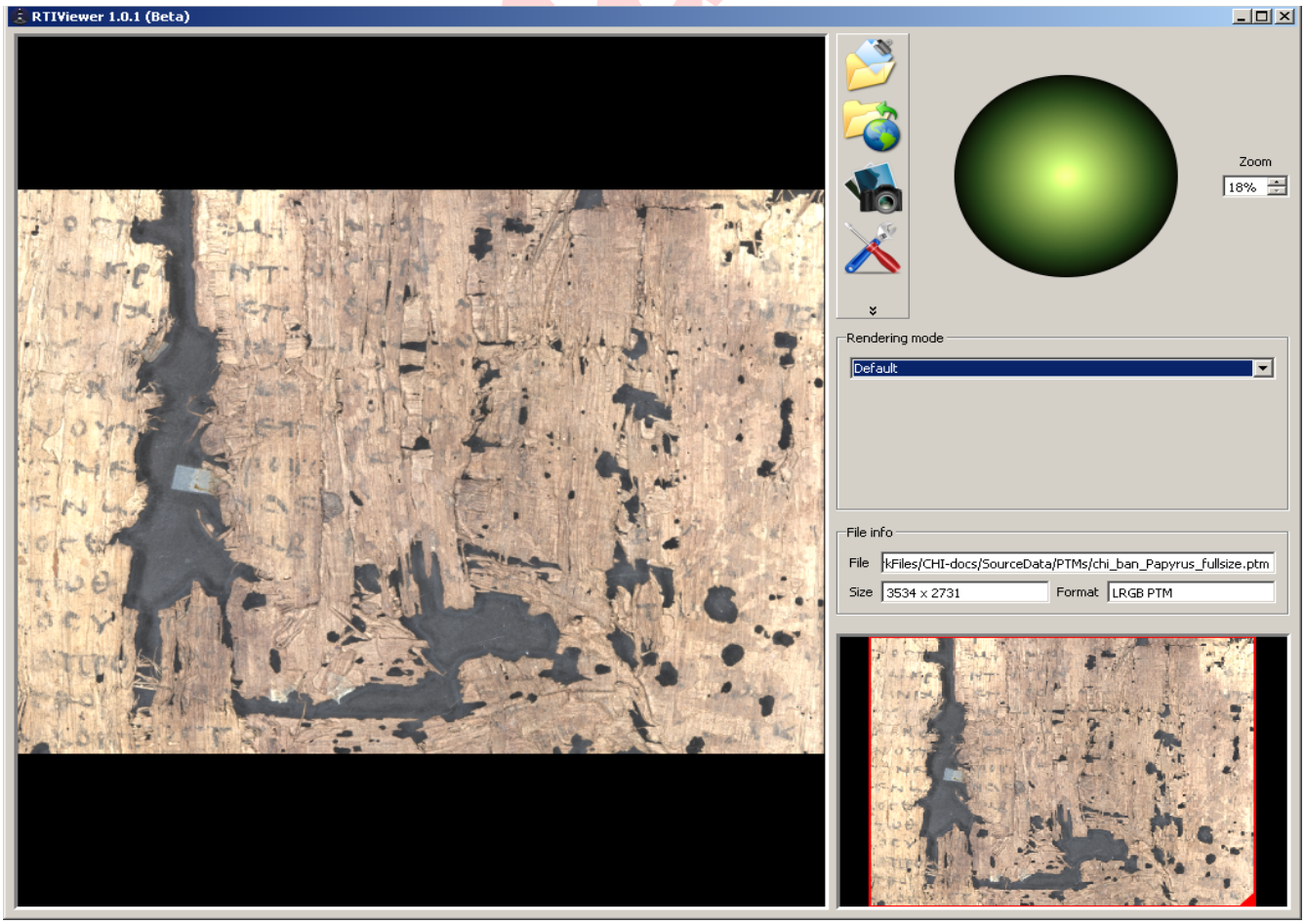
- Polynomial Texture Maps (PTM files) (Other tools are available for viewing this format)
- Hemispherical Harmonics Maps (HSH files)
- Universal Reflectance Transformation Imaging (URTI files)

The viewer can display both single-view and multi-view images; a multi-view RTI is a collection of single-view images together with optical flow data that allows the generation of intermediate views.

RTIViewer offers interactive rendering of images, allowing you to change the view and alter the apparent direction of lighting. In addition, it offers a number of enhancement modes, which apply mathematical transformations to the image data to enhance or emphasize particular features of the target object.

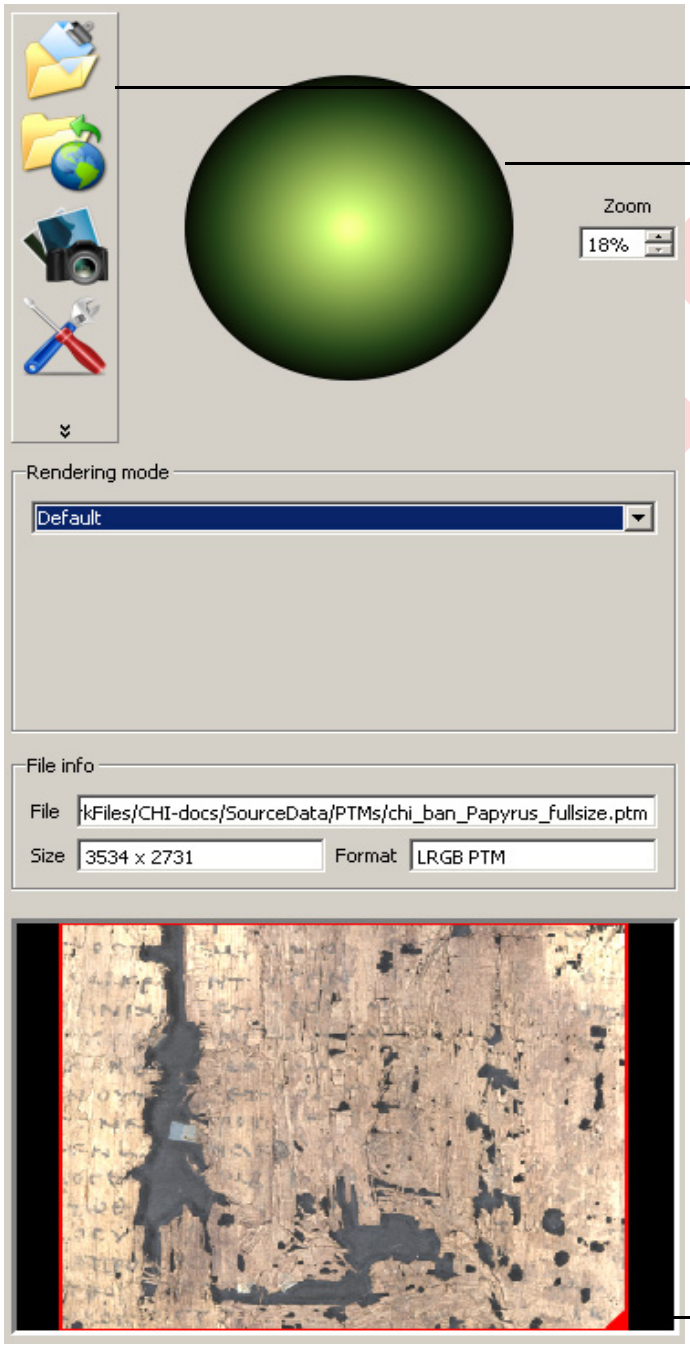
The RTI Viewer window

The RTI Viewer GUI allows you to load and examine image files, providing options for manipulating the image to take advantage of the captured specular data in ways that help you study the target object.



Main viewing panel **Control panel**

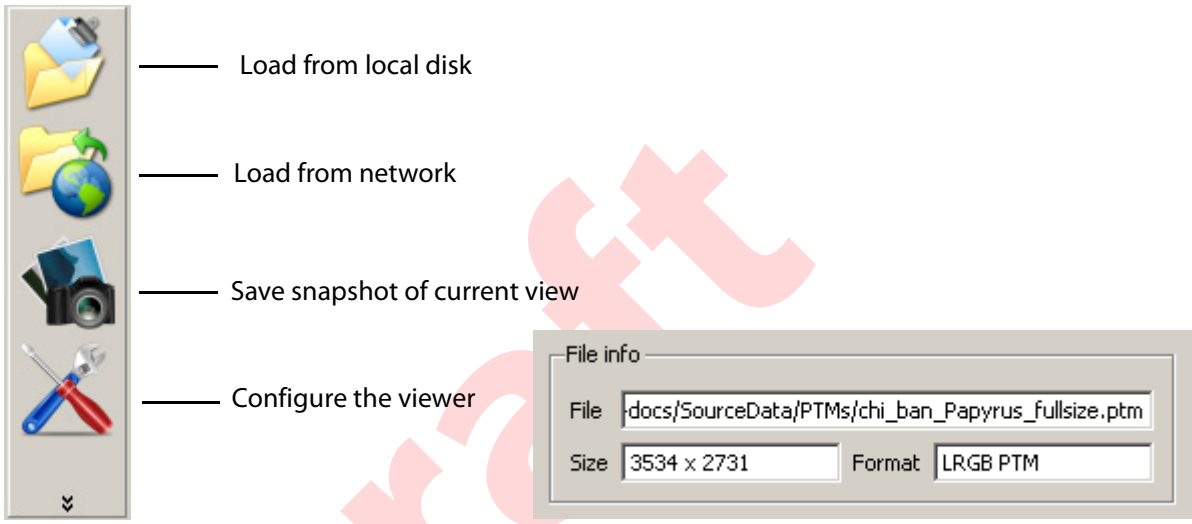
- The control panel on the right allows you to load image files, save views, move the angle of the virtual light on the image, and configure the view in a number of ways.
- The main viewing panel on the left displays the current image, rendered and lit according to your choices in the control panel.



Menu bar and file details

The icons on the menu bar allow you to:

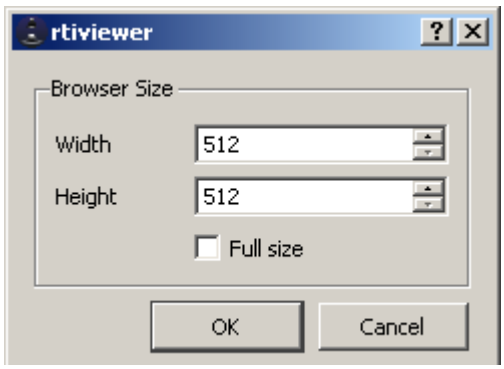
- Browse your local disk to find and load image files for viewing.
- Browse the internet to find and load image files kept on remote servers; see "Creating and viewing remote image files" on page 6.

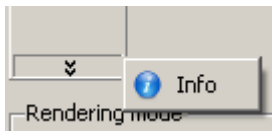


When you have loaded a file, the location, size, and format are shown in the File info box.

The menu also allows you to:

- Save a *snapshot*, which is a PNG or JPEG image of the current view shown in the main viewing panel; that is, the currently selected portion of the file, with the currently selected lighting angle and rendering style.
- Configure the viewer; the configuration dialog allows you to set the size of the viewer window.
- Bring up the About box , which provides version information and contact information for the developers and sponsors.





Bring up About box

Creating and viewing remote image files

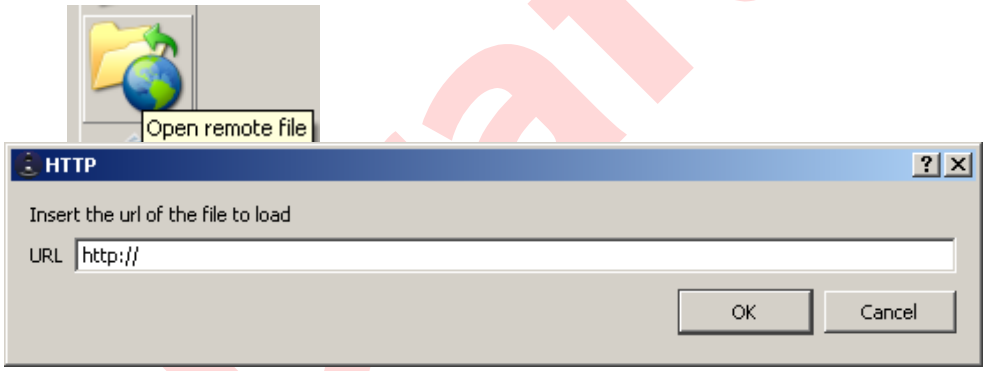
RTIs are typically enormous files with very fine resolution; for this reason, it can be more practical to store the images on servers for sharing. The RTI Viewer allows you to load and display images stored on a local hard drive, or on a remote server through an HTTP connection.

Currently, remote viewing is available only for files in the PTM format, which you must preprocess using the RTI Webmaker command-line tool. This tool converts the PTM images into a more compact format that permits remote loading in chunks through HTTP. The command take two arguments, the path to the PTM file, and the *resolution level*, which controls how many chunks to produce. For example:

```
RTIWebmaker ..\rtiImage\test.ptm 3
```

The tool produces a folder containing the converted files; you can copy the entire folder to the server. The URL of the image is the URL of the folder, with the extension `.ptm`.

To browse for a remote image file, click the "Open remote file" icon, and enter the URL in the resulting dialog.



Efficient storage of RTIs using multi-resolution tiling and JPEG2000 compression allows asynchronous loading, with increasing resolution as loading proceeds.

Tiled image data with increasing resolution allows incremental loading from a remote site.

Image navigation and lighting

You can control the portion of the image you are viewing, and the angle of the virtual light; the light controller and image navigator in the control panel allow you to make changes, and also reflect the current state when you change the view by directly manipulating the image in the main viewing panel.

Using the image navigator

The small image at the bottom right allows you to select a subset of the image to show in the main image panel.

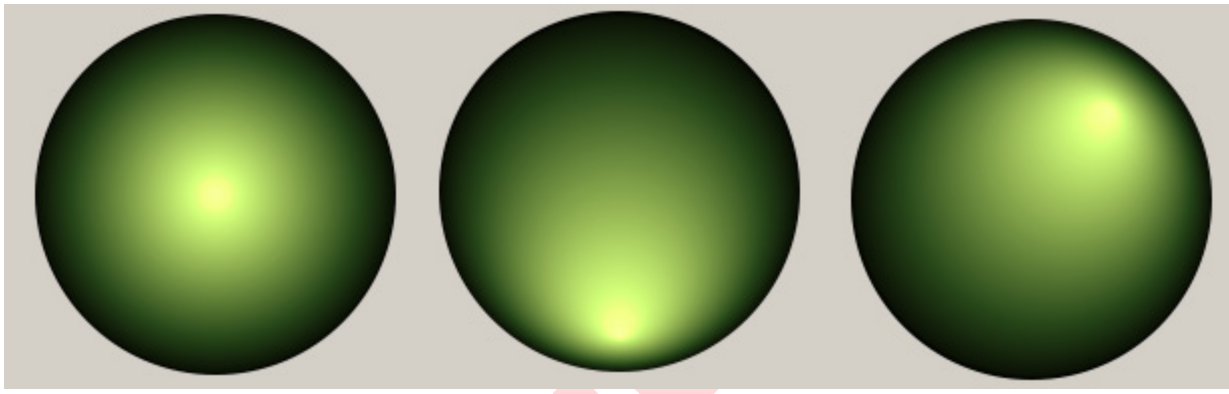
- Click anywhere in the red square to drag it around the small image. The portion of the image inside the square is shown in the large viewing panel.
- Drag the triangle in the lower right corner of the red square to resize the selection (within the built-in constraints).
- Use the scroll wheel on the mouse to zoom in and out.

Using the light controller

The green circle controls the angle of the virtual light in the large viewing panel. The bright spot is the light source, shown as if it were reflected in a dome. You can drag the spot around the dome to change the angle.

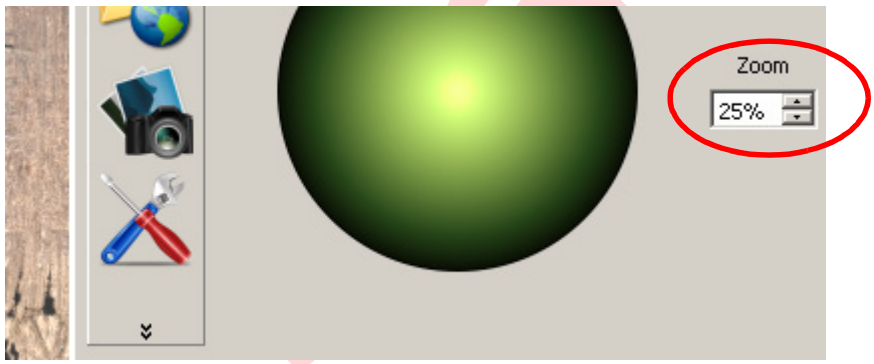
- When the light source is in the center of the dome, the virtual light comes from the “high noon” position, directly above (or in front of) the object.

- As you drag the light source to the top, bottom, right, or left, the virtual light approaches the horizon in that direction, creating a raked-lighting effect.



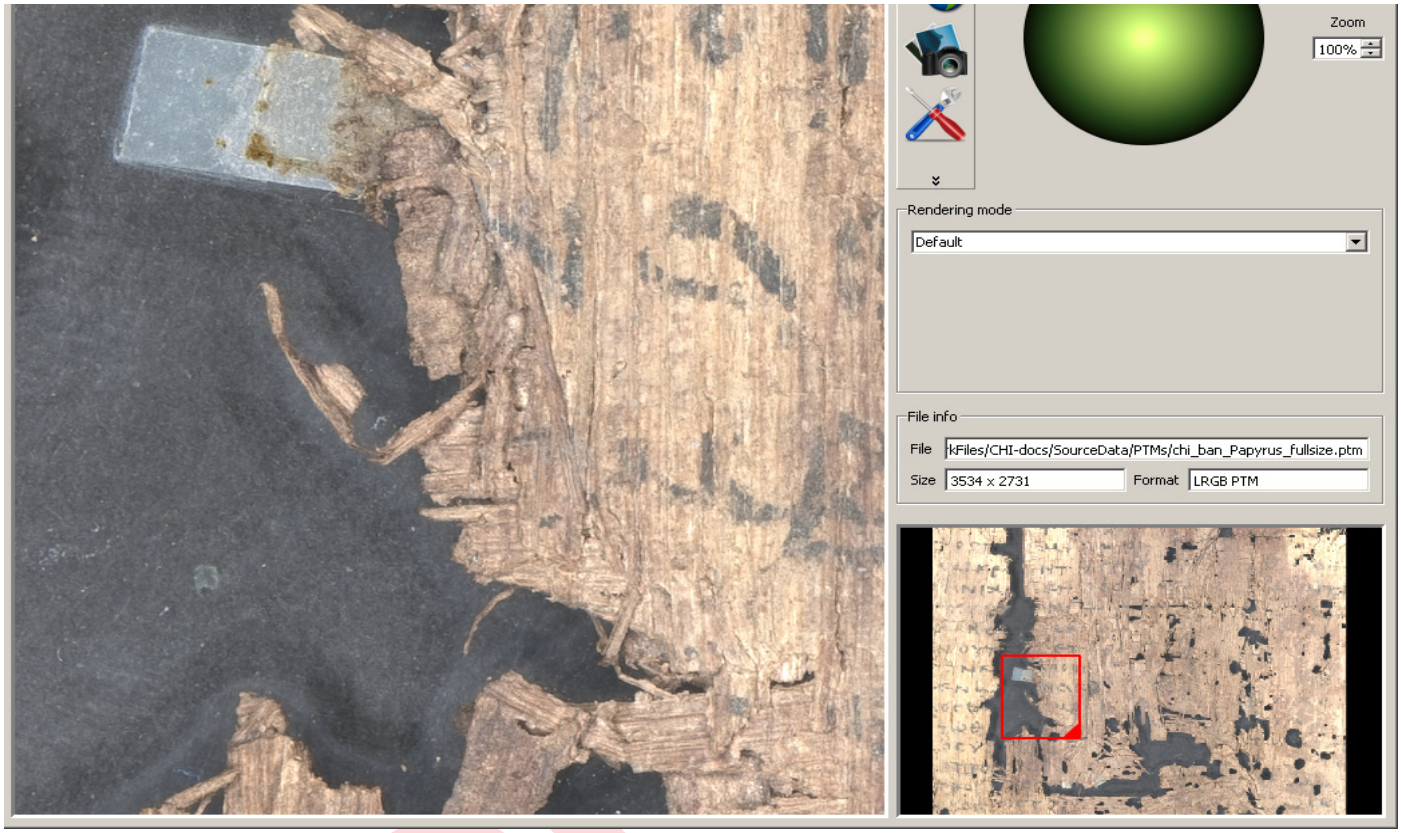
Zooming

Next to the light controller, a Zoom selector allows you to change the magnification at which the image is displayed.



By default, an image is displayed at a magnification factor that allow the entire image to be seen in the viewing area. You can use the up and down arrows in the Zoom selector to increase and decrease the magnification my 1% increments, or you can type a new zoom factor into the text box and press return.

You can zoom in to a magnification above 100%, although this decreases the resolution of the image.



Manipulating the image view in the main viewing panel

You can also manipulate the image view directly from the main viewing panel; the navigator updates to show you what part of the image is currently displayed, and the light controller updates to show you the current light angle.

- Left-click in the large image and drag in any direction to move the image in that direction.
- Right-click in the large image and drag to adjust the lighting angle.
- Use the scroll wheel in the large image to zoom in and out. (You can also zoom in with the keyboard shortcut CTRL+ and zoom out with CTRL-.)
- Double-click a point in the image to center and zoom in on that point.

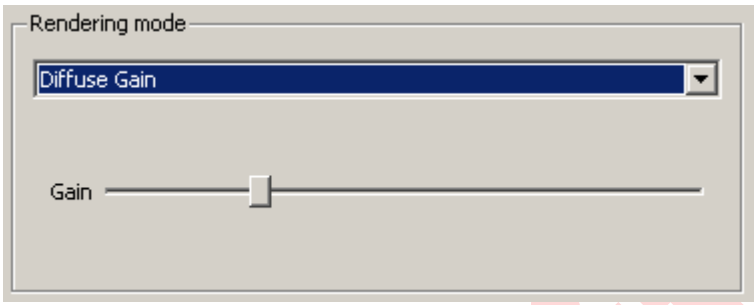
Rendering modes

Applications such as Adobe Photoshop can digitally enhance traditional images (to lighten or darken them, or change the color tone, for instance) by applying mathematical transformations to the color information at each pixel. Various kinds of transformations (often called *filters* or *effects*) consider the relations between pixels to find edges, for example, and perform sharpening or blurring. The RTI Viewer can also perform color transformations—for instance, it can transform colors into grayscale values, to make a color image into a black-and-white image, and can sharpen in various ways.

While traditional image files record only color information for each pixel, an RTI also records the *normal* at each pixel, providing information about the angle of reflection of the object's surface at that point. The RTI

Viewer can also apply mathematical transformations to the normal information, resulting in reflective enhancements of various kinds.

The *rendering mode* controls how the information in the RTI is transformed to an image on the screen. When you select a rendering mode, the UI provides appropriate controls with which to set the parameters that mode uses.



Not all rendering modes can be applied to all types of images; only those that can be applied to the current image are offered in the drop-down menu.

Basic rendering modes

Rendering mode	Description	Parameters
Default	Presents the image without mathematical enhancement.	none
Diffuse gain	Retains the maximum luminance at the normal direction, but increases the directional sensitivity of the surface to the changing light, using the specified gain factor. This mode enhances the perception of the surface shape of the object.	**Gain**: Adjusts the amount of enhancement.
Specular enhancement	Adds a specular (reflective) effect to the surface of the object, affecting the contrast and brightness. This mode also enhances the perception of the surface shape.	**Kd**: Adjusts the diffusive factor. **Ks**: Adjusts the specular constant. **N**: Adjusts the specular exponent.

Sharpening modes

Sharpening applies an *unsharp mask* to the image data in order to enhance the high frequency details and increase the edge contrast of the image. Sharpening algorithms look for discontinuities in the data that typically indicate edges or shadows in the photographed object. The opposite of sharpening is smoothing, which has the effect of blurring edges in the image. In an RTI, the mask can be applied to the normal data, finding and emphasizing sharp changes in depth as well as color.

RTIViewer offers several variations on the sharpening algorithm:

- Image unsharp masking enhances edge contrast by applying the specified gain factor to image color data.
- Normal unsharp masking enhances surface contrast by applying the specified gain factor to image normal data, as well as color data.
- Luminance unsharp masking creates a different effect, amplifying depth discontinuities without affecting the color, by applying the specified gain factor only to normal data.
- Coefficient unsharp masking emphasizes discontinuities in reflectivity, by applying the gain factor to each coefficient of the reflectance function.

Rendering mode	Description	Parameters
Normal Unsharp Masking	Applies an unsharp mask to the surface normals.	**Gain**: Adjusts the amount of enhancement. **Environment**: Adjusts <<what? >>
Image Unsharp Masking	Applies an unsharp mask to the Y channel of the color space YUV.	**Gain**: Adjusts the amount of enhancement.
Luminance Unsharp Masking	Applies an unsharp mask to the luminance component of an LRGB PTM; cannot be applied to simple RGB files, which do not include luminance data.	**Gain**: Adjusts the amount of enhancement.
Coefficient Unsharp Masking	Applies an unsharp mask to the coefficients of the polynomial of the PTM.	**Gain**: Adjusts the amount of enhancement.

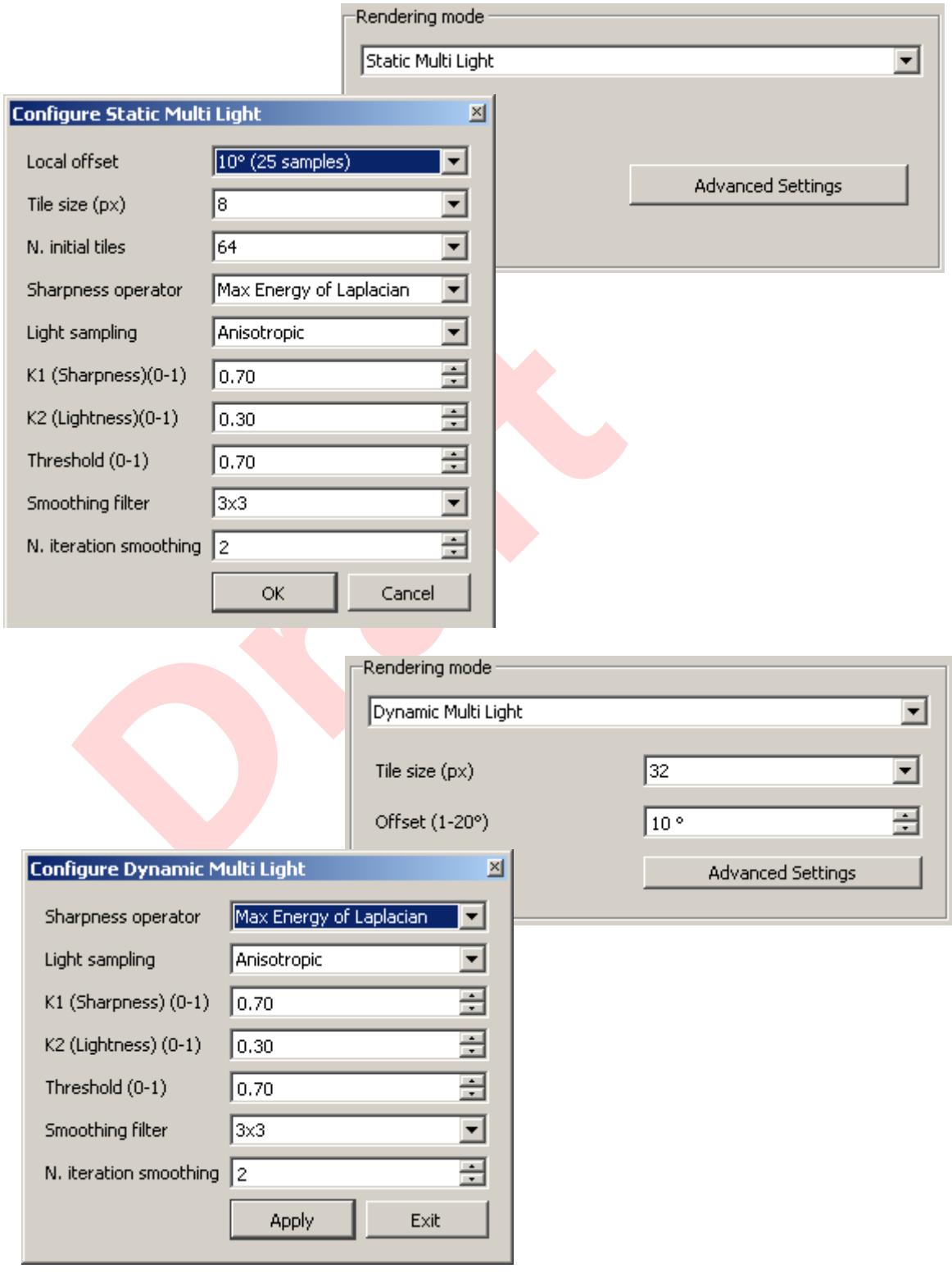
Multi-light enhancement modes

The multi-light enhancement modes illuminate different parts of an image in different ways in order to enhance surface details, optimizing sharpness and brightness.

To do this, the algorithm subdivides the image into tiles, then, for each tile, chooses the light direction that maximizes a chosen *energy function*. You can specify the number and size of the tiles, the energy function to maximize, and various factors in the algorithm.

Static Multi Light	Produces a high-contrast, well-illuminated static image, suitable for stand-alone presentation, high-quality printing, and so on.
Dynamic Multi Light	Adapts the light direction in order to improve the perception of details on the surface.

The two multi-light enhancement modes have a number of parameters that allow you to vary the effects; click **Advanced Settings** to bring up the configuration dialog. The parameters are offered slightly differently for the two modes, but are essentially the same. The dynamic mode offers different defaults and more range of choices (although this means, of course, that the calculations take longer).



Let's have non-mathematical descriptions of the effects, and what the factors change, if possible ie "sharpness/lightness"

Multi-light mode parameters

Local offset

Offset (1-20°)

basic description

- For Static mode, you can choose from these values:

  5° (9 samples)
  10° (25 samples)
  15° (49 samples)

- For Dynamic mode, you can choose any value between 1 and 20 degrees.

Tile size (px)

basic description

- For Static mode, you can choose from these values:

  8
  16
  32

- For Dynamic mode, you can choose from these values:

  0
  8
  16
  24
  32

N. initial tiles

basic description

- For Static mode only, you can choose from these values:

  4
  16
  64

why is this not available for dynamic mode?

Sharpness operator

basic description

- You can choose from these values:

  Max Laplacian
  Max Energy of Laplacian
  L1 norm Sobel
  L2 norm Sobel

Light sampling	*basic description* ▶ You can choose from these values: Isotropic Anisotropic
K1 (Sharpness)(0-1)	*basic description* ▶ You can choose a percentage value from 0.0 to 1.0.
K2 (Lightness)(0-1)	*basic description* ▶ You can choose a percentage value from 0.0 to 1.0.
Threshold (0-1)	*basic description* ▶ You can choose a percentage value from 0.0 to 1.0.
Smoothing filter	*basic description* ▶ You can choose from these values: 3x3 5x5 7x7
N. iteration smoothing	*basic description* ▶ You can choose a value from 0 to 10.