DIGITAL PHOTOGRAPHY AT A HIGHER POWER

STRATA FOTO 3D™

USER GUIDE

STRATA

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Chapter 1

Welcome to

Strata Foto 3D

1.1. Introduction

Strata Foto 3D is an efficient, cost-effective system for modeling real world objects. Powered by 3DSOM's patented model generation and sophisticated texturing technology, Foto 3D allows a 3D model to be created quickly and inexpensively while requiring far less technical skill or expensive hardware than similar systems. Working seamlessly with the Strata family of 3D products, Foto 3D creates models that can be displayed and used in a variety of applications ranging from online product catalogs to 3D computer games. When used in conjunction with modeling software like Strata 3D CX, Strata Foto 3D also allows virtual enhancements to existing products to be prototyped quickly and easily.

Creating a new Foto 3D model involves following a simple workflow:

1. **Photograph**

   - Print and mount the specially designed calibration mat.
   - Place an object on a pedestal that is positioned on the mat.
   - Set in front of a plain color background and under even lighting.
   - Use a digital camera, preferably mounted on a tripod, to take pictures of the object. The object and mat are turned as a unit and about 20 photographs are taken from various angles.
   - Upload the photos to a folder in your computer.
   - Load the images into a new Foto 3D project.

2. **Mask**
    - In each photo, the silhouette of the object is determined by a process called masking. Auto-masking wizards and tools help separate the object from it's background.
3. **Model**
    - The silhouettes are combined to generate a 3D model automatically within a few minutes.
    - The model can be simplified and made more compact by a process called decimation.
    - The model can be smoothed using a tool that detects hard edges and rounds off the faces between those edges while still adhering to the shape required by the silhouettes.
4. **Texture**
    - The photos are then used to automatically paint the surface of the model with a U-V mapped baked-on texture.
    - Several tools help to ensure the texture is seamless and allow it to be changed with an image editor.
5. **Display**
    - The final model can be saved and exported for display in a VRML-enabled web browser that will rotate the object and zoom in on the object's details.
    - The model can also be imported into a 3D editing and rendering software such as Strata 3D CX for further enhancement and for it to be used in scenes and renders.
    - Finally, the model can be imported into Strata Live 3D for interactive 3D display either with a sophisticated Java viewer or within PDF documents such as in a product catalog. (Displayed using Adobe's free Acrobat Reader without a plug-in.)

About this User Guide

This User Guide is laid out to enhance your ability to learn the software quickly. Foto 3D provides some extremely powerful tools for modeling real-life objects, but to understand how to use them well requires a basic knowledge of the entire Foto 3D workflow. This manual has three parts:

Part 1 - Getting Started

Installing and getting acquainted with the software.

- **Chapter 1** will help you get the software loaded and launched.
- **Chapter 2** is a quick tutorial to take you through the steps of building a simple model using the automated wizards.

Part 2 - The Tools and Basic Workflow

Touring the workspace, explanation of each tool and control, and how to use the Wizards that initiate each of the three stages of the Workflow.

- **Chapter 3** gives you a tour of the Workspace, followed by a detailed explanation of the menu items and buttons found on the screen.
- **Chapter 4** helps you setup to photograph your own objects, explaining what the software requires to be able to successfully create a model from your photos.
- **Chapter 5** takes you through the three stages of the workflow used for every model - masking images, generating the wireframe and texturing the surface.

Part 3 - Advanced Techniques

Advanced tools and techniques for each stage of the workflow.

- **Chapter 6** provides recommendations for photographers about how to optimize a photo studio setup for use with Foto 3D.
- **Chapter 7** describes the advanced tools for editing and improving the masks and the wireframe model produced by those Wizards.
- **Chapter 8** describes the advanced tools for editing and improving the surface texture produced by that Wizard.
- **Chapter 9** has suggestions for display, use and rendering of the finished Foto 3D model.

Appendix

The Appendix includes a Glossary, steps for calibrating a lens, support and upgrade options, and a copy of the License Agreement.

1.2. Installing Foto 3D

Before installing Foto 3D, please ensure that the computer meets the following minimum and recommended requirements.

Requirements

PC Hardware

- CPU: Pentium 3 or equivalent, minimum 733MHz; Pentium 4 is recommended.
- Physical RAM: 128MB minimum, 256MB or higher recommended.
- Graphics card capable of supporting 32 bit color (true-color setting).
- 12MB free disk space for software installation.
- Mouse and Keyboard.
- Digital camera: 3Mp or higher resolution recommended.
- Means for uploading images from the camera (USB or firewire cable, card reader or CD/DVD).

Monitor resolution:

- 1024x768 minimum (small system fonts)
- 1152x864 minimum (large system fonts)
- 1280x1024 recommended

Operating System

- Microsoft Windows 2000 (Service Pack 4).
- Microsoft Windows XP

Licensing

In essence, the software license allows you to install the Foto 3D software on a single computer for use by the registered user of that computer. Copies are permitted solely for the purpose of backing up the computer.

Please refer to the End-User Licensing Agreement found in the Appendix and on the installation screen. If you do not understand or agree with all of its terms, do not install the Foto 3D software.

Installation

To install Foto 3D, please insert the CD or download and run the installer **Strata Foto 3D.exe** and follow the on-screen instructions. You will be asked to accept the End-User Licensing Agreement and enter your serial number as part of the installation.

You will be given a choice of "minimum" or "typical/complete" installation. The difference is whether the approximately 24 MB of example files are installed, that are referred to in this User Guide. We recommend installing these files, which will be placed in the "**Examples**" folder in the installation directory. They can be deleted at any time.

When you have finished, you will be able to run Foto 3D either by double-clicking on the icon installed on your desktop or by choosing *Strata Foto 3D* from the Start Menu.

Uninstallation

You can uninstall Foto 3D by using the Windows Add/Remove Programs Wizard found in the Control Panel. If you have modified the example projects or saved other projects to the program installation directories, your new or modified files will be left where you saved them. All other files will be removed.

Chapter 2

Getting Started

2.1. A Tutorial for Creating Your First Model

This tutorial will guide you through making your first model and trying out the basic features in Foto 3D. Some of the example photos we will use in this book are intentionally not very good. You will see that the lighting has a color cast, the white balance was not set correctly, the images are under-exposed and lack contrast, and there are some strong reflections. These imperfections in the photography will help demonstrate the power of the features and automated tools found in Foto 3D. In later chapters, we will revisit these examples to demonstrate some of the more sophisticated tools and options.

Figure 2.1.1. New Installation Welcome Screen.

Step 1

Launch the Foto 3D program. The Welcome screen will be displayed.

Step 2

These Welcome Screen buttons are somewhat self-explanatory. The first button labeled "Load the Images and Build the Example Project" launches the "Make All" wizard, described below, which automatically executes all the steps of this tutorial. While it is a powerful feature, and may even be entertaining to watch, it won't teach you very much.

The second button will load the finished project so that you may try the various texture editing features!

For the purposes of this tutorial, we will begin a project the usual way. Click the third button, "Start using Strata Foto 3D for your own project" to close this Welcome Screen and display the program's workspace.

Step 3

In the Main Toolbar, click the first button, the **New project...** button to begin a new model. An “Open” image files dialog box will appear.

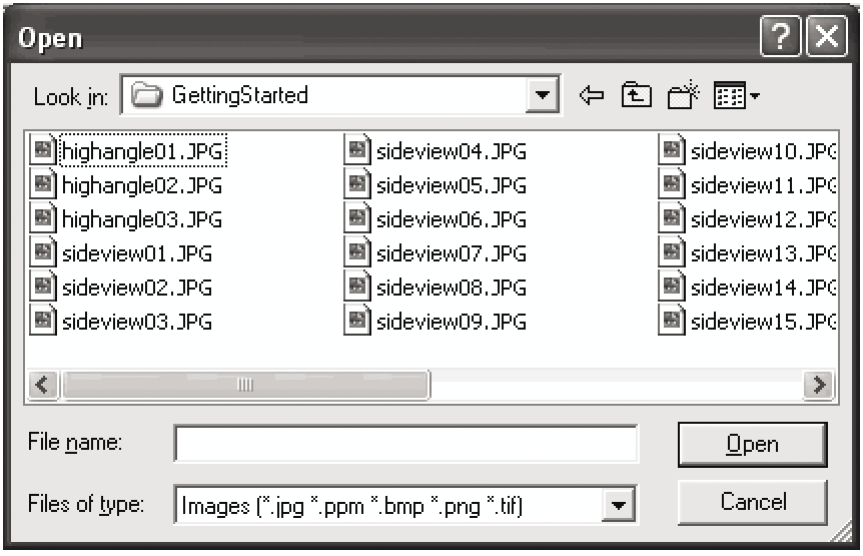


Figure 2.1.2. New Project - Open Image files dialog box.

Step 4

The "Open" image files dialog box allows you to select the photos you want to use to create a new model. For the purpose of this tutorial, we have included a set of photos for you to use. Navigate to the **Examples\FossilBox** directory installed with the application. (If you used the installation defaults, the full path will be **c:\Program Files\Strata\Strata Foto 3D\Examples\FossilBox**.) Click on and select the first photo, then hold down the Shift key and click on the last photo to highlight all the photos in the folder. Then click **"Open"** to start the loading process.

Step 5

You should now see the following view.

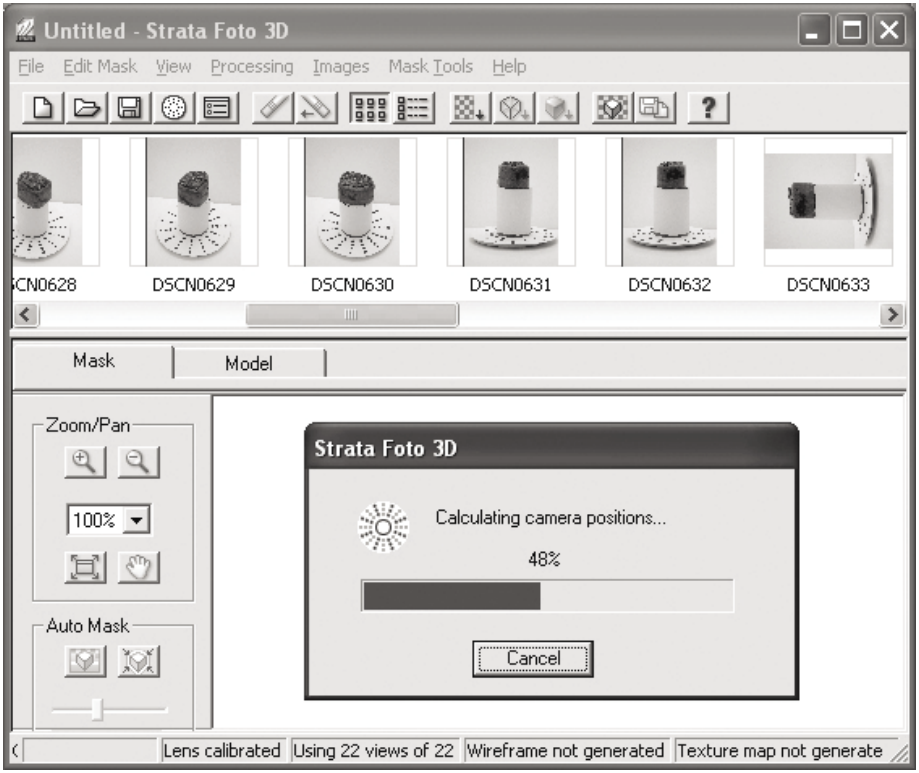


Figure 2.1.3. Foto 3D Main Window with the *Mask Window* selected.

The upper half of the workspace window includes a standard Windows Menubar and the Main Toolbar. The lower half of the window displays either the *Mask Window* or the *Model Window* and their associated palette of tools and settings. Across the bottom, a status bar displays help about the currently selected tool and information about the current project.

As the selected photos are loaded, you will see a progress bar as the camera angles are analyzed and thumbnails are added to the *Thumbnail Window*. A warning dialog will display for any images in which the Foto 3D calibration mat is not visible and therefore the camera angle cannot be determined. These images will be automatically tagged as "rejected" from the automated modeling process and appear marked with an "X". This is normal for photos taken of the underside of an object. A later chapter will tell you how to align and use these photos to add detail to the model. For now, simply click "OK" for the process to continue until all of the images are loaded.

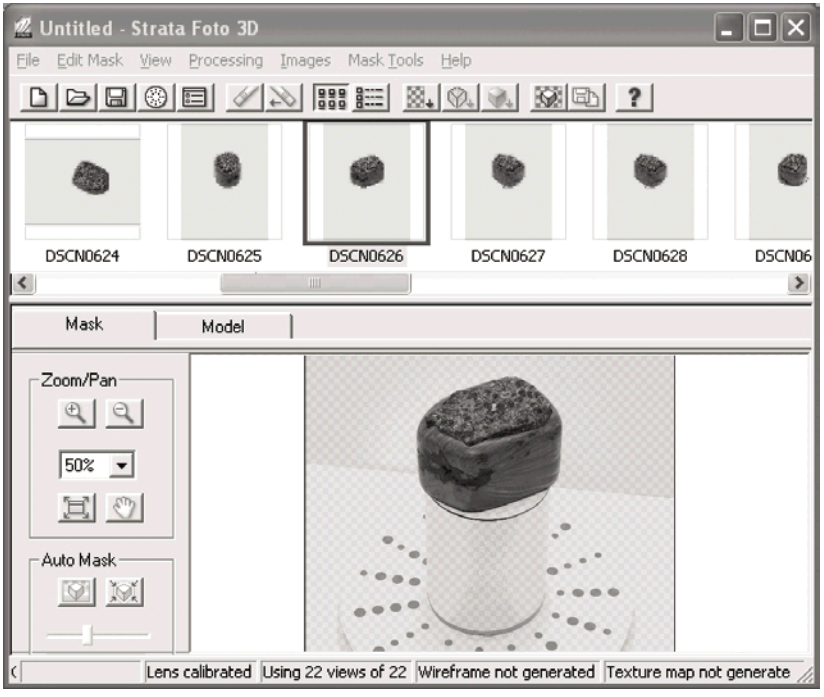


Figure 2.1.4. A photo with semi-transparent mask displayed in the *Mask Window*.

Step 6

We will now use Foto 3D's auto-masking tool. In the Main Toolbar, click the **Mask all images...** button to start the wizard and for this first try, use the default settings. The wizard will attempt to mask each of the images in order to isolate the object from it's background. At the conclusion of the process, click **"Finish"** to close the wizard. Each mask may be examined by clicking image thumbnails. The masked area will display in a selected mask color like red and also with some transparency in the display window.

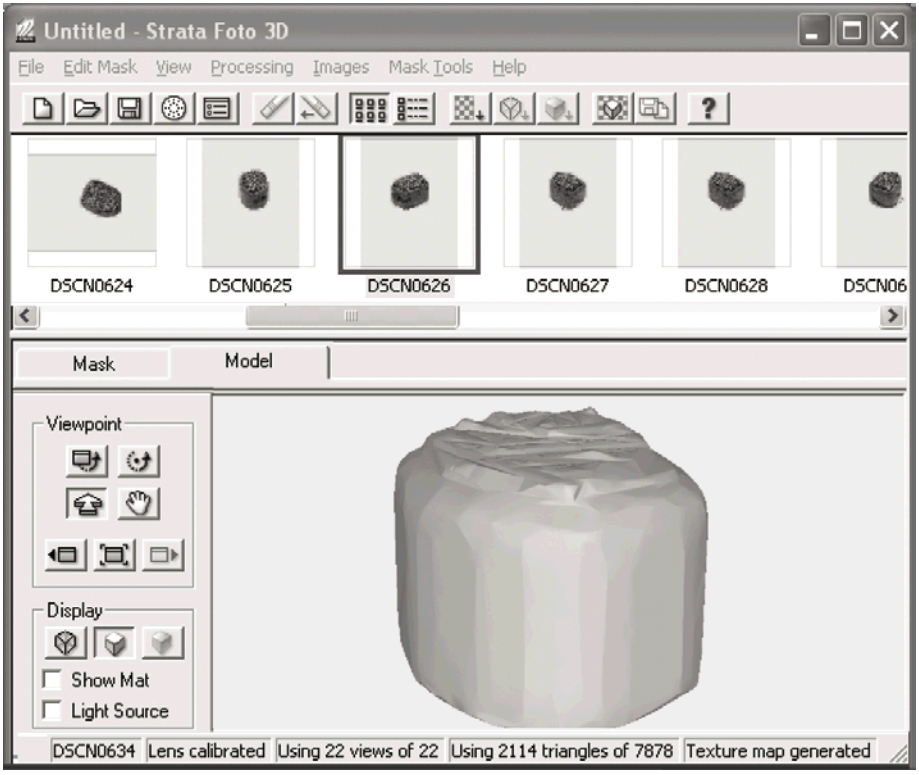


Figure 2.1.5. A generated model displayed in "flat shaded mode" in the *Model Window*.

Step 7

The next step is for the software to trace the outline of the object in each of the photographs and construct a 3D wireframe model of the object. In the Main Toolbar, click the **Generate Wireframe...** button to start the Wireframe Generation Wizard. Choose the "Generate Wireframe" option and, again, use the default settings. You will see the resulting triangular mesh. Choose the "Optimize Surface" option to produce a finer grain, more precise mesh.

At the conclusion of the process, click **"Finish"** to close the wizard. As the wizard closes, a process called decimation is initiated to simplify the wireframe in order to reduce memory requirements and loading time when displaying or rendering the finished model. The resulting 3D wireframe model may be examined and rotated in the display window.

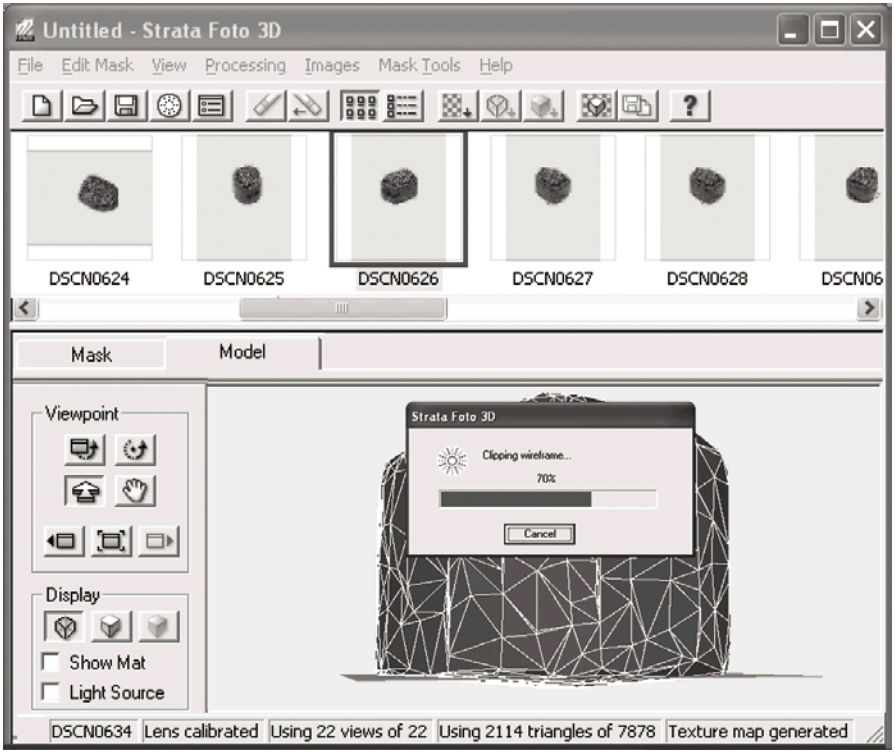


Figure 2.1.6. A decimated wireframe model displayed in "wireframe mode" with the clipping plane being applied to trim the bottom.

Step 8

The automatic masking tool may not always identify where the object ends and the pedestal it is sitting upon begins, particularly if the object is casting a shadow onto the pedestal. While the model's photos and masks for this area can be refined, it is easier to trim off the excess geometry using the "Clipping Plane" tool. On the left side of the *Model Window* appears the Model Palette, a toolbox that contains buttons in a grouping called "Edit Geometry". Click on the middle, **Move clip plane** button and drag the blue clipping plane, that now appears in the main display area, up to the place where you want to shave off the bottom of the mesh that corresponds with the pedestal. Once the plane is in position, click on the right, **Clip model** button to complete the trimming process.

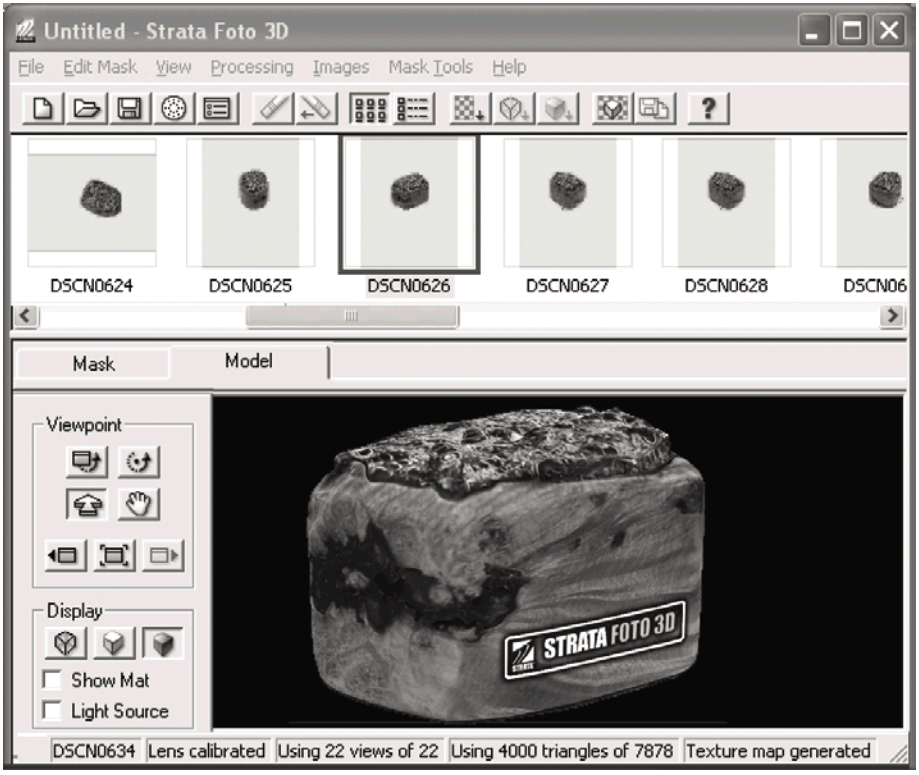


Figure 2.1.7. A finished textured model (with a logo applied as a decal - Chapter 8.)

Step 9

Now that we have a model, we will proceed to paint the surface texture using the same photos. In the Main Toolbar, click the **Generate texture map...** button to start the Texture Generation Wizard.

Once again, use the default settings. As each photo is processed, you will see the painted texture being updated with the surface color detail obtained from that photo. At the conclusion of the process, click "Finish" to close the wizard.

Step 10

We are now ready to save and export the finished model. Click the **Save project** button to give the project a name and save it in the folder containing the photos (optional but recommended).

Click the **Export model...** button (disabled in the unlicensed demo version) to export the model and texture. Use the default VRML World format to write the model as a VRML 2 .WRL file with .jpg texture that is recognized by many 3D modeling programs, web browsers and viewers. If you have a VRML viewer installed on your computer, that viewer will be launched to display the file. VRML is also the preferred format to pass the new model and it's texture into Strata 3D CX or similar 3D scene modeling and rendering software and to Strata Live 3D for creating interactive web displays and exciting 3D PDF files that can be displayed with Adobe's free Acrobat Reader (version 7 and higher).

Chapter 3

Foto 3D Workspace and Tool Reference

3.1. Tour the Foto 3D Workspace

A typical view of Foto 3D is shown in Figure 3.1.1.

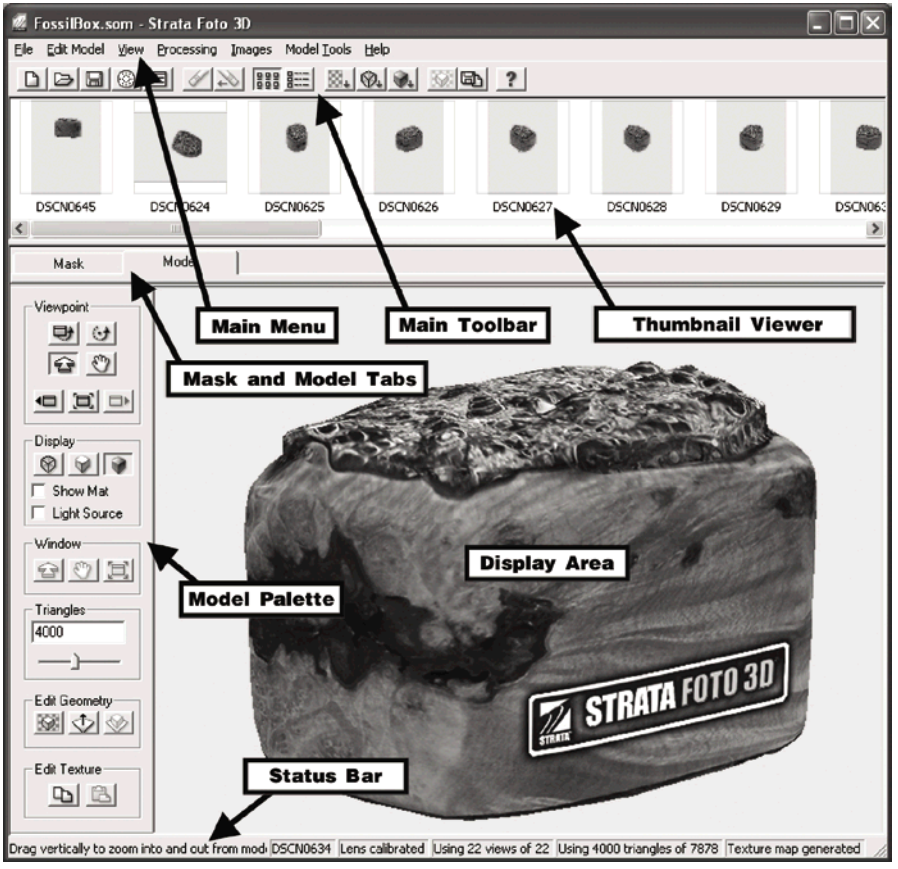


Figure 3.1.1. Foto 3D workspace with the *Model Window* tab selected.

So that you can follow along on your screen, we have included a project file for you to use. In the Main Toolbar, click the **Open project...** button to open an existing project. The Examples folder installed with the application has several sets of photos and project files for you to experiment with to learn the software. In this case, navigate to the **Examples\FossilBox** directory installed with the application. (If you used the installation defaults, the full path will be **c:\Program Files\Strata\Strata Foto 3D\Examples\FossilBox**.) Click on and select the project file named **fossilbox.som** and click "Open" to load the project. You should now see the same view as Figure 3.1.1.

As described before, the upper half of the screen includes a standard Windows Menubar, the Main Toolbar and the *Thumbnail Window*. The lower half of the screen displays either the *Mask Window* or the *Model Window* and on the left is a tool palette with the tools and settings associated with each of these views. Across the bottom, a status bar displays tips about the currently selected tool and information about the project's status. Each of these elements is described below.

The Main Toolbar

This toolbar is used to perform most major operations on a Foto 3D project. You can toggle whether it is displayed or not using the **View > Toolbar** menu item. Each of the buttons in the toolbar is described in detail in section 3.2, The Main Toolbar, later in this chapter.

The Status Bar

The status bar is shown across the bottom of the Foto 3D window. You can toggle whether it is displayed using the **View > Status Bar** menu item.

TIP: To quickly find out what a button does, hover over the button with the mouse to display a brief tooltip. Also look at the text displayed at the left side of the status bar for further details and options.

At the right end of the Status Bar are a series of information fields relating to the current project, including:

- The filename of the photo that is currently displayed in the *Mask Window* or the closest photo to the current viewpoint displayed in the *Model Window*.
- How many images are currently loaded in the project and how many of those are in use.
- If a model has been generated, how many triangles are in the displayed model.
- Whether a texture map has been created.

The Thumbnail Window

This area is used to manage the photos or images that are associated with the current Foto 3D Project. By default, the images are displayed as thumbnails, but can be shown as a list with detailed information about each image by selecting the **View image details** button. Selecting the **View as icons** button will return to viewing thumbnails.

Click and drag the horizontal bar below the *Thumbnail Window*, moving it up or down, to alter how much of the screen height is used to display thumbnails.

TIP: In thumbnail mode, detailed information about an image is displayed as a tooltip when you hover over it's thumbnail.

Most operations from the **Images** menu, such as the **Images > Delete Images** menu item, are performed on the currently selected set of thumbnails. Images can be selected by clicking them or dragging a selection rectangle around them. The SHIFT key can be used to select a range of image files and the CTRL key to add or remove the clicked file from the current selection.

TIP: Double-clicking on a thumbnail is a shortcut for the **Images > Edit Mask** menu item and loads that image into the Mask Window.

All the operations available in the *Thumbnail Window*, together with descriptions of the information that can be displayed for each image, are described more fully in The Thumbnail Window section that follows.

The Mask Window

Click on the **Mask** tab to display this window and the **Mask Palette** of tools. Use this view to examine and edit the *mask* for a particular photo. You can zoom into a mask to see more detail using tools found in the *Mask* palette.

In the *Mask* palette, there is also a set of tools for automating the masking process. These are described in detail in the Fine Tuning the Auto-Masking Process section of Chapter 7. There is also a set of tools for manually editing masks.

TIP: In addition to the buttons on the *Mask* palette, you can right-click in the *Mask Window* to view the context menu and access more options.

For a detailed description of all the tools and operations available in this window, see The Mask Window and Palette section later in this Chapter.

The Model Window

Click on the **Model** tab to display this window and the **Model Palette** of tools. This window is used to display the 3D *model* that is being generated by Foto 3D. You can use the tools in the Model Palette to rotate the object and zoom in to look at it in detail.

TIP: Use the  **Reset view** button to return to the default viewing position.

Viewpoint navigation buttons allow you to change how the model is displayed. There are also controls for editing the model's geometry including altering the number of triangles used to construct it, clipping away the pedestal the model was sitting upon, and editing its texture.

TIP: In addition to the buttons on the *Model* palette, you can right-click in the *Model Window* to view the context menu and access more options.

For a detailed description of all the tools and operations available in this window, see The Model Window and Palette section later in this Chapter.

Reference Guide

The remainder of this chapter serves primarily as a Reference Guide to identify each of the tools and controls that are available on the screen and briefly explain their purpose. Subsequent chapters will discuss how and when to use these tools effectively.

3.2. The Main Toolbar

Figure 3.2.1. Main Toolbar

The Main Toolbar is used to perform most major operations on a Foto 3D project. You can toggle whether it is displayed by using the **View > Toolbar** menu item. The buttons on the toolbar are shortcuts to certain highly-used menu items. These highly-used menu items are being listed first, in the order that their buttons appear on the toolbar.
In the section following this one is a list of the remaining Main Menu items and their functions.

Project Operations

The **New project...** button closes the current project and starts a new one, prompting you to select the images to use to begin the new project. You can select more than one image by dragging a selection rectangle round the filenames or by using the Shift and Ctrl keys to add or remove files from the selection. All the images should be in the same directory, but can be saved in different formats. You can always add more images later by using the **Images > Add Images...** menu item.

The **Open project...** button closes the current project and opens a previously saved project. Foto 3D will try to find the images used in the project based upon the folder they were located in when you last saved the project. If they are not found there, it will look in the same directory as the project file itself. Finally, if they still can not be found, you will be

prompted to locate the images. Canceling this image loading process will allow the project model and its texture to be loaded. You can still generate a new wireframe or texture, or perform any other tasks that require accessing the photos and their masks.

The **Save project** button saves the current state of the project. If you haven't previously saved the project, you will be prompted for a filename. Note that the undo information is not saved with the project and neither are the source photos, nor their masks as image files that can be used in another project. (See Images > Masking > Save Masks) Unless you do not wish to edit the project further, the original photos should be retained with the project file in order to resume working with the project at a later time.

The **Print mat...** button is used to print out the *calibration mat*. This will open a print dialog so you can choose the printer to use. You can change the size of the mat from the page setup dialog by choosing the **File > Page Setup...** menu item.

The **Change settings...** button opens the *Strata Foto 3D Settings Window* where you can alter various settings associated with the application and current project. The current settings are saved when you close Foto 3D and are reloaded as defaults the next time you start the program. Most project settings are also saved into and reloaded from the Foto 3D Project file.

Editing

The **Undo model or mask change** button returns either the currently displayed mask (when the *Mask Window* is active) or the model (when the *Model Window* is active) to its state before the previous operation. Recent changes to a mask can be undone, as can any operation that modifies the model geometry or texture map.

Note: Changes made directly to the image files used in the project such as changing their file type or deleting them from the project are not kept in the history and cannot be undone.

The  **Redo model or mask change** button re-applies the last operation that has been undone as long as it is selected right after using the **Edit Model > Undo Model Edit** menu item. It will apply either to the currently loaded mask or the model depending on whether the *Mask Window* or the *Model Window* was active at the time of the Undo.

View Controls

The  **View as icons** button switches the *Thumbnail Window* to displaying thumbnails for each image.

The  **View image details** button switches the *Thumbnail Window* to displaying a columnar list of the project's image files, together with their attributes and details.

Model Generation

The  **Mask all images...** button opens the **Generate Masks Wizard** to guide you through automatically creating masks for an active selection or all of the loaded and "included" images. See the section Masking Photographs for more details.

The  **Generate Wireframe...** button opens the **Generate Wireframe Wizard** to guide you through creating the 3D Wireframe model of the object and optimizing the surface geometry. See the section Building the Wireframe Model for more details.

The  **Generate texture map...** button opens the **Generate Texture Wizard** to guide you through generating a new texture for the model. See the section Adding Surface Texture for more details.

The  **Make all** button can be used to build a complete model automatically. It will create a new project, prompting you to select photos. It then proceeds to open and run the three main wizards, the **Mask Generation Wizard**, the **Wireframe Generation Wizard**, and the **Texture Generation Wizard** in succession, and then opens the *Export Window* ready for you to choose how to save your finished model. You can interrupt this process at any point by interacting with one of the wizards; for example, clicking a **Back** button.

Export

The **Export model...** button opens the *Export Window* for exporting the finished model. The section Displaying and Exporting the Finished Model describes the options available.

Help

The **User Guide...** button opens the help browser and displays this User Guide.

3.3. The Main Menu

File menu

The **File > New** menu item begins a new project, the same as the **New project...** button described previously in the preceding section about The Main Toolbar.

The **File > Open...** menu item opens an existing project, the same as the **Open project...** button described in the preceding section.

The **File > Close** menu item closes the current project. You will be prompted to save the project first if you have made any unsaved changes.

The **File > Save** menu item saves the current project, the same as the **Save project** button described previously.

The **File > Save As...** menu item saves the current state of the project similar to the **File > Save** menu item but allows a different file name to be entered.

The **File > Page Setup...** menu item allows you to decide how big to print the *calibration mat*. You can either set the diameter of the mat or choose to fit it onto a chosen number of pages. When printing across multiple pages, you will need to combine the pages accurately using the markings provided.

The **File > Print Preview...** menu item displays a preview of the *calibration mat* so you can see how it will print on your chosen printer.

The **File > Print Mat...** menu item prints a calibration mat, the same as the **Print mat...** button described previously.

The **File > Settings...** menu item opens the preference settings window, the same as the **Change settings...** button described previously.

The **File > Export...** menu item exports the finished model, the same as the **Export model...** button described previously.

The **File > Exit** menu item closes Foto 3D prompting you to save any unsaved project first.

The **Main Menu > File** menu also contains a list of up to four of the most recently opened files as a shortcut for opening these projects.

Edit menu

The **Edit Model > Undo Model Edit** menu item will undo the latest revision to the item displayed in the work area, the same as the **Undo model or mask change** button described previously.

The **Edit Model > Redo Model Edit** menu item will reapply the most recent change to the item displayed in the work area that was reversed by the **Edit Model > Undo Model Edit** menu item, the same as the **Redo model or mask change** button described previously.

The **Edit > Copy** menu item (when the *Model Window* is active and the texture map has been generated) copies the current view of the model onto the Windows clipboard ready for texture editing in an external application.

The **Edit > Paste** menu item (when the *Model Window* is active) blends the image on the Windows clipboard back into the texture map.
The image on the clipboard must be the same size as the other images in the project and should be an edited version of an image obtained using the **Texture Editing > Copy Texture** menu item.

View menu

The **View > View Image Thumbnails** menu item will display the project's images as thumbnails in the *Thumbnail Window*, the same as the **View as icons** button described previously.

The **View > View Image Details** menu item will display the project's images as a detailed list in the *Thumbnail Window*, the same as the  **View image details** button described previously.

The **View > Mask Palette** menu item activates the *Mask Window* for viewing and editing masks, hiding the *Model Window*.

The **View > Model Palette** menu item activates the *Model Window* for viewing and editing the model, hiding the *Mask Window*.

The **View > Toolbar** menu item toggles the display of the Main Toolbar at the top of the Foto 3D window.

The **View > Palette** menu item toggles the display of the *Mask* palette associated with the *Mask Window* and the *Model* palette associated with the *Mask Window*.

The **View > Status Bar** menu item toggles the display of the Status Bar at the bottom of the Foto 3D window.

Processing menu

The **Processing > Make All** menu item will launch the Make All Wizard, the same as the  **Make all** button described previously.

The **Processing > Mask All Images...** menu item will launch the Mask Wizard, the same as the **Mask all images...** button described previously.

The **Processing > Generate Wireframe...** menu item will launch the Generate Wireframe Wizard, the same as the  **Generate Wireframe...** button described previously.

The **Processing > Generate Texture Map...** menu item will launch the Generate Texture Wizard, the same as the  **Generate texture map...** button described previously.

Images menu

This menu is described under The Thumbnail Window section later in this Chapter.

Mask Tools menu and Model Tools menu

These menus are described later in this Chapter under The Mask Window and Palette and The Model Window and Palette sections, respectively.

Help menu

The **Help > User Guide...** menu item will display this User Guide, the same as the **User Guide...** button described previously.

The **Help > About Strata Foto 3D ...** menu item opens a dialog with information about the current version of the software and credits.

3.4. The Thumbnail Window

This section describes how to manage the images in a Foto 3D Project using the *Thumbnail Window* and how to perform operations on multiple images at once.

The **Images** menu can be accessed either from the Main Menubar or by right-clicking in the *Thumbnail Window*.

TIP: If the project contains more images than will fit on the screen and you are doing a lot of work with the *Thumbnail Window*, try dragging the separator below the *Thumbnail Window* down so that the images are displayed in more than one row.

Organizing Images in Thumbnail Mode

Clicking the **View as icons** button will switch to "thumbnail mode" (the default when a project is loaded or created).

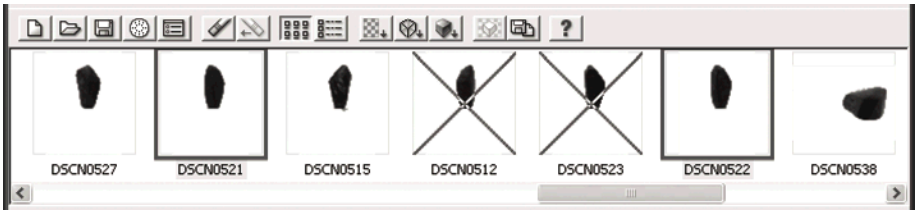


Figure 3.4.1. The *Thumbnail Window* in thumbnail mode with some images selected and some marked "rejected".

The thumbnails are initially shown in the order in which they were added to the project. If you change the current sort order when viewing the list of images in details mode, then the thumbnails will be displayed sorted in the same order (see Organizing Images in Details Mode). When multiple rows of thumbnails are visible, note that the images are sorted down the rows, then across the columns.

If the camera orientation can be determined for an image, the image will be displayed rotated so that the object is displayed upright - this may be a different orientation than the original image file in the project folder.

You can select one or more thumbnails using the mouse or keyboard. Clicking on an image selects it. Dragging a selection marquee around a region of thumbnails will select the group. Holding down SHIFT key will add or remove the range of images between the last selected image and the current one. Holding down the CTRL key will add or remove clicked files from the current selection. The cursor keys can also be used to navigate around the thumbnails.

Hovering over one of the thumbnails will bring up a tooltip with the details for that image. These details are described in the Image Properties section.

TIP: When you load a saved project with lots of images, you can cancel the thumbnail loading if you are not interested in seeing them. You will still be able to perform operations on these images.

You can load a single thumbnail when the Mask Window is displayed by double-clicking on it or dragging it into the Mask Window for editing.

You can load (or reload) the thumbnails at any time by using the **Images > Load Thumbnails** menu item.

Organizing Images in Details Mode

Clicking the **View image details** button will switch to "details mode". Each image is displayed as a row in this mode with the various information associated with it in columns to the right of the image file

name as shown in Figure 3.4.2. The contents of the columns are described under Image Properties, below.

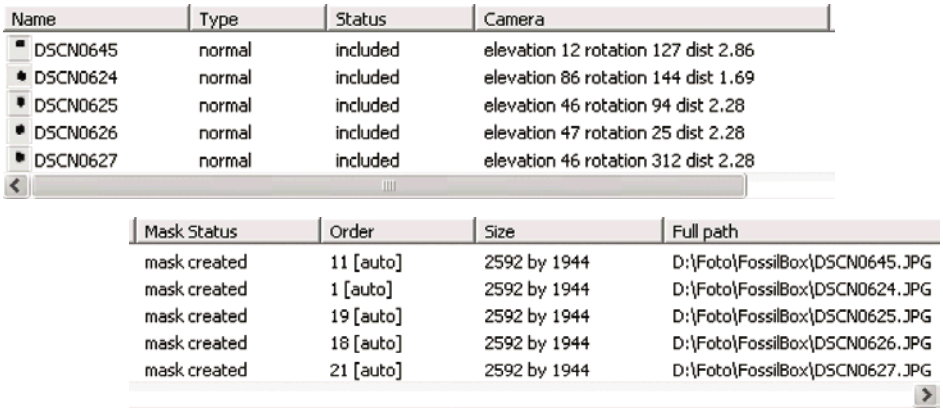


Figure 3.4.2. The *Thumbnail Window* in details mode.

You can sort the images by any column by clicking on the column header. Clicking a second time reverses the sort order and a third time returns to project order. An arrow in the column header shows which column, if any, is determining the sort order. The sort order also affects the order thumbnails are displayed when switched to thumbnail mode.

You can also change the display order of the columns by dragging the column headers to a new position. You can change the display width of a column by dragging the separator between the column headers.

Image Properties

This section describes the properties that are associated with each image and how they can be changed. You can see the properties for an image by hovering the mouse over it in thumbnail mode or by switching to details mode using the **View image details** button.

"Name"

By default this is the filename of the image (without the path or extension), but if you wish, you can edit this to be more meaningful. This is useful in the thumbnail view where this is the only information displayed next to an image.

Changing this image name only affects how it is displayed, it will not rename the associated image file in the project folder.

"Type"

Most images are described as ***"normal"***, which means that the mask associated with the image will be used to generate the geometry and the color information in the image will be used to generate the texture.

You can change how selected images are used by the software with the **Images > Image Type** menu (found on the Main Menu or the right-click context menu). Selecting the **Image Type > Geometry Only** menu item changes the type to ***"silhouette"*** while selecting the **Image Type > Texture Only** menu item changes the type to ***"texture"***. Finally, if the image has been created by the **Geometry Editing > Create Silhouette** menu item, then the type will be ***"synthetic"***.

"Status"

Images can be marked as ***"rejected"*** by selecting them and then choosing the **Images > Reject Images** menu item or right-clicking in the Thumbnail Viewer and selecting the **Reject Images** menu item. Being marked ***"rejected"*** means that subsequent operations will ignore the image. In *thumbnail mode*, an "X" is drawn over the image; in *details mode* the "X" is over the icon at the beginning of the line. By default, all images with a visible calibration mat will be ***"included"***.

This field will display ***"aligning"*** if this image is currently being aligned with the *Align Wizard*.

"Camera"

When an image is loaded into Foto 3D for the first time, the software automatically attempts to determine the camera's position relative to the object. It does this by locating and analyzing how the *calibration mat* appears in the image. The camera elevation and rotation angles are displayed in this field (to the nearest degree) as well as a number representing a relative distance to the object.

In some cases, this field will indicate that the camera location is not known for an image. Such an image will initially be marked as *rejected* since, without knowing the camera position, it cannot be used.
To manually specify the camera position, use the **Images > Align Image...** menu item as described in the section Adding Texture to the Bottom of an Object found in Chapter 8.

"Mask Status"

This field displays ***"mask created"*** if a mask exists for this image.

"Order"

This field displays the ordering and importance weighting of the images according to which images contribute the most information to the final shape and texture. There are several operations that process images using this order, such as surface optimization and texture generation.

Advanced users can override the automatic ordering by using your own knowledge of the object to mark selected images as higher priority by using the **Images > Image Order** menu item.

"Size"

This field displays the size of the source image in pixels.

"Full path"

This field displays the full path and file name of the image file.
If the thumbnail image has not been loaded, this will be the last known location of the image. When a saved project is reopened, Foto 3D will look for the image in its last known location. If it can't be found, it will look in the same directory as the project file, and if it still can't be found there, the user will be prompted to locate the file.

The Images Menu

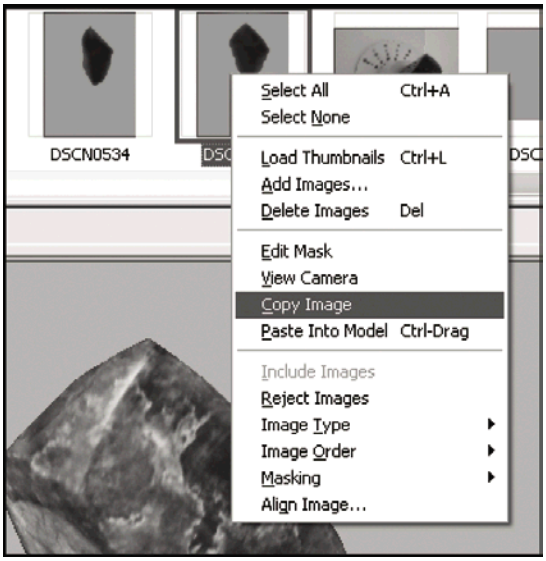


Figure 3.4.3. The right-click context menu for the Thumbnail Viewer.

Managing Images

The **Images > Select All** menu item and the **Images > Select None** menu item can be used as shortcuts for selecting images. Operations that usually work on a selection of image thumbnails will, by default, be applied to *all images* if none are selected.

Choosing the **Images > Load Thumbnails** menu item will select any unloaded thumbnails from the currently selected images and attempt to load them from the source image files on disk. If all the selected images have already had their thumbnails loaded, then they will all be refreshed from the source image files (in the event the files were edited externally).

Use the **Images > Add Images...** menu item to add new images to the project. You will be prompted to select one or more files from the hard drive and then each will be added in turn. As the images are added, the camera position is calculated. If this fails (usually because the calibration mat isn't in the photograph) you will be notified and the image will be *rejected*. As will be explained in Chapter 8, you will need to align these images by hand using the *Align Wizard*.

A photo may be added more than once to the same project. As will be described in Chapter 8, this is useful for having one instance of a photo that is set to "geometry only" and masked to define the object's silhouette, and another instance that is set to "texture only" and is masked to exclude reflections that you do not want to appear in the model's texture map.

Note: Foto 3D will only operate with images that are all the same size (dimensions in pixels) and orientation. Images of different sizes *can* be added to the project for convenience, but will be marked as *rejected*.

To remove images from the project, select them and then choose the **Images > Delete Images** menu item. This will leave the image intact in the project folder, but will destroy any unsaved mask created in Foto 3D and remove the image from the project database.
Note: An image deletion cannot be undone; an accidentally deleted image would have to be re-added to the project.

Using images

Choosing the **Images > Edit Mask** menu item, or simply double-clicking on a thumbnail when the Mask Window is displayed or dragging that thumbnail onto the display area will load the selected image into the *Mask Window* for viewing or editing the mask.

Choosing the **Images > View Camera** menu item, or simply double-clicking on a thumbnail with the Model Window displayed or dragging that thumbnail onto the display area, will change the camera viewpoint in the *Model Window* to match the camera position used to take the selected image.

Choosing the **Images > Copy Image** menu item places a copy of the selected image in the Windows clipboard so that it can easily be pasted into an external image editor like Photoshop. The image will have been subsampled and color adjusted, if these options are chosen, so it will blend with the other images used to make the texture map. (Making a duplicate of an image in order to apply a different mask is accomplished by loading a second instance of the photo by using the **Images > Add Images...** menu item.)

Once the model geometry has been generated, you can choose the **Images > Paste Into Model** menu item to blend a selected image into the texture map.

Operations on Images

The **Images > Include Images** menu item works to "unreject" any images you previously chose to reject. It will mark the selected images as ***"included"*** (no longer *rejected*) so that they are used in subsequent operations. To be ***"included"***, images must be the same size and have a defined camera position - if the camera position wizard rejected the images, you will be unable to change their status using this command. (Use the **Images > Align Image...** menu item)

The **Images > Reject Images** menu item will mark the selected images as "rejected" so that they are ignored for subsequent operations including masking, wireframe model generation and texture generation. Images that are *rejected* can be left as-is and ignored, deleted from the project, or aligned manually and then ***"included"***.

The **Images > Image Type** menu allows the image's type or purpose (such as "geometry only" or "texture only")to be altered as described in the Image Properties section.

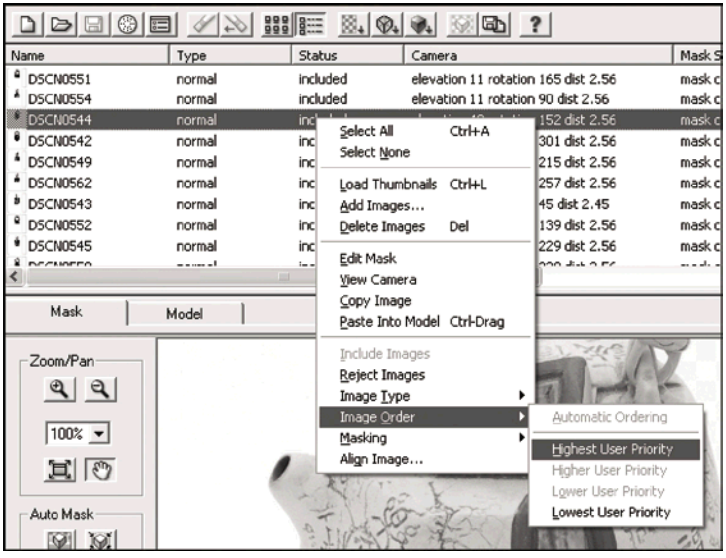


Figure 3.4.4. Changing image to Highest Importance using the Image Order menu.

The **Images > Image Order** menu allows the order of the images to be altered. Images are often processed in the default "project order" as described in the *Image Properties* section, but you can use this menu to mark selected images as high priority and emphasize these images by selecting ***"Image Boosting"*** in the *Texture Generation Wizard*.

The **Images > Masking** menu allows you to work on the masks associated with the selected image thumbnails.

The **Images > Align Image...** menu item allows you to align additional photographs taken without the *calibration mat* or taken after the object has been moved. See the section Adding Texture to the Bottom of an Object in Chapter 8 for details.

3.5. The Mask Window and Palette

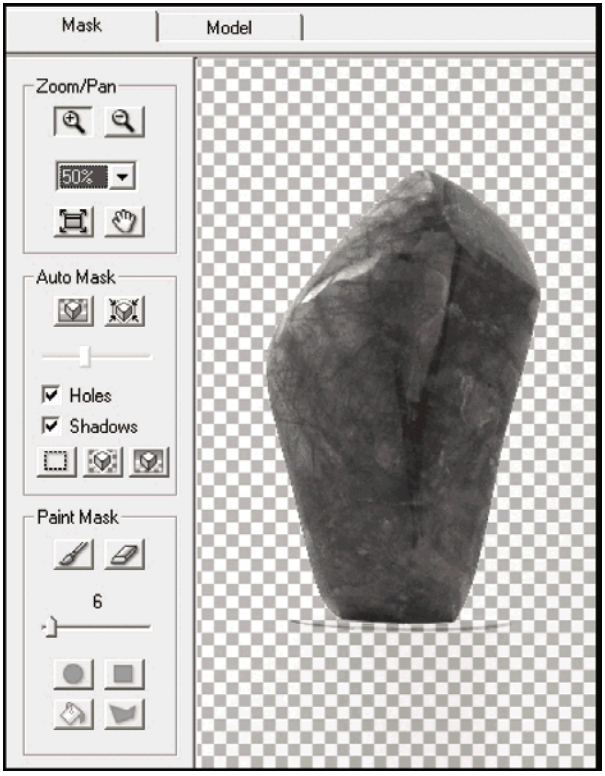


Figure 3.5.1. The Mask Window containing the Mask Palette and Mask Display Area.

This section on the *Mask Window and Palette* describes the tools available for examining and editing the *mask* associated with each image in the project. Please read Chapter 7 to understand when and why you might want to do this plus tips for using the tools effectively.

Except for the interactive masking slider, all the masking tools available from the *Mask* palette can also be accessed from the **Main Menu > Mask Tools** menu or by right-clicking in the *Mask Window* Display Area. This Palette of masking tools can be displayed either from the Main Menu by selecting the **View > Mask Palette** menu item, or by clicking on the **Mask** tab.

How Masks Affect the 3D Model

This brief conceptual explanation is to help you understand the purpose of the mask tools and how to get the most out of them. A more detailed and illustrated explanation is provided in Chapter 6.

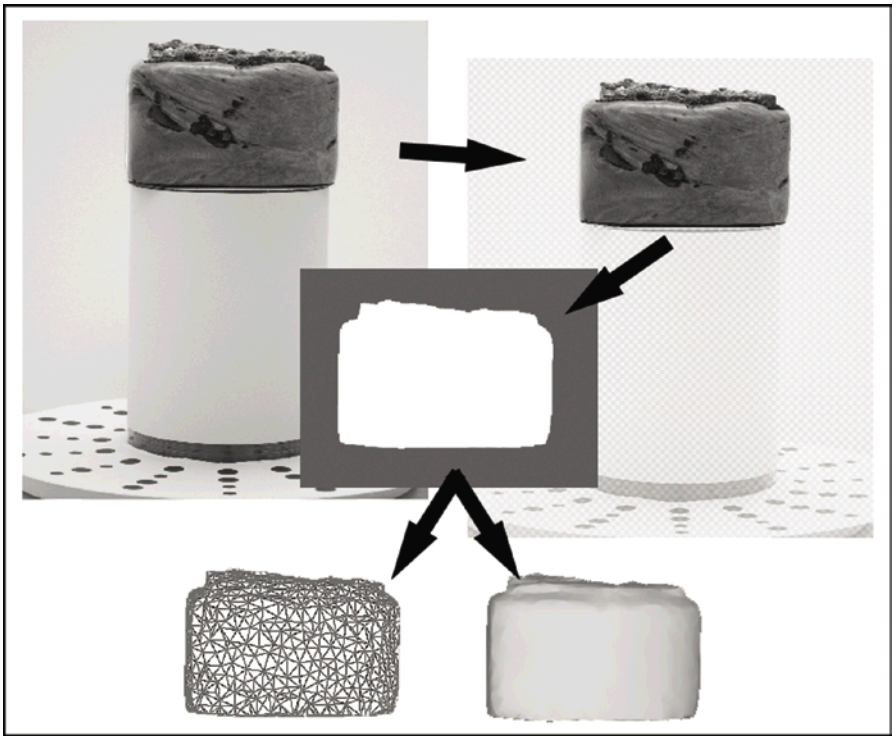


Figure 3.5.2. Photo -> Masked Photo -> Silhouette -> Wireframe and Shaded Mesh

A mask is created to identify the outline or silhouette of the object, as seen from the camera's viewpoint. The *Generate Wireframe* process which constructs the 3D model can be visualized as a sculptor taking a block of clay and projecting each image mask onto it from the viewpoint of the camera. Wherever the projected mask appears on the clay, the clay is sliced away until the model's silhouette matches the masked silhouette obtained from the object's photo taken from that perspective.

Because previously processed masks may have fully cut away a particular area of clay, some masks may have little or no effect, especially if the mask is not set tight to the object in that view. For this reason, not every image needs to be masked. Sometimes only portions of images that clearly show an important profile or areas of needed detail need to be precisely masked to improve the precision of the model.

This also explains why none of the masks can cut into the object as once the clay is removed; the model is deformed and will only be restored by correcting the mask and generating the wireframe model over again.

There are two primary mechanisms that cause the auto-masking tools to produce inferior models. One is that a shiny surface can reflect the background and, especially if the allow *"Holes"* feature is checked, these regions can be mistakenly perceived as holes in the object. It only takes one image with these reflections masked as "background" to deform the resulting model.

The other mechanism is when areas of the model do not have enough contrast or color difference from the background and the mask penetrates into the object. This is best solved by improving the lighting or choice of background. It is also improved by adjusting the "background threshold" setting described below.

Viewing an Image and it's Mask

Click on the **Mask** tab to display the Mask Window. Whenever the Mask Window is displayed, you can load a photo and its mask into the display area for editing by either double-clicking on a thumbnail in the *Thumbnail Window*, dragging and dropping a thumbnail onto the *Mask Window's* display area, or selecting an image and choosing the **Images > Edit Mask** menu item.

The mask is displayed as a semi-transparent overlay over the color photo. The masked region defines the parts of this view that are definitely not part of the object (in other words, the background). It is important not to over-mask the object, but it does not necessarily matter if you do not mask all of the background. In particular, the stand can be fully cut away using the Clipping Plane tool, described later, and so masking areas below the bottom of the object is not necessary.

TIP: It is perfectly acceptable to set the thresholds described below to produce a few pixels of anti-alias "fringe" around the object where the edge of the object blends with the background color. As illustrated in Figure 3.5.3, a consistent width fringe with a smoother edge will produce a better model than either a jagged edge that produces artifacts in the mesh or risking part of the object being inadvertently masked as background and therefore being cut away from the model by setting the background threshold too close to the object's color range.

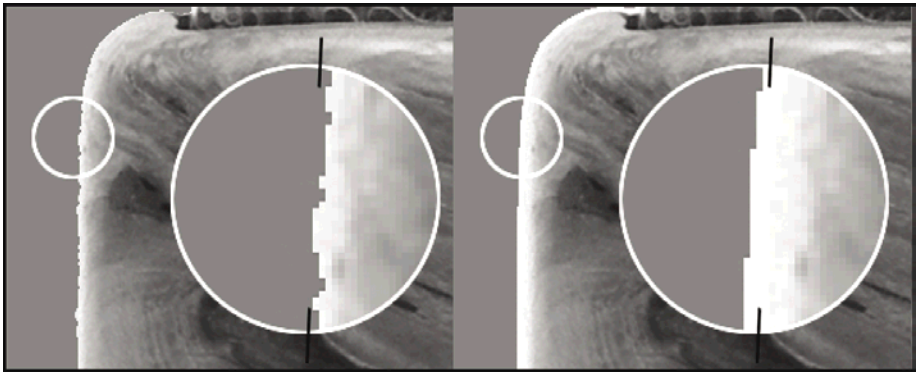


Figure 3.5.3. Slight Under-mask with Smooth Fringe produces a smoother model surface.

You can change how the mask is displayed, choosing from solid color, semi-transparent, or hidden, using the **Mask Tools > Display Mask ...** menu. In The Strata Foto 3D Settings Window you can change the color used to identify masked areas so they show up well against your images.

With the **Zoom in** button or the **Zoom out** button selected, you can zoom into or out from the image by a single click of the left mouse button. You can zoom into a particular region by selecting the **Zoom in** button and using the mouse to drag out a rectangular marquee around the area of interest. Alternatively, you can select the zoom value using the zoom level drop down box or the **Mask Tools > Zoom to...** menu.

When you are zoomed into the image, you can scroll around freely in two dimensions by selecting the **Pan image** button. Alternatively, you can use the scrollbars around the window to scroll vertically or horizontally.

TIP: As a shortcut, holding down the SPACEBAR temporarily switches to the **Pan image** tool. Releasing it restores the previously selected tool.

The **Zoom to fit** button changes the magnification and re-centers the display so that the entire unmasked region fits within the window.

Undoing Mask Changes

A short undo history is kept for all changes to the masks for each image. You can only undo changes to the image that is currently displayed in the *Mask Window*, but the history is kept separately for each image, even while you have a different image displayed in the *Mask Window*. Even changes made by using the *Mask Wizard* can be undone. This can be particularly useful for seeing whether automatic masking with different parameters has made an improvement or not. Note that this undo information is not saved in the project file and is only available for the current session.

Use the **Undo model or mask change** button in the Main Toolbar to return to the previous mask for the displayed image and the **Redo model or mask change** button to re-apply the change.

Automatic Masking Tools

The automatic masking tools in the *Mask Palette* enable you to perform automatic masking interactively, allowing you to adjust the parameters to improve the mask and to apply the tools to only selected regions of the image. See the sections on Fine Tuning the Auto-Masking Process and Masking with the Shrink-Wrap tool in Chapter 7 for a description of how to use these tools effectively.

The  **Regenerate mask** button sets up interactive masking for the current image. After this has been run, the threshold for the image can be varied interactively by adjusting the slider that appears below this button. Changing this slider also adjusts the background threshold setting that will be used as the default for automatically masking images using the *Mask Wizard*.

The  **Shrink-Wrap Mask** button sets up an alternative interactive masking technique. Unlike **Regenerate mask** this technique uses the current mask as a starting point and then shrinks the unmasked region by selecting adjacent areas of similar color. Again, moving the slider adjusts the tolerance and determines the extent that the unmasked regions are shrunk. This tool can be applied to just a portion of an image if an area has been selected with the selection tool.

The  **Unmask image** button is a quick way of removing the entire mask for the displayed image.

The  **Clean Mask** button is only available once a wireframe model has been generated. Clicking on it uses the shape of the current model to clean up the mask so that all parts of the image that fall outside the model when viewed from this viewpoint are masked out. It is a quick way to create a mask as a safe starting point to use with the other masking tools. It can also be used for generating an initial mask for new images added to the project.

The ***"Shadows"*** checkbox toggles whether color normalization is used by the automatic masking algorithms to attempt to identify and compensate for shadows on the backdrop. Changing this option does not have an effect on an existing mask; only on newly generated masks.

If the allow ***"Holes"*** checkbox is selected, the automatic masking tools will locate and mask any areas within the object's outline boundaries that are truly holes where the background can be seen. It may also create isolated patches of mask, such as on surfaces in the middle of the object that are reflecting the background or that are transparent. If your object is made of a single structure without any holes, it is worth keeping this option deselected to avoid holes being made in the object, particularly if the object has glossy surfaces or specular highlights. The option can be interactively changed for just one image or just a region within an image, as described below.

Manual Masking Tools

The manual masking tools allow you to modify the mask by hand. The process is time consuming and we recommend that wherever possible you avoid manual masking by using the automatic masking tools, improving the lighting in your photo, or using the semi-automatic tools for refining a mask. In addition, the section on Editing Masks with an External Application found in Chapter 7 explains how to use your favorite third party image editing software to perform masking.

Each tool can be used either with the **Paint mask** button selected to add to the masked region or with the **Unpaint mask** button selected to add to the unmasked region.

TIP: While using any of the manual masking tools, you can temporarily switch between **Paint mask** and **Unpaint mask** by holding the Ctrl key.

There are two brush tools for freehand mask painting. Click on either the **Round Brush** button or the **Square Brush** button to select them. The size of the brush is adjusted using the slider above these tools. The cursor changes to show the shape and size of the brush (except when fully zoomed in).

TIP: You can also use the < and > keys to change the brush size in large steps or the , and . keys to change the brush size in single pixel steps.

Note: If you are zoomed in, as you paint near the edge of the window, the window will automatically scroll to keep the brush visible. If you don't like this behavior or it is too slow on your graphics card, you can switch it off by de-selecting the ***"Automatically scroll canvas when painting"*** option in the *Strata Foto 3D Settings Window*.

The **Fill mask** button selects a simple fill tool. Clicking within a region of unmasked pixels will mask them (or vice versa depending on the current painting mode).

The **Fill Polygon** button enables a polygon drawing mode. Click once to place each vertex of the polygon you want to fill, and then double-click on the last vertex to complete the polygon and perform the fill. As you click each vertex, you can drag the vertex to adjust the position of the line before releasing the mouse button. To abort without performing the polygon fill, simply select a different tool.

Figure 3.5.4. The Polygon Tool being used to trim the mask to restore the straight side of a cylindrical bottle where the label was overmasked due to having a color very similar to the background.

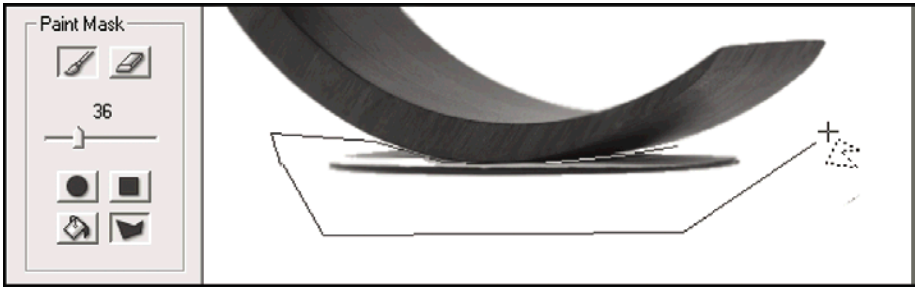


Figure 3.5.5. The Polygon Tool being used to trim the object (add to the mask) and define a smooth curve for the object's silhouette at a place where deep shadows make interactive masking ineffective because of their similarity in color to the object.

TIP: The polygon tool is a quick and powerful way to smooth out rough edges on a mask. Click once to set an anchor near a curved edge that needs trimming. Click and hold at a second point and move your mouse, adjusting how the line segment will trim off the edge like a knife. When you are satisfied, release the mouse and double-click on the side of the line that you want trimmed to complete the process. (This technique will trim from the object by adding to the mask or trim from the mask by adding to the unmasked area, depending on which paint mode button is active.)

3.6. The Model Window and Palette

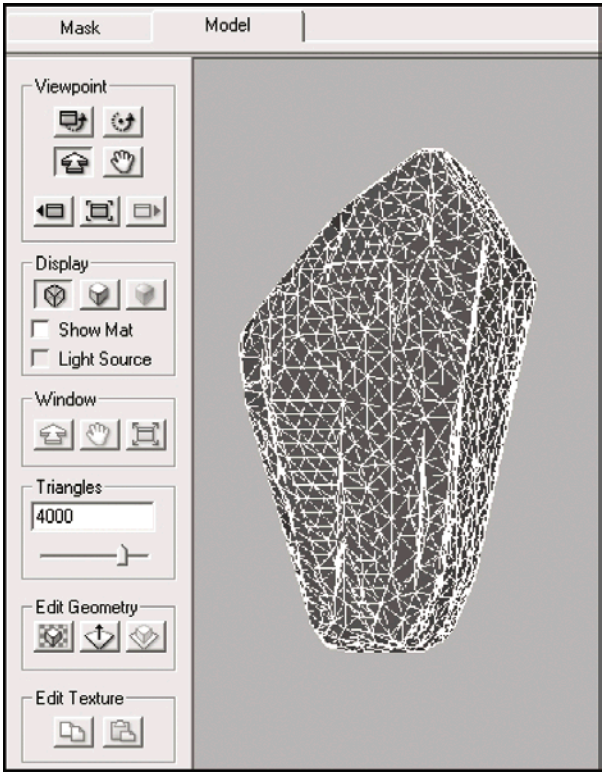


Figure 3.6.1. The Model Window containing the Model Palette and Model Display Area (Wireframe display mode.)

This section describes the tools available for viewing and modifying the 3D model displayed in the *Model Window*. Please read about Surface Optimization in Chapter 7 and Texturing in Chapter 8 to learn more about why and when to use these tools and for tips on making the most of the tools available.

This Palette of modeling tools can be accessed either from the Main Menu by selecting the **View > Model Palette** menu item, or by clicking on the **Model** tab. Except for the *"Number of Triangles" Decimation Slider*, all the modeling tools available from the *Model* palette can also be accessed from the **Main Menu > Model Tools** menu or by right-clicking in the *Model Window* display area.

Viewpoint Tools

There are several tools for moving the model around in 3D space to look at it from different viewpoints. These all operate using click and drag with the left mouse button.

With the  **Rotate model** button selected, dragging the mouse rotates the object in all directions about its center in 3D space.

With the  **Move model** button selected, dragging the mouse moves the object left, right, up or down.

The  **Spin model** button causes the mouse to rotate the object on the screen around the object's center.

Using the  **Zoom model** button, dragging up and down the screen moves the object forwards and backwards, making it appear larger or smaller. The mouse wheel can also be used to do this.

TIP: Holding down Ctrl will temporarily swap between pairs of these tools (swapping rotate and spin or zoom and move), returning to the original tool when the key is released.

Clicking the  **Reset view** button will return the model to its default position. This zooms out to make the whole object visible in the window and rotates it to be viewed from the direction of the "tick mark" found on the calibration mat.

Clicking the **Last view** button will return the viewpoint to a previous position.

Clicking the **Next view** button after **Last view** will move forward in the viewpoint history.

Display Options

These options affect what is seen in the **Model window**; and, in particular, how the model is drawn. Depending on the features that have been generated for the model, not all of these options will be available.

TIP: It is sometimes helpful to hide the texture to, for example, look for deformities in the shape. You can also change the colors used for the window background and the wireframe by opening The Strata Foto 3D Settings Window using the **File > Settings...** menu item or by clicking the **Change settings...** button.

The **View wireframe model** button displays the model as a mesh with outlines around the edge of each triangle. This can be used to get a feel for how many triangles are currently being used in the mesh and where they are dense or sparse.

The **View flat shaded model** button displays the model as a solid object but without texture. This is a good display mode to use when reducing the number of triangles in the mesh using the Decimation Slider (in order to reduce file size and loading time) since you can more easily see when the shape of the object starts to deform due to over-simplification (excessive decimation).

The **View textured model** button displays the final model with a texture map generated from the photos.

TIP: You can use keyboard shortcuts to swap between display modes: **View wireframe model** (F5), **View flat shaded model** (F6) and **View textured model** (F7).

The **Show Mat** checkbox toggles the display of a virtual calibration mat. This can be useful to understand the object's orientation, particularly during and after *alignment* operations.

When the textured model is displayed, the **Light Source** checkbox toggles a virtual light source. This is a useful preview if you are intending to export the model to a 3D editing package where you might relight it.

The **Display Mode > Display Cameras** menu item toggles the display of all of the camera positions for the images used in the project. This is helpful for examining the pattern of photographs being used to model an object to determine if any key angles were missed, as opposed to inadequately masked.

Alignment Window Tools

Alignment is explained in the section Adding Texture to the Bottom of an Object in Chapter 8. During *alignment* operations, the image being aligned is displayed as a backdrop behind the model so that the model can be positioned to match the image. To help do this more accurately, there is a set of tools that are enabled only during alignment operations.

With the  **Magnify View** button selected, dragging the mouse up and down the screen zooms into or out of the current image, allowing more or less detail to be seen. This differs from **Zoom model** which moves the object closer to the camera, thereby altering the perspective; instead, this tool keeps the object fixed relative to the background image.

With the  **Pan View** button selected, dragging the mouse scrolls around the image, moving the object and the background image as a unit. Again this differs from **Move model** which would move the object relative to the background image.

TIP: Holding down the Ctrl key will temporarily swap between these two tools, returning to the original tool when the key is released.

Clicking on the  **Full Image** button will reset the magnification so that the whole image fits in the window.

Decimation Slider

The model is generated as a highly detailed *triangle mesh* and a technique known as *decimation* is used to allow the number of triangles used to form the exported model's mesh to be varied interactively. Reducing the number of triangle is usually desirable as it reduces the model's complexity, which therefore reduces it's file size, loading time and the memory and processing power needed by 3D modeling software to render it. As the number of triangles is reduced, the vertices that contribute least to the shape of the object are successively removed, resulting in a simpler mesh with fewer triangles.

The number of triangles used to form the currently displayed mesh is shown in the *Model* palette. Below it, there is a slider that can be used to interactively change the number of triangles. Alternatively, you can type a number directly into the number of triangles textbox.

Note: If the slider is replaced with a **Decimate** button, then you have probably canceled the "initializing decimation" process. Click this button to setup the model for decimation and re-display the slider.

You can change the number of triangles even after the model has been textured, but it may be worth re-generating the texture once the final number of triangles has been selected, to best match the texture to the new mesh. See the section on Adjusting Decimation in the section Building the Wireframe Model in Chapter 5 for more on choosing an appropriate number of triangles.

Note: The Sub-Division Surface (SDS) tools for smoothing a mesh in Strata 3D CX, Silo and similar modeling software will further smooth the tri-mesh produced by Foto 3D. If you intend to apply subdivision smoothing, it is advantageous to view the model in wireframe mode and use this decimation tool to simplify the mesh to its minimum essential structure.

Geometry Editing Tools

The buttons in this group are used to modify the shape of the existing model and are enabled only after a 3D wireframe model has been generated.

The  **Create silhouette** button will create a new image in the project from the current viewpoint, using the current geometry to define the mask for the image. This mask can then be edited and will modify the geometry next time the surface is generated. If texture has also been generated, you will be offered the chance to save a rendering of the model as a new image file in the project folder. The section on Improving the Model By Adding Silhouettes in Chapter 7 explains how to use this feature.

When the  **Move clip plane** button is selected the clipping plane is shown in the window. Dragging the mouse up and down moves the plane up and down. Because photos are usually taken from above the object, there is usually a slight 'dome' remaining under the base of the object. Clipping is used to remove any wireframe structure associated with the stand that the object was placed on. To hide the clipping plane without applying it, simply drag it down below the base of the model.

Clicking the  **Clip model** button causes wireframe geometry below the current position of the clipping plane to be cut off. You can undo this operation by selecting the **Edit Model > Undo Model Edit** menu item. See “clipping away the stand” in the section on Building the Wireframe Model in Chapter 5 for more details.

Texture Editing Tools

Once a texture map has been generated, it can be edited using an intuitive 2D interface by taking a snapshot of the rendered model from a particular viewpoint, modifying it in a separate image editing software package, and then pasting it back into the model. The sections on texture editing in Chapter 8 describe different ways in which this technique can be used

Clicking the **Copy View** button renders a snapshot of the model from the current viewpoint and places it on the clipboard. This is the preferred method for editing the texture with an image editor such as Adobe Photoshop or Corel Paint Shop Pro.

Clicking the **Paste View** button blends the image on the clipboard into the current texture map. This is the preferred method of overlaying an edited texture image from a photo editor such as Adobe Photoshop in place of the original. The image dimensions must be left unchanged so that the returned image has the same dimensions as the other images in the project. You can undo this operation by selecting the **Edit Model > Undo Model Edit** menu item.

3.7. The Strata Foto 3D Settings Window

The *Strata Foto 3D Settings Window* is shown in Figure 3.7.1. It can be opened by clicking the **Change settings...** button or choosing the **File > Settings...** menu item.

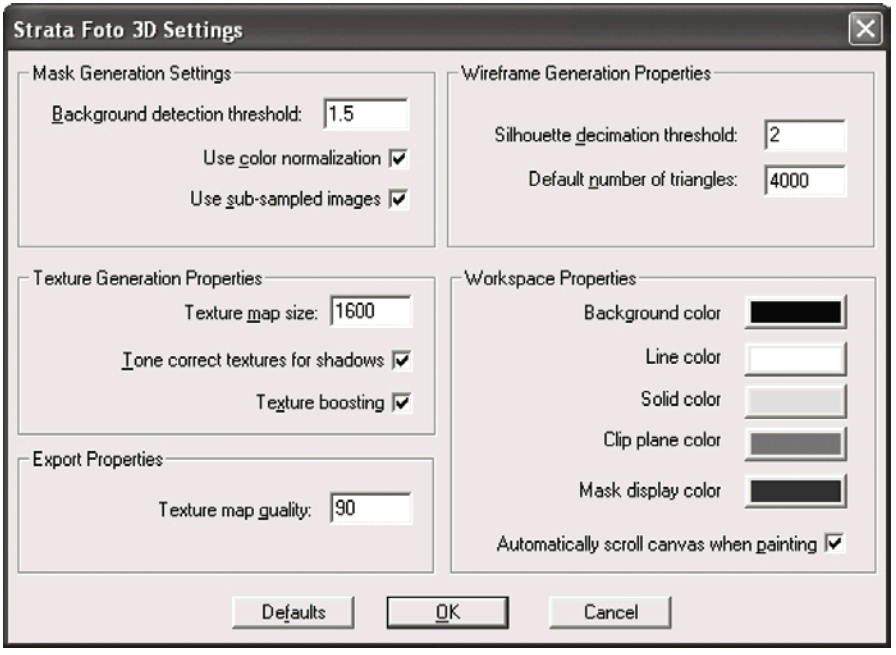


Figure 3.7.1. The *Strata Foto 3D Settings Window* with default options.

All settings are saved with and loaded from the Foto 3D Project file except for the ***"Automatically scroll canvas when painting"*** option. These settings will be restored as the defaults the next time you load the project. To return to the default values for all settings, select the **Defaults** button. Click the **OK** button to keep any changes you have made and close the window. If you click the **Cancel** button, the *Settings Window* will close and any changes you have made will be discarded.

Most of the settings can be adjusted when doing individual processing steps, however it can be useful to set up default values so that operations such as the **Processing > Make All** menu item can run without interruption.

"Mask Generation Settings"

These settings affect the automatic mask generation process initiated by the *Mask Generation Wizard* and initial position for the *mask slider* for the **Regenerate mask** button and **Shrink-Wrap Mask** button.

The ***"Background detection threshold"*** controls how much of the image is treated as background when it is masked. A higher value causes more of each image to be masked. Adjust this value if you generally find too much or too little of each image is included in the mask.

When the ***"Use color normalization"*** option (visible on the *Mask* palette as the ***"Shadows"*** option) is selected the auto-masking process tries to compensate for shadows falling on the backdrop. If you have a controlled lighting setup, it is best to deselect this option.

When the ***"Use sub-sampled images"*** option is enabled, in order to speed up the masking and texturing processes, Foto 3D will resample photos to create lower resolution versions whenever the source photos are more than roughly 3.5 megapixels in resolution (triggered by being over 1,500 pixels on the short dimension).

Note: If you wish to create the highest possible quality model, deselect this option; but, realize that the maximum size of the final texture map covering all sides of the object is 1600x1600 pixels and so any additional detail retained in source images may nevertheless be lost in the final texture map.

"Wireframe Generation Properties"

These settings affect the wireframe generation process initiated by using the Wireframe Generation Wizard.

The ***"Silhouette decimation threshold"*** is used to remove unwanted detail in the silhouettes before generating the surface. A higher number has the effect of smoothing the silhouette outlines before the wireframe model is constructed. This will avoid too many unwanted triangles being created and speed up the process. If you want to capture every last detail in your silhouettes, reduce this value.

The ***"Default number of triangles"*** determines the initial number of triangles used to display the model when it is created. The number of triangles can also be changed interactively after the wireframe model has been generated.

"Texture Generation Properties"

These settings affect the texture generation process initiated by the *Texture Wizard*.

The ***"Texture map size"*** sets the size in pixels of the resulting *texture map*. The texture map is always square and the size determines the tradeoff between the detail in the texture and the amount of storage required for the texture map and loading time when viewing the model online. Generally, values such as 512, 768 or 1024 pixels tend to be adequate for most uses. For Foto 3D, the maximum texture size is 1600 pixels. (For the Professional version the maximum is 4096 pixels.)

When the ***"Tone correct textures"*** for shadows flag is enabled, Foto 3D will try to compensate for variations in exposure between the images which would otherwise cause the surface texture to have unwanted variations in intensity. If you are using controlled lighting conditions or are experiencing unwanted color shifts in the textures, you may prefer to turn this option off.

When the ***"Texture boosting"*** option is enabled, Foto 3D automatically picks a set of about 6 key views and uses these to add detail to the *texture map*. Otherwise, Foto 3D will attempt to blend together information from all the images, which can result in unwanted blurring

or shadowing of details, particularly if there is any slight mis-registration of images due to errors in the lens calibration, inaccuracies in the mesh geometry, or movement of the object during photography. Images can be manually selected for boosting by revising the processing order using the **Images > Image Order** menu item in the Thumbnail Viewer.

"Export Properties"

This setting affects the default value that appears in the *Export Window*. The ***"Texture quality"*** compression setting reduces the size of the *texture map* image file by increasing the compression at the risk of producing compression artifacts that reduce texture quality.
This value is set between 1 (lowest quality) and 100 (highest quality).

"Workspace Properties"

These settings control how masks and models are displayed in the *Mask Window* and *Model Window*.

Various colors are used in the interface and can be altered to suit the images and object being modeled. Altering the displayed mask color can be very helpful during mask editing. Similarly, when aligning images, changing the wireframe or solid colors can make it easier to see fine detail. Clicking on any of the colors opens a standard color selection dialog.

The ***"Automatically scroll canvas when painting"*** option can be disabled to stop the Display Window from automatically scrolling when painting a mask area that falls near the edge of the display window. With certain graphics cards or alternative mouse hardware, such as a graphics tablet, this feature may make painting difficult.

Chapter 4

The Photo Shoot

4.1. What You Will Need

Figure 4.1.1. An object, on a stand, with a backdrop.

You will need the following items:

- The object you want to model
- A stand or pedestal for the object
- A smooth plain color backdrop
- A Foto 3D *calibration mat*
- Optional - a turntable

TIP: Adhere the mat and pedestal to a turntable or "lazy susan" to allow the object, pedestal and mat to be easily rotated as a unit.

The Object

Foto 3D works well with many kinds of objects but *may* have trouble modeling transparent objects such as items made of non-colored glass, extremely complicated shapes like a hairbrush, or highly reflective objects like mirrors or chrome, and objects with deep recesses like a coffee cup.

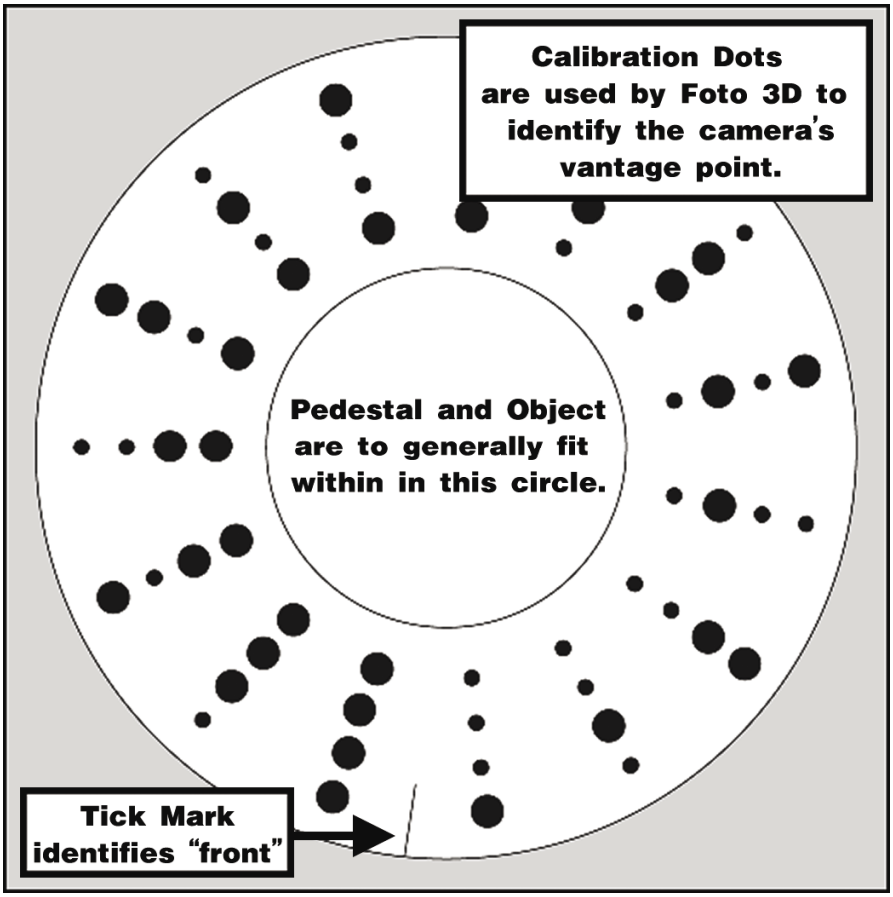


Figure 4.1.2. The Foto 3D *calibration mat*

The Mat

The Foto 3D *calibration mat* is a flat sheet of paper or card stock printed with special markings that Foto 3D uses to determine the angle from which each photograph was taken. The mat has a small tick mark that the software associates with the "front view" of the object. While aligning the object to the tick is not necessary and the default 'front view' can be changed at export; it is a bit more convenient if they are aligned

The Foto 3D *calibration mat* can be printed from within the Foto 3D software, using the **Print mat...** button on the *Main Window* toolbar.

The mat must be perfectly flat and it is recommended that the calibration mat be firmly adhered onto a rigid flat surface.

For smaller objects, a mat may be printed on a sheet of letter size white card stock or heavyweight paper. You can select the paper size and mat diameter by choosing the **File > Page Setup...** menu item. All of the important calibration mat features lie within the outer circle and the mat must be large enough for the dot pattern to be visible when viewed from the top. (See Figure 4.1.2.) Printing the mat with a diameter 2.2 - 2.5 times wider than the object is usually ideal. For example, a 12 inch diameter mat printed on Super B (13"x19") card stock fits an object up to about 5.5 inches in diameter.

TIP: The mat may be trimmed to the outer circle. If you do trim the mat, make sure it lies flat (not curling up at the edges), and, if necessary, adhere it to a flat rigid surface such as foam core or gator board. Even the slightest bending or curling of the calibration mat will distort your models.

The Stand

A stand or pedestal is useful for raising the object away from the markings on the mat and reducing shadows cast onto the mat. It also helps to better shape the bottom edges of models by completely surrounding the object's bottom edge with backdrop by using a pedestal that is narrower than the object.

The ideal stand is::

- Able to support the object.
- Narrower than the object's base.
- Opaque and non-reflective.
- The same color as the backdrop (for automatic masking).
- Stable enough to keep the object from moving relative to the mat when rotated. (Adhere it to the mat if necessary).

TIP: If the stand and/or object is too large and excessively overlaps the markings on the *calibration mat*, you will need to use a larger mat.

The Backdrop

The ideal backdrop is an untextured, uncreased, solid color matte surface that will provide a consistent contrasting background behind the object. This will allow Foto 3D to automatically determine which parts of the image correspond to the object during masking. If you are unable to use a suitable backdrop, you will spend more time manually masking the photographs. (See the section on Masking Photographs in Chapter 5.)

The backdrop should be:

- plain colored or white with a non-reflective matte finish.
- smooth and free from marks or creases.
- able to fully surround the object from the camera's viewpoint.

When possible, choose a color that is not present in the object and generally contrasts with the object. Light colors work better than dark colors. Avoid large backgrounds with strong colors, including chroma-tint green or blue, as they can add a color cast to reflective sides of the model. Light neutral gray is best for objects with shiny or reflective surfaces.

TIP: A large sheet of white "foam core" posterboard works as a quick, inexpensive and effective backdrop. Also, making an "enclosure" of additional sheets of white foam core placed on the sides and tilted at 45 degrees will help diffuse and bounce light coming from above to the sides of an object.

The Foto 3D software assumes that any "features" it finds as it traces around the outline of the object belong to the object. If Foto 3D is unable to separate object from background automatically, you may need to mask the images by hand using the masking tools.

4.2. Lighting and Camera Setup

Lighting Setup

Foto 3D can handle photographs taken under a variety of conditions and will correct for many lighting problems. Two typical studio-style setups are shown below, one a beginning low-budget desktop arrangement and the other a typical professional studio setup. This chapter is a basic overview of the process. Advanced tips for achieving more professional results and using the software more efficiently are outlined in Chapter 6.

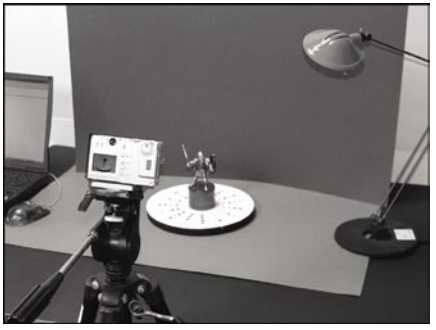


Figure 4.2.1. Basic setup.

Figure 4.2.2. Professional studio setup.

Observe the following points:

- Avoid strong shadows on the backdrop, *calibration mat* or object.
- Make sure there is enough light to take pictures without having to use the on-camera flash.
- Light both sides of the object with the same color lights. (Avoid working near a window.)

Camera Setup

A high quality camera will produce the best results; however the camera does not need to be high resolution. The detail obtainable with images in excess of about 3.5 - 5.0 megapixels is lost.

- Use a digital camera.
- Use a high quality setting to minimize JPEG compression artifacts.

- Mount the camera on a rigid tripod.
- Disable the built-in flash to prevent strong shadows and speculars.
- If the camera has digital zoom, disable it.
- If the camera has spot focus, use it to focus on the object and mat.
- Verify the lens is free of dust, smudges and fingerprints.
- Best results are obtained by locking the exposure or shooting manual exposure and reducing the aperture to increase the depth of field (area in focus) as much as possible.

4.3. Taking Photographs

Foto 3D requires around 20 photographs, taken from various angles, to create a 3D model of an object.

Before you begin...

- Check that the stand and the object are stable, and will not wobble or fall over when the mat is turned (adhere them together if necessary and/or use a turntable).
- Setup the camera and tripod so that the object and mat completely fill the frame by getting in close or using a zoom lens, but they must *not* go off the edge of the frame in any photo.
- If you use a zoom lens, you should keep the same setting for all of the pictures you need to take. While the Foto 3D software can recognize and usually accommodate a change in the zoom setting of the lens, it is best to find an optimum setting to use for all shots and leave it unchanged for the duration of the project.
- If the software does not recognize the lens settings of your camera, you may be asked to calibrate the lens. If so, try to do so at the same zoom setting that you used to shoot the project. (The calibration process is described in Calibrating the Lens in the Appendix.)

- If using a turntable and your camera is on a tripod, fully rotate the object and mat prior to shooting to ensure the object remains in the frame at all rotation angles.
- If the camera allows you to lock the exposure settings or manually set exposure, do so.
- Before shooting, it is recommended that you upload a sample photo to the software and check it for lighting issues that may affect the efficiency of the auto-masking function (described later).

It does not matter if the backdrop obscures some of the markings on the calibration mat as long as the front half of the mat is fully visible.

Once you begin taking photographs, do not shift the object's position on the stand or the stand relative to the calibration mat. If the object is accidentally moved relative to the mat, discard the previous photos and shoot again.

After you have taken your photographs, do not crop or resize the images in any way. All the images must be the same size as one another or Foto 3D will refuse to accept them as input.

Taking Side Views

For this first set, take about 15 photographs of the sides of the object from different angles. The mat has 15 rows of dots that can conveniently be used to line up each rotation. You will discover in later chapters that up to 30 or more side view shots may be preferred for creating a very precise model of a rounded, smooth, unusually shaped object; while only 4 or 8 shots may be all that's really needed to fully model a box.

Figure 4.3.1. A set of side views of an object rotated through a full revolution

Frame these views so that the *calibration mat* takes up about one-third of the total image. The camera should be at the midline of the object, looking slightly downwards to ensure the mat is clearly visible as shown in Figure 4.3.2. Make sure for these side view photos that the bottom of the backdrop fully surrounds the object and "cuts through" the stand.

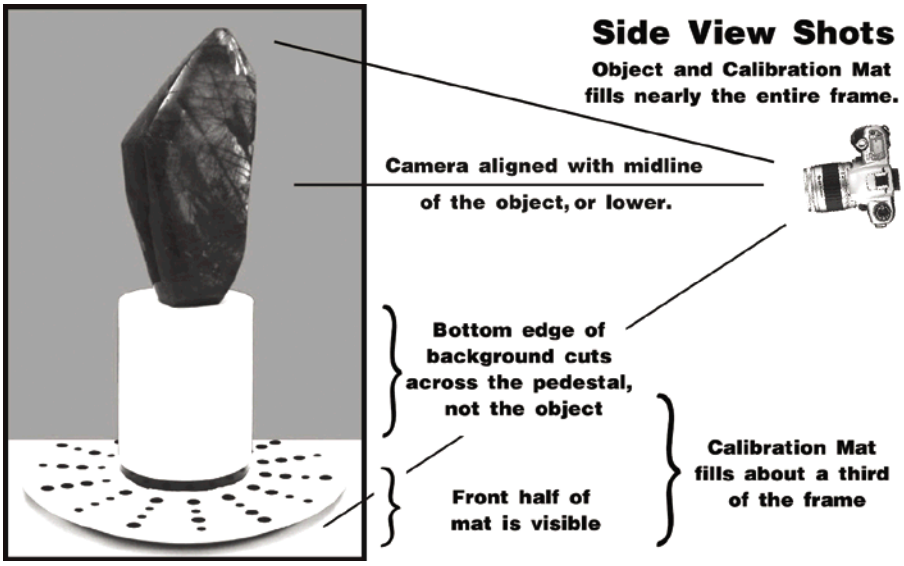


Figure 4.3.2. Correct camera position for the first set of photos.

TIP: Use a turntable or rotate the mat either clockwise or counter-clockwise so that each of the 15 sets of calibration dots aligns with the camera.

Taking High-Angle Photographs

Take an additional three to seven photographs from a higher angle looking downward on the object, as shown in Figure 4.3.3.

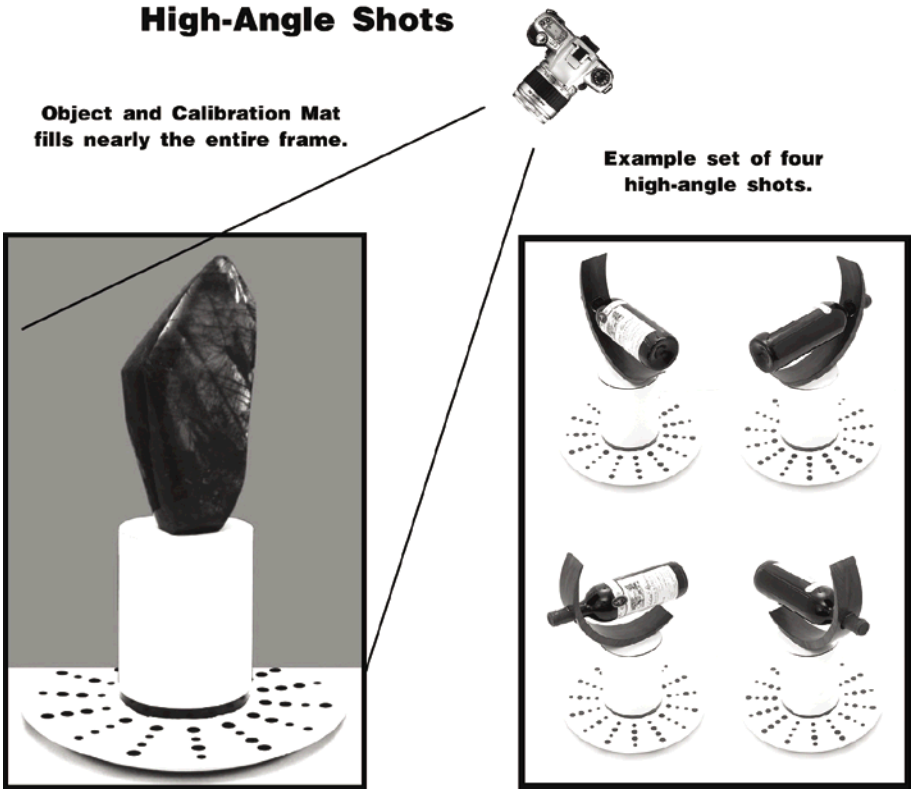


Figure 4.3.3. Correct camera position for high-angle photographs.

The elevation of the camera should be high enough to look downward on the object, without actually being a top-down photograph; about a 60 degree angle above the midline.

A minimum of three photographs should be taken from different viewpoints by rotating the *calibration mat* and object to three positions, roughly 120 degrees apart. If more photos are needed to capture surface texture and silhouette details, adjust the spacing accordingly.

Taking a Top-Down Photograph

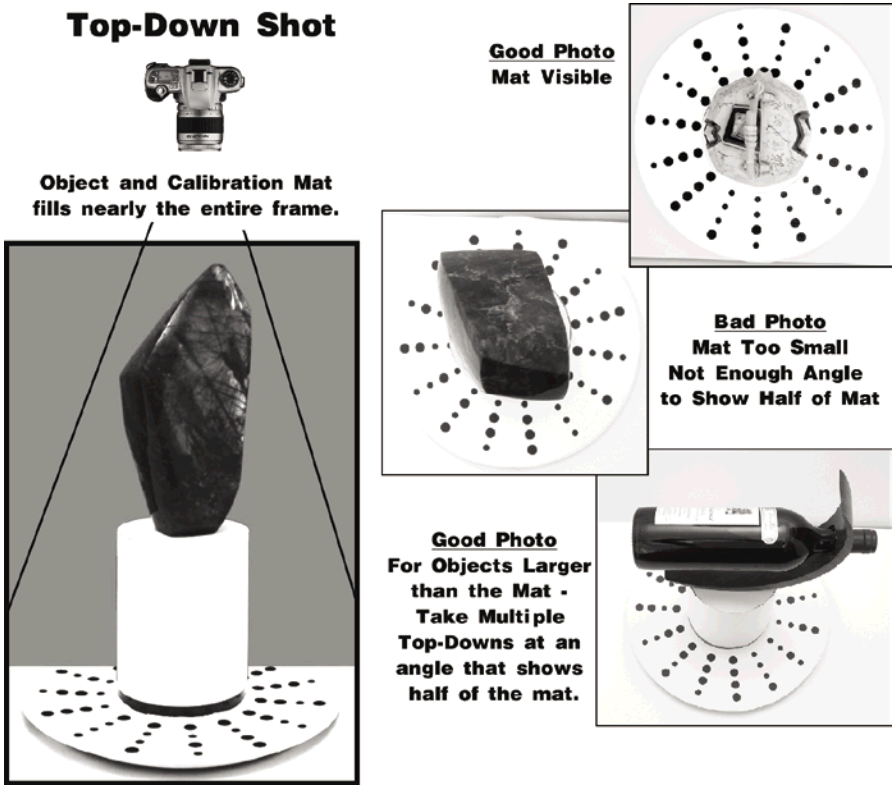


Figure 4.3.4. Top-down view of the object.

Take a single "top-down" (i.e., bird's-eye view) photograph of the object, as shown.

It is important to ensure that the object does not excessively overlap too many of the mat markings. If this happens then it is possible to take the photo from a slight angle to ensure that more of the markings are fully visible in the photograph. If the object is large for the mat, take a set of two or three photos from as high an angle as you can while still being able to see the inside row of dots on at least half of the mat.

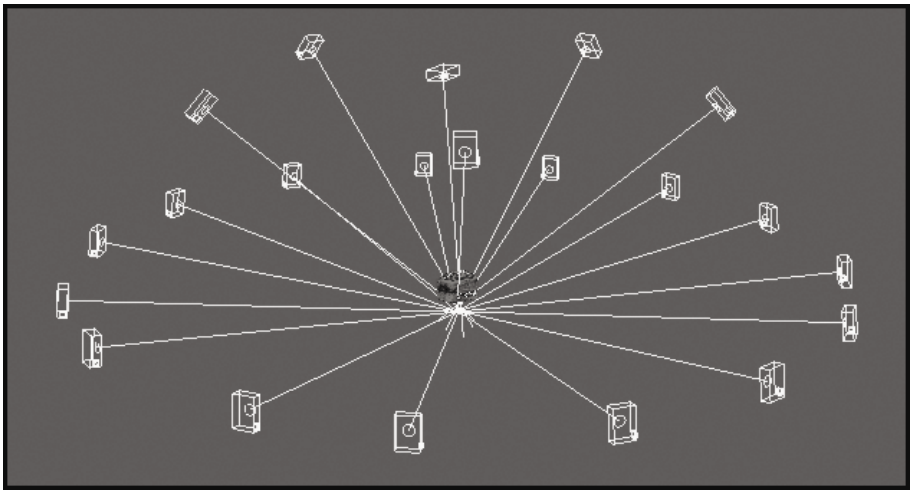


Figure 4.3.5. Generated Model with "Camera View" turned "on", showing the camera positions and angles of the "included" project photos.

This "Camera View" display (activated by selecting the **Images > View Camera** menu item) shows the pattern of photos described in this section: 15 side views, in this case 5 high-angle views and a top-down view.

TIP: After generating a wireframe (described later) that appears to have irregularities in it's shape, it may be convenient to turn on "Camera View" to see if any important photo angles were missed so that you may shoot any missing shots, add them to the project, and regenerate the initial wireframe.

4.4. Saving and Uploading Photographs

Once the set of photographs have been taken, they should be uploaded onto your computer and saved in a separate (new) directory for use with Foto 3D. Be sure that your upload software does not attempt to crop or resize the images. You do not need to rotate portrait orientation images to face "up"; the Foto 3D software will detect and rotate them for you.

Foto 3D accepts images in TIFF, JPEG, PNG, or BMP format.

It is recommended that all photographs of a particular object be saved in the same directory: this will make it easier to select them when creating a Foto 3D Project.

After photos are added to a project, Foto 3D immediately begins to prepare thumbnails and analyze them to determine the orientation of the camera and calibration mat, and whether lens distortion can be corrected using the EXIF data provided in the image or using a lens calibration profile that has been created and saved. If EXIF data is missing and a lens profile has not been loaded, then Foto 3D will report the problem and suggest launching the Lens Calibration Wizard.

With newer cameras, most users will never have to use the Lens Calibration Wizard and so the steps for using the wizard to create and load a lens profile are described in the Appendix.

TIP: If your camera is newer than the current edition of the software, visit the Strata Foto 3D Support page on the **www.Strata.com** website (find the link in the **Help** menu) to download the latest version of the file **camera.txt**, the database of camera lenses that have been carefully tested and profiled for use with Foto 3D. The new file simply replaces the current one in the program installation directory. Close and reopen the Foto 3D software for the new file to take effect.

Additional Photos

For some models there may be a need to take additional photographs. For example, a photograph taken of the underside of an object can be used to add texture detail to the bottom surface of a model. These photos can either be included in the project from the outset or added later (in which case it is useful to make their names easily distinguishable). Use the **Images > Add Images** menu item to add photos to an existing project.

It is sometimes helpful to shoot additional photos of the object, such as the bottom, with the object sitting on the pedestal with the mat included. An advantage is that a carefully selected Background Threshold setting might mask this photo as well as it masks others without any additional

effort. In order to make auto-masking available for these photos, either interactively or using **Mask All** and the Mask Generation Wizard, the software needs to have the mat visible in the image to help identify the object's position and which areas are to be treated as object and which are background. Without a mat, the only interactive tool available is Shrink-Wrap. (Both tools are described in Chapter 7.)

TIP: **IMPORTANT** - If you happened to take a photo of the bottom of the object with the calibration mat visible in the frame, or additional photos of the object in a different position on the mat than the rest of the photo set, you must be sure to mark these images ***"rejected"*** before trying to generate an initial wireframe model. If not, either the software will report that it is unable to generate a wireframe, or the resulting wireframe will be totally corrupted.

See the section called Adding Texture to the Bottom of an Object in Chapter 8 for details about how additional photographs taken without the mat may be aligned and used to add in additional texture to a model.

Chapter 5

Creating A Model . . .

The Workflow

5.1. The Sequence of Events in Foto 3D

As described in the Introduction, there are five major steps to creating a Foto 3D model: Photograph, Mask, Model, Texture and Export. The heart of the modeling process itself involves the three stages; Masking, Modeling, and Texturing. These stages are repeated and refined as necessary until the desired result has been achieved. The following diagram illustrates the process.

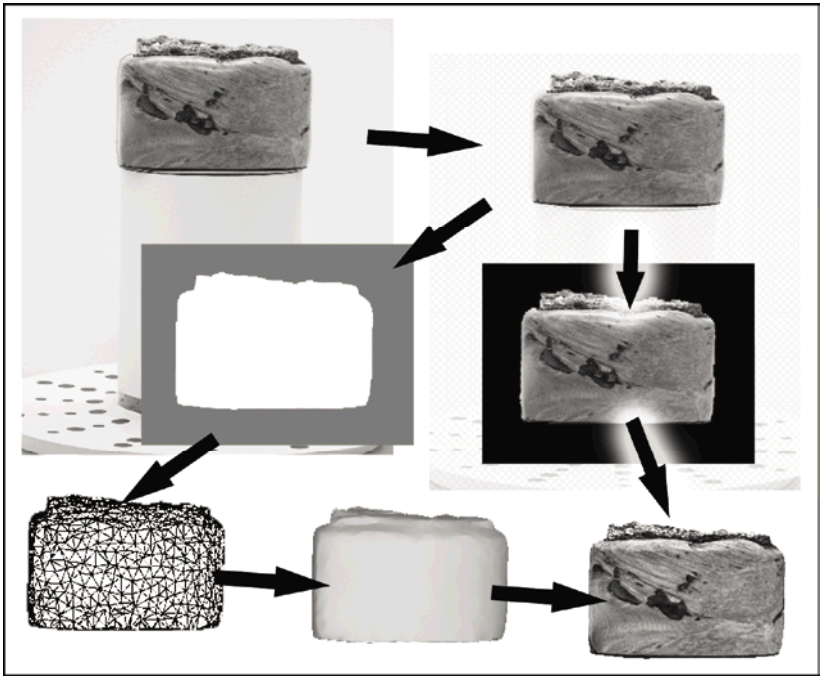


Figure 5.1.1. Basic Foto 3D process.

The process starts with a set of photographs.

- **Masking** - Through a process called masking, the outline of the object is determined from the viewpoint of each photo to create a silhouette of the object. The same mask is usually used to also identify the usable areas of each photo for painting the model's surface.
- **Modeling** - The silhouettes from all of the photos are combined to create a 3D wireframe mesh, a mathematical model that defines the object's shape in 3D space. The surface of that mesh is refined and smoothed through a process called Surface Optimization and then simplified through a process called Decimation.
- **Texturing** - Finally, the masked images are used again to project color and texture onto the outside surface of the 3D model.

Each of these processes has a Wizard tool that greatly simplifies the work involved in modeling most objects. The remainder of this chapter covers each of these process wizards in greater detail.

5.2. Starting a New Project

To create a new Foto 3D Project, upload a set of photos to your computer, launch the Foto 3D software, then select the **File > New** menu item or click the **New project...** button. A dialog box for opening files will appear for you to select image files to add to the new project.

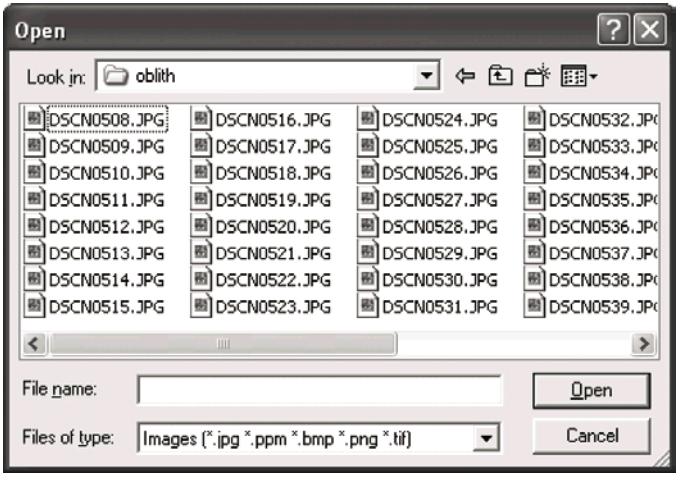


Figure 5.2.1. The Image Selection and Loading Dialog Box.

Note: Multiple files may be selected in the dialog by holding down the Shift key to select a range. The Ctrl key may also be used to add or remove clicked files to or from the selection. Use the drop-down file type filter to show only images of a particular file type.

Try It Out!

Foto 3D is supplied with several sets of sample photos for you to learn the software, such as those in the `Examples\Oblith` directory included with your installation. You can add all the photos found in this directory to a new project. The photos of the bottom of an object that do not include the *calibration mat* will automatically be marked as ***"rejected"*** (just click **OK** to accept this). Any photos of the bottom that also have the mat will need to be marked ***"rejected"*** by you before you build a wireframe (as a reminder, their filenames will have "rejectme" in them). These bottom photos will be used later as described in the section Adding Texture to the Bottom of an Object found in Chapter 8.

TIP: Once a project has been created, you can drag and drop additional image files from Windows Explorer into Foto 3D. Alternatively, use the **Images > Add Images...** menu item.

After selecting the desired images, Foto 3D will load them and try to determine the camera location for each image. Once the camera information has been calculated, each image is shown rotated so that it appears right way up.

Lens Calibration

If Foto 3D does not recognize the camera lens you are using, you will be asked if you wish to launch the Lens Calibration Wizard. Standard zoom lenses and wide-angle lenses may exhibit significant lens distortion. The Lens Calibration Wizard allows you to take additional photos for the purpose of eliminating lens distortion to improve the modeling accuracy. (See Calibrating the Lens in the Appendix for instructions on using this wizard.)

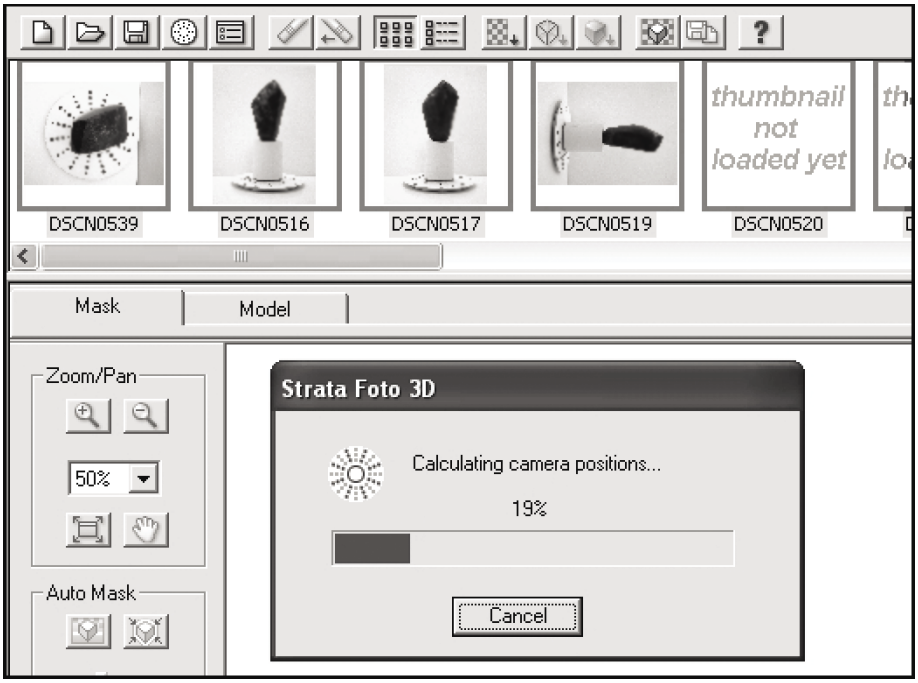


Figure 5.2.2. A mixture of photos being loaded with landscape and portrait framing. Once analyzed, Foto 3D rotates images to display "right-side up".

Note: The image files as stored in the project folder must all be in the same orientation (landscape or portrait) and be the same size in pixels. This does not mean the photographer cannot shoot all the photos of an object in a combination of landscape and portrait framing; it just means to wait and let Foto 3D handle the rotation of any portrait orientation images as they are loaded in the project. Rotating any files in advance of loading in Foto 3D will cause them to be "rejected."

If the *calibration mat* could not be found in the image, or if sufficient areas of the mat are not clearly visible, then the image will be marked as ***"rejected"*** and an error message displayed. This might be caused by the markings being too light or blurred for Foto 3D to identify the pattern.

TIP: Check the lighting by loading a few test photographs. If the images are being rejected, try shooting from a higher angle to ensure a good view of the *calibration mat*, re-check the lighting and be sure the background is not covering too much of the mat.

5.3. Masking Photographs

After shooting and adding photos to the project, the first stage in using Foto 3D to generate a model is to mask the images. "Masking the images" refers to the process of identifying the object and separating it from the background, pedestal, and anything else that appears in the photo. This section of the User Guide explains the basic process for automatically masking images within Foto 3D using the auto-masking process in the Mask All Images Wizard.

The reference section in Chapter 3 about The Mask Window and Palette explains how to manually edit a single mask within Foto 3D.

More advanced masking tools and techniques are described in Chapter 7, including ...

- Fine Tuning the Auto-Masking Process
- Masking with the Shrink-Wrap tool
- Using Clean Mask with Shrink-Wrap to Mask a Set of Images
- Editing Masks with an External Application

Using the Mask All Images Wizard

Step 1

If you want to automatically mask all the images (or all the unmasked images), click the  **Mask all images...** button to launch the *Mask Wizard* to guide you through the auto-masking process.

If you just want to apply auto-masking to a few of the images, you can select them, then click the **Masking > Mask Images...** menu item. This opens the same *Mask Wizard* as before, but only affects the masks of the currently selected images.

Try It Out!
To try this out, follow the instructions in the Starting a New Project section to create a new project from the images in the **Examples\Oblith** directory included with your installation.

Step 2

Before the masking operation starts, you may modify the parameters.

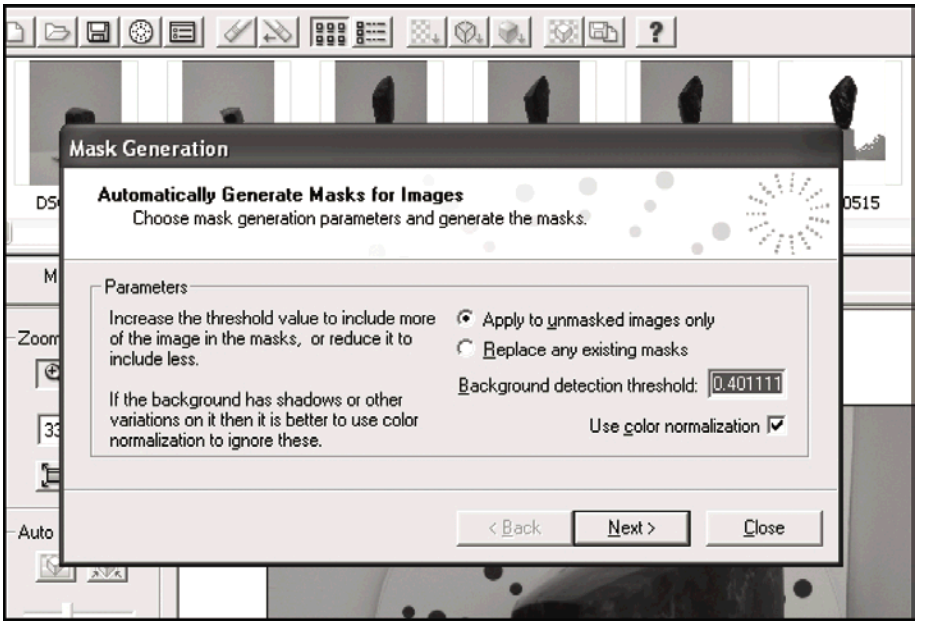


Figure 5.3.1. Mask Generation Wizard - Settings Dialog.

If you want to discard all the existing masks on your images, then select the ***"Replace any existing masks"*** option. If some images have had their masks manually edited, then *unselect* this option to prevent Foto 3D from over-writing these edits.

You should select the ***"Use color normalization"*** option if you think you might have shadows or variations in lighting on the backdrop. Foto 3D will attempt to compensate for the shadows and avoid treating them as part of the object.

The ***"Background detection threshold"*** field lets you change the threshold that is used to separate the foreground from the background. You should only change this from the default value if you are having problems generating the masks (see Step 4, below).

Step 3

Click the **Next >** button to start the masking process.

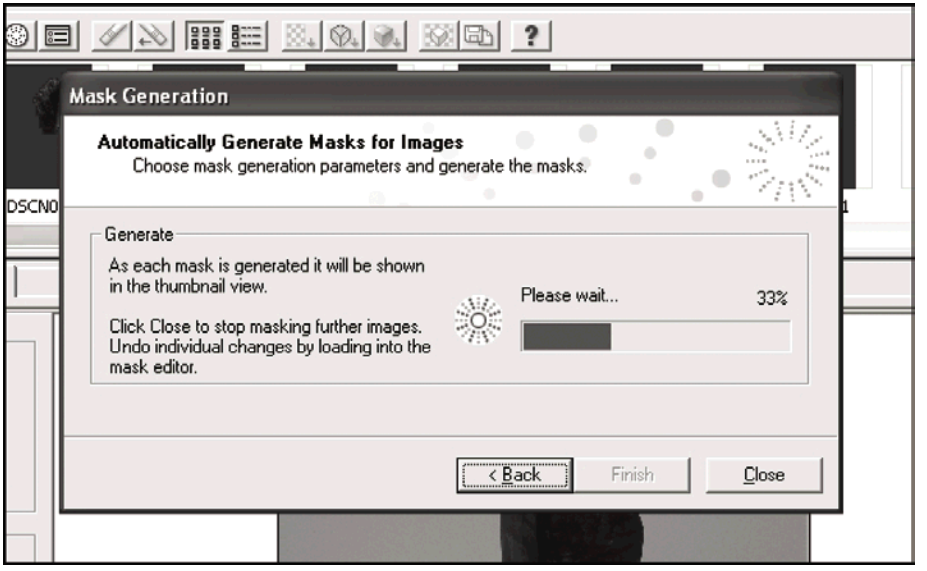


Figure 5.3.2. Mask Generation Wizard - Progress Bar -(Click "Back" to revise settings and restart.)

TIP: If you have an image displayed in the *Mask Window* when you initiate auto-masking, you will see each image displayed as it is masked.

Step 4

Check through the masks by looking at the thumbnails in the *Thumbnail Window* or load each one into the *Mask Window* by double-clicking on each thumbnail or by dragging the thumbnail into the display area.

It is important that no part of the object becomes covered by the mask in ***any*** of the images; otherwise some of the object will be carved away when you create the 3D wireframe model. It is less important that all of the background is masked, since Foto 3D will often be able to use masks from several other images to define the shape of the object.

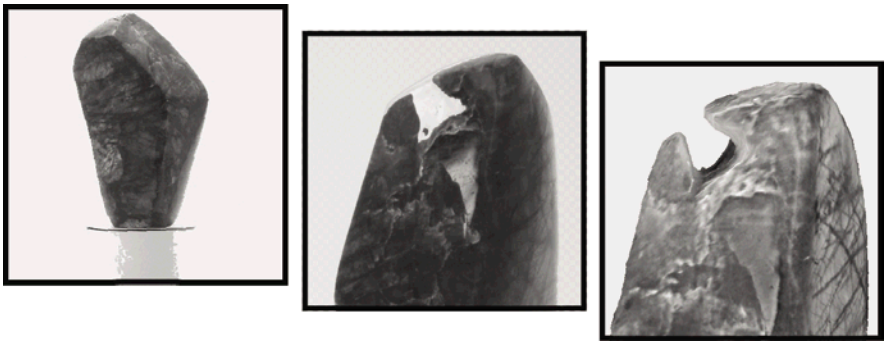


Figure 5.3.3. Mask Examples - Left mask with unmasked pedestal is OK, Center mask is overmasked causing deformity in model shown at right.

Shown above are a couple examples of masking. In the first example, this mask is OK as long as the shape of the base of the object is either masked clearly in another image or the *Clipping Plane* tool is used to remove the pedestal. In the second example, this mask must be altered; otherwise, the result will be the model on the right that has a gash cut through it. This overmasking by the auto-masking process is caused by a reflection of the background onto the object's glossy surface being masked as a continuation of the background.

TIP: The automatic masking process requires good contrast between the background and the object. A good choice of background color will result in much better automatic masking. Lighting can also affect the results.

If the masks do not look right as they are being generated, click the **Back** button to return to the *Mask Generation Window* and either try changing the parameters or use Interactive Masking to determine the best parameters (Interactive Masking is described in Chapter 7).

If areas of the background are consistently not being masked then increase the ***"Background detection threshold"***. If regions of the object are being incorrectly included in the mask, then reduce this number.

You can try adjusting this setting through trial and error by changing it by about a tenth at a time. The range of permitted values is 0.1 - 10.0.

The value is used as a multiplier, so a one-tenth change has a more profound effect at the lower end of the scale.

TIP: We find applying the interactive masking process in Chapter 7 to a representative side view image to be a much more expedient way to determine the optimum threshold setting to use on the project as a whole. Once that optimum threshold has been determined, this wizard can be re-launched to mask all of the images using that optimum setting. For convenience, the setting is automatically inserted as the new default value for this threshold.

It is also better to under-mask (use a lower value) rather than risk having the mask accidentally penetrate the object in one or two images (as shown in the previous example) and then apply the **Shrink-Wrap tool** described in the section Masking with the Shrink-Wrap tool in Chapter 7 to improve some of the masks if the resulting wireframe does not conform well to the object.

Step 5

When you are finished, click the **Finish** button to close the *Mask Wizard*.

In some cases the automatic masking of an image may not be perfect; but this is not a problem as the masked images can be improved individually as explained in the sections on Fine Tuning the Auto-Masking Process and Masking with the Shrink-Wrap tool in Chapter 7.

TIP: It can be useful to save masks associated with a set of images in order to use them in another Foto 3D Project. Use the **Masking > Save Masks...** menu item to do this. Each mask is saved using the same filename as the photo it corresponds with, but with a different file extension. This makes it easy to select and load the masks into a new project.

5.4. Building the Wireframe Model

Generating a 3D *wireframe model* is the second stage in completing a Foto 3D model. The wireframe model represents the shape of the object reproduced as a triangle mesh. Foto 3D uses the mask associated with each of the images to deduce the shape of the object from its silhouettes.

The following basic operations for producing a *wireframe model* are described in this section ...

- Using the Wireframe Generation Wizard
- Adjusting Decimation
- Clipping Away the Pedestal

More advanced techniques can be found in Chapter 7:

- Optimizing Surface Geometry
- Improving the Model By Adding Silhouettes
- Modeling Parts of an Object

Using the Wireframe Generation Wizard

Starting Point

You should create masks for a sufficient number of images before you do this operation. The minimum requirement is three masked images, but you will usually need between 10 and 30 masked photos to capture the shape of most objects.

Try It Out!
To try this out, load the **oblith.som** project from the **Examples\Oblith** directory with your installation which already has masked images. It already has a mesh created, but you can generate a new one.

Step 1

The *wireframe model* is generated with the help of the **Wireframe Generation Wizard** which is launched by clicking on the **Generate Wireframe...** button or selecting the **Processing > Generate Wireframe...** menu item.

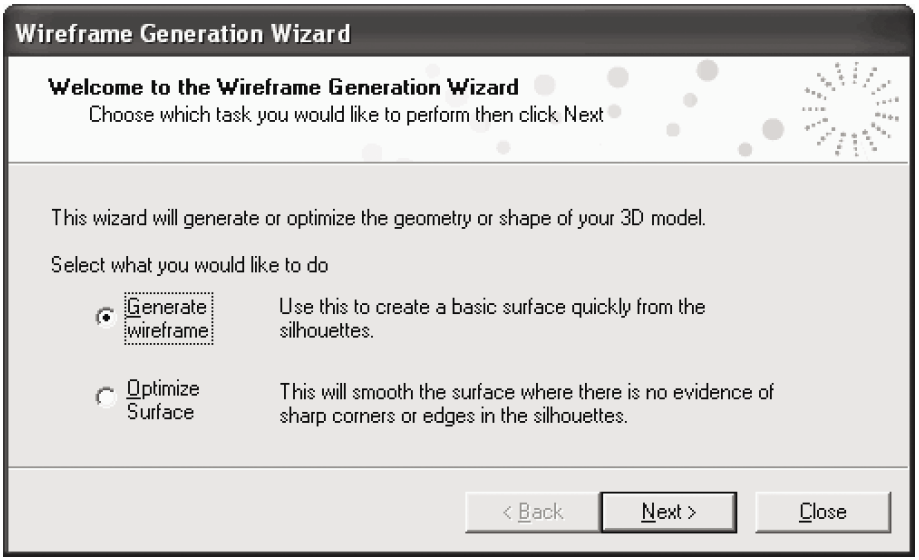


Figure 5.4.1. Launching the Wireframe Generation Wizard to create a wireframe model from masks.

When the **Wireframe Generation Wizard** is opened, choose the first option, ***"Generate Wireframe"*** to create the initial mesh and then click the **Next** button to proceed to the next page of the wizard. (The other option is described in the section on Optimizing Surface Geometry in Chapter 7.)

Step 2

You can alter various parameters before generating the wireframe. You will find that the default values will be sufficient in most cases.

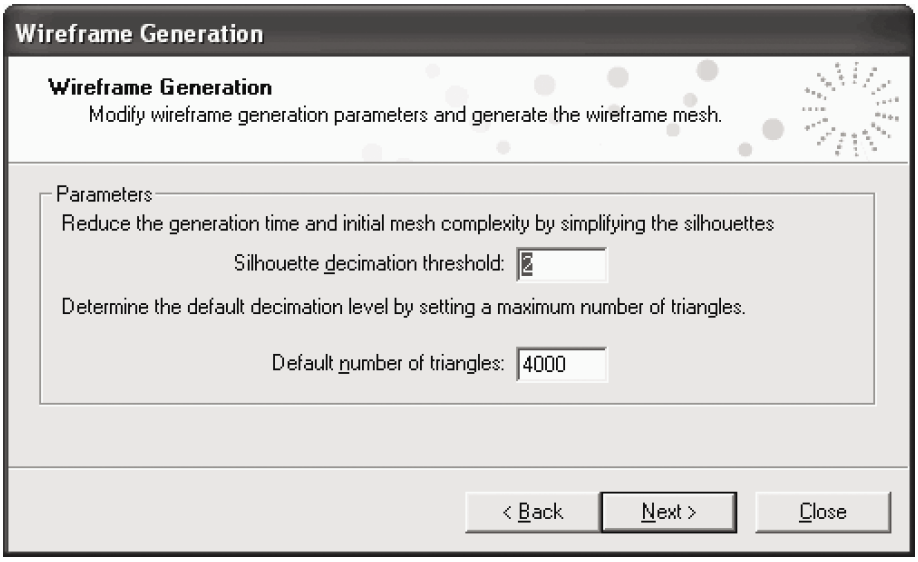


Figure 5.4.2. Parameters for generating a wireframe.

The ***"Silhouette decimation threshold"*** setting affects the complexity of the triangle mesh generated from the silhouettes and saved in the project file, before it has had any decimation applied. This threshold can be set from 1 to 100 and represents the number of pixels of distance that is allowed between the closest triangle's outer edge and the masked edge of the object. A small value improves the model's accuracy in terms of how closely it conforms to each silhouette by causing mesh edges to be broken into many smaller line segments and therefore more triangles are used to more closely track to a silhouette. A very low value combined with masks having very jagged edges may also create geometry that exceeds the memory of your computer and require extremely long processing times to compute. Also, the masks for these key edges must be of similar accuracy to truly have any benefit derived from the extra complexity and processing required the higher accuracy requirement.

If you are using images larger than about 4 megapixels and have turned off the ***"Use sub-sampled images"*** option in the *Strata Foto 3D Settings Window*, then you will most likely want to use a higher number of pixels in this setting, in proportion to the larger dimensions, in pixels, of the photos. Setting this value in the 2 - 5 pixel range generally produces the best results.

The default value for the ***"Default number of triangles"*** setting is set in the *Strata Foto 3D Settings Window* and is usually left unchanged in this window since the interactive decimation slider in the Model Palette allows the triangle count to be changed at any time. This setting simply determines the default complexity of the triangle mesh when it is first displayed in the Model Window.

These default values for these two options are set in the *Strata Foto 3D Settings Window*, and also described in the reference section on The Strata Foto 3D Settings Window in Chapter 3.

Step 3

Click the **Next** button to start generating the wireframe.

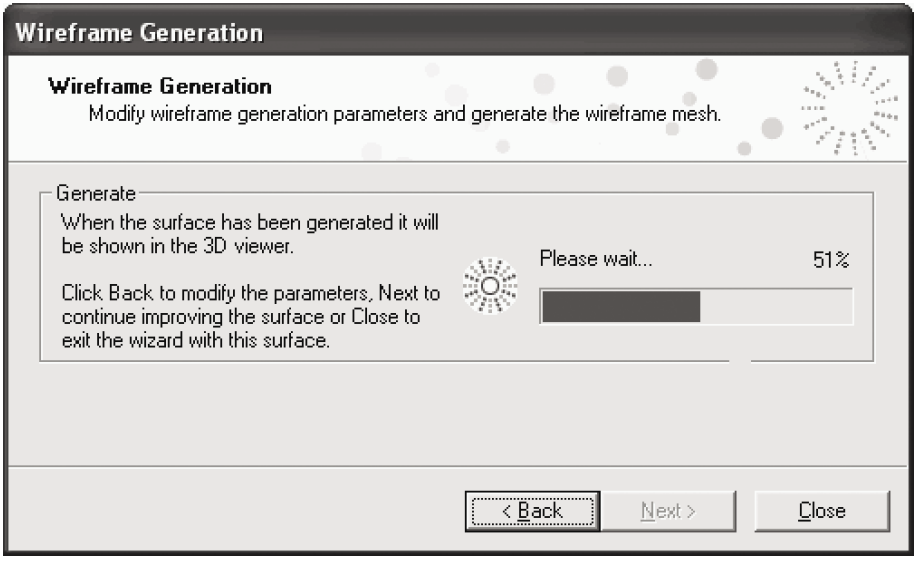


Figure 5.4.3. Progress screen for generating a wireframe.

You won't see any results until the process has completed, but you can cancel part-way through if it seems to be taking an excessively long time. To reduce processing time or minimize the number of unexpected stripe-like artifacts in the mesh, try clicking the **Back** button, then increase the ***"Silhouette decimation threshold"***.

When the process is complete, clicking "**Finish**" will close this window and the model will be made ready for the next step, adjusting decimation.

TIP: If you are experimenting with changing parameters, you can return to the last wireframe you generated by closing the **Wireframe Generation Wizard** then using the **Undo model or mask change** button

Adjusting Decimation

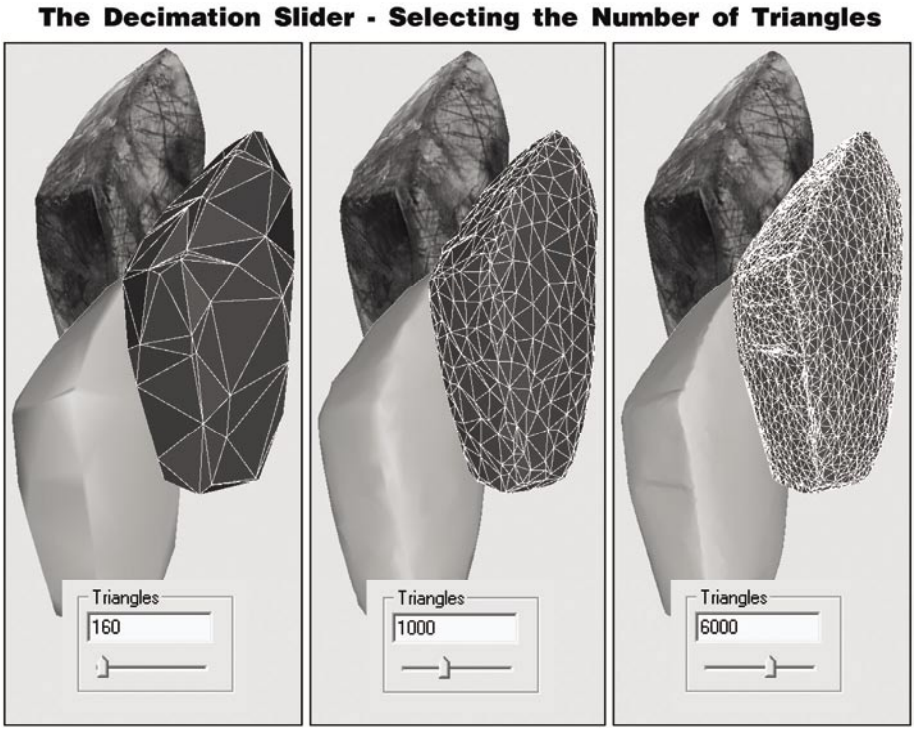


Figure 5.4.4. Effect of the Decimation Slider.

The model is stored as a *triangle mesh* and a technique known as *decimation* is used to allow the number of triangles in the mesh to be varied interactively.

It is possible to adjust the decimation of the wireframe model using the slider in the *Model* palette. Moving the slider to the left decreases the model's polygon count (reducing the definition of the final model); moving the slider to the right increases the model's polygon count (improving the definition and fine detail in the model's mesh).

Note: If a **Decimate** button is displayed in the place of the slider, then click the button and wait for the decimation information to be calculated. (This can occur as a result of canceling certain operations.)

Internally, Foto 3D retains all of the mesh detail captured from the silhouettes when the wireframe is generated. This allows you to change the number of triangles used for display at any time, even after a texture map has been created. Remember, however, that the following operations will use just the triangles currently displayed in the mesh:

- Exporting the model will only export the displayed triangles.
- Generating a texture map will upwardly limit the number of triangles to those currently displayed at the time it was generated. (To display more triangles, discard and regenerate the texture.)

TIP: Use as many triangles as you require to model the object and **no more**. The best way to choose an appropriate number is to view the model in either **View textured model** (F7) mode or **View flat shaded model** (F6) mode and then reduce the number of triangles until you see unacceptable distortion of the model surface due to over-simplification.

There are several reasons to minimize the number of triangles:

- Models with large numbers of triangles are slower to download over the web and require more processing power to display. An overly complex model can exceed the 64Mb memory limit for Java-based viewer software like Strata Live 3D.

- If you plan to include the model in a larger scene using modeling software like Strata 3D CX, simpler models reduce the total memory required to manipulate and display scenes; particularly those with many objects. The complexity also significantly impacts the rendering time required for scenes and animations.
- Finally, advanced modeling tools like sub-division surface (SDS) modeling in Strata 3D CX are more effective with a simpler starting mesh.

Clipping Away the Pedestal

Sometimes there will be unwanted geometry that looks like a dome or cone at the base of the object. This is usually due to photos not being taken from a low enough angle to shape the bottom surface of the object (a consequence of shooting side view shots from a higher angle, closer to midline of the object, to ensure the *calibration mat* is fully visible). Also, the auto-mask process may have considered the pedestal to be part of the object and not the backdrop (usually due to shadows).

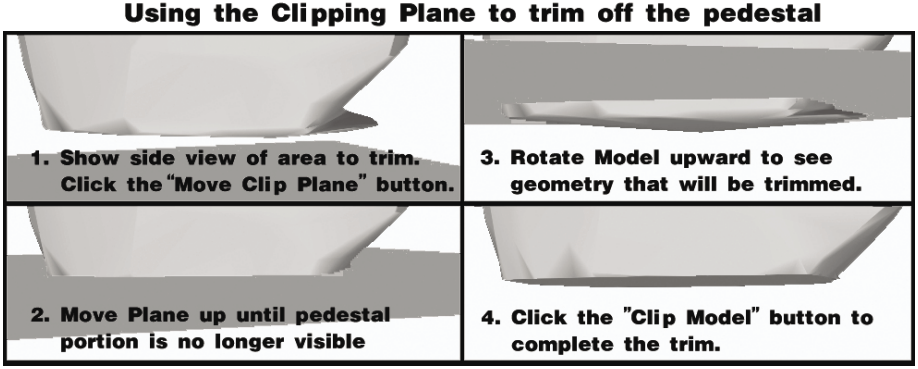


Figure 5.4.5. Steps for clipping off an unmasked portion of the pedestal.

Step 1

Select a side view of the object where you can clearly see the geometry you want to remove.

Select the **Move clip plane** button on the Model Palette and you will see the clipping plane displayed below the model.

Step 2

With the left mouse button pressed, drag the mouse upwards to move the clipping plane up until it is placed at the desired location to trim the bottom off of the model. All geometry below the plane will be removed.

Step 3

At this point, a quick way to rotate the model to see the clipping plane from a different angle is to hold down the Ctrl key to temporarily switch to the rotate model tool.

Step 4

Click the **Clip model** button to complete the process. It will take a moment for Foto 3D to reconstruct the mesh without the clipped geometry.

You can use **Undo model or mask change** button to return to the previous geometry if you have removed too much.

If you decide not to complete the clipping operation, you can hide the clipping plane by dragging it off the bottom of the screen.

5.5. Adding Surface Texture

Generating a surface texture to "paint" the model is the third stage of completing a model in Foto 3D. This section explains how to create a *texture map* for the model.

The process of generating a *texture map* uses the wireframe model and the original photos to determine how each triangle should be colored. The information from these images is blended together to provide a seamless "baked on" texture.

More advanced texturing operations are described in Chapter 8:

- Adding Texture to the Bottom of an Object
- Editing the Surface Texture
- Removing Texture Artifacts

Using the Texture Generation Wizard

Starting Point

Load and mask a set of photos and generate a wireframe mesh.

Try It Out!
To try this out, load the **oblith.som** project from the **Examples\Oblith** directory with your installation. Although it already has a texture created, you can generate a new one. To see this clearly, click on the  **Generate Wireframe...** button or select the **Processing > Generate Wireframe...** menu item to regenerate the wireframe, which will also discard the existing texture.

Step 1

Open the *Texture Wizard* by clicking the  **Generate texture map...** button.

Step 2

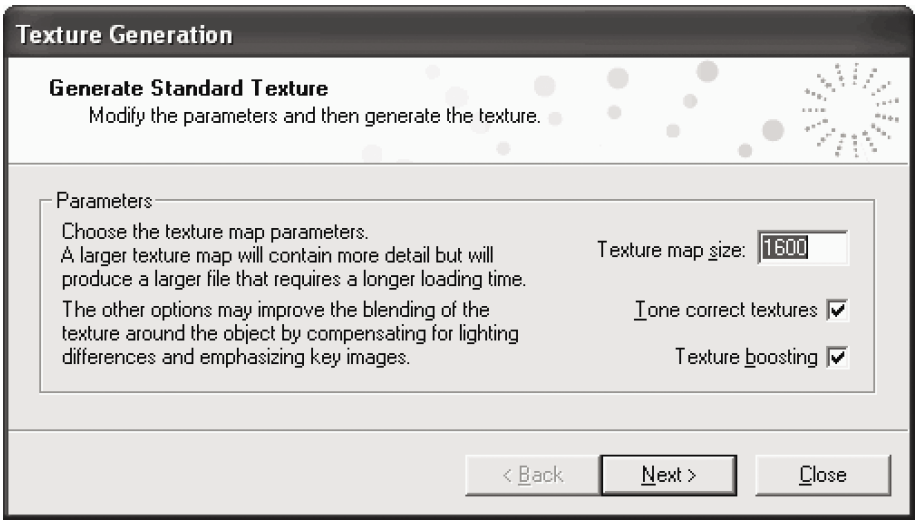


Figure 5.5.1. Parameters for generating a surface texture.

Before you start generating the texture, you can alter the settings (these options are described in more detail in the reference section on The Strata Foto 3D Settings Window in Chapter 3):

- Use ***"Texture map size"*** to set the dimensions of the final texture map in pixels. The maximum size is 1600 pixels for Foto 3D (up to 4096 pixels for the Professional version). Use a value of 512 pixels for an object with little detail or 1024 pixels for an object with more detail.
- The ***"Tone correct textures"*** option is used to enhance the color of the images and compensate for uneven lighting. This option normalizes the unmasked areas of each image so that images blend more consistently. Turn this option off for photo sets shot in a controlled lighting environment.
- The ***"Texture boosting"*** option emphasizes a small set of key images when building the textures. When turned off, all images are used.

TIP: With ***"Texture boosting"*** turned on, Foto 3D automatically selects the key images according to Project Order and the spacing of images around the object. You can manually select an image as high priority and override the automatic image ordering by switching the *Thumbnail Window* to details mode and using the **Images > Image Order** menu.

Step 3

Click the **Next** button to start the texture generation process.

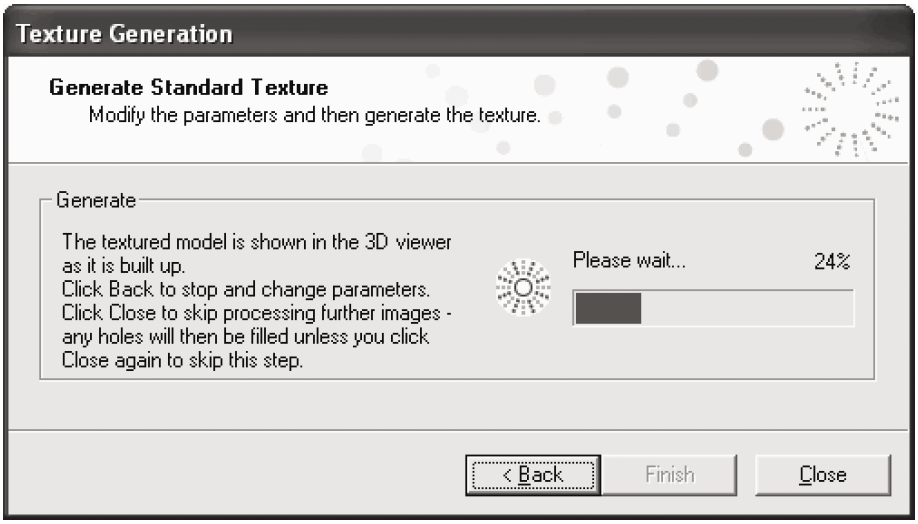


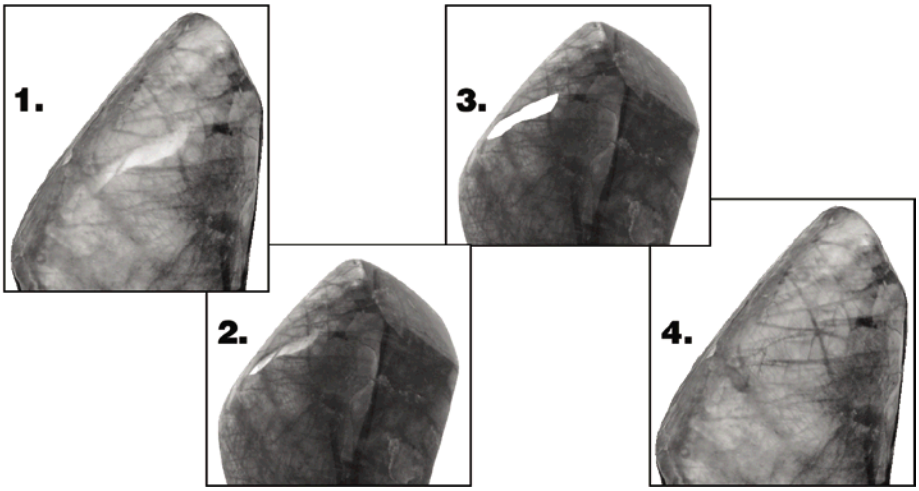
Figure 5.5.2. Progress screen for generating a texture.

As each image is processed, the model is updated to reflect the current texture map. You can stop texture generation when you are satisfied with the results, or leave it to finish processing the remaining images.

If you are trying different settings, you can use the **Undo model or mask change** button to return to the previous state of the texture for comparison. Click the **Back** button to stop processing, change settings and restart the process.

Masking Out Reflections in Textures

Foto 3D excludes masked (background) regions from the textures. If there are specular highlights, reflections, or other undesirable features on an image, you can manually mask these regions prior to building the textures. (Do this after generating the wireframe or by using an image marked "texture only"; otherwise the mask changes will affect the shape of the model the next time a wireframe is generated.)



5.5.3. 1) Reflection in final texture, 2) Step 1 - Locate photo having reflection, 3) Step 2 - Use mask tools to hide reflection (set image type to "texture only"), and 4) Step 3 - Regenerate Texture (another photo will fill in the masked area).

In the alternative, you can load two copies of the same photo and use it with one mask for generating geometry and with another mask for generating texture. Select the already loaded image and click the **Image Type > Geometry Only** menu item so that this image and it's mask are used only to create the wireframe mesh. Use the menu item to select the same photo in the project folder and load a second instance of it. With this second copy selected, click the **Image Type > Texture Only** menu item so that this duplicate copy of image and it's mask are used only to create the texture map. Then create a mask to hide the unwanted highlights and reflections. This two-mask approach allows you the flexibility to regenerate the wireframe model at any time using the original mask and regenerate the texture using the “texture only” mask.

Note: In the event you create two masks using the same photo and choose to Save Masks, because masks are named according to the photo they are associated with, the second mask to be saved will overwrite the first one without warning. Solve this by saving the masks individually using two different directories. Avoid this by copying the source photo in Windows Explorer and giving it a different name before going to the step of adding the second image. This causes the second mask to be saved using the different file name. If you are not concerned about saving the masks individually to use in another project, then the procedure suggested in this Tip works just fine.

5.6. Exporting the Finished Model

Now that your Foto 3D model is completed, this section describes how to export your model for viewing outside Foto 3D

Refer to Chapter 9 for additional details about using your new model with other applications and viewers.

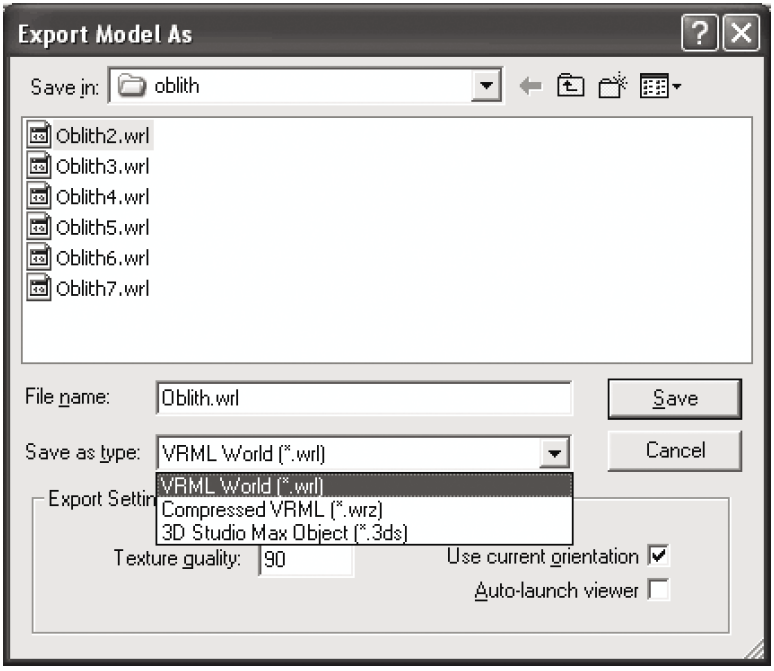


Figure 5.6.1. The Foto 3D *Export Window* with the Export Type drop-down list displayed.

Foto 3D can export models in one of 3 formats by using the  **Export model...** button or the **File > Export...** menu item.

- WRL - VRML 2.0
- WRZ - Compressed VRML 2.0
- 3DS - 3D Studio Max compatible object file

Many of the output formats create several different files. During export, you will be prompted before overwriting any existing files. Canceling will cancel the export but may leave some already exported files in the selected export directory.

Export Dialog Options

"Use current orientation": this checkbox applies to VRML exports (WRL and WGZ) and rotates the exported model so that it will initially appear facing the same direction as currently displayed in the *Model Window*. If left unchecked, the front view is determined by the tick mark on the calibration mat and the object will appear in the same orientation as it does after clicking the **Reset View** menu item button.

"Texture quality": controls the size of the texture map by changing the JPEG compression level to produce a smaller file size at the expense of reducing the texture quality and creating artifacts. This field accepts a value between 1 (lowest quality) and 100 (highest quality). A value between 65 and 95 is usually recommended.

"Auto-launch viewer": when this checkbox is selected, Foto 3D will attempt to open the exported file in an external application. The file associations setup in the operating system determine which application (if any) is launched.

Exporting to VRML 2.0

These options export the model to VRML 2.0 format for viewing directly with a VRML viewer or for importing into other applications such as Strata 3D CX. Two files are produced by this export option:

- WRL or (WRZ) file containing the model itself.
- JPG file containing the texture map.

The WRZ file is just the WRL file but compressed using ZIP for faster transmission. It can be read by most viewers that handle VRML.

The WRL format is preferred for maximum compatibility with the highest level of model detail. The WRL format is imported seamlessly by Strata 3D CX, Silo and Strata Live 3D.

Exporting a 3D Studio Max Object

This option exports the model to a file suitable for reading by software that accepts the 3D Studio Max file format. The following files are produced by this export option:

- 3DS file containing the model
- JPG file containing the texture map.

The 3DS Format is an older, less sophisticated object file format. If given a choice, use the more feature rich VRML format.

Chapter 6

Techniques for Improving

The Photography

6.1. Lighting and Camera Setup

Lighting Advice for Professional Studios …

- Use diffused light sources such as softboxes.
- Flood the scene evenly from all sides; avoid hotspots.
- Avoid or cover point lights that will cause speculars.
- Use a matte white reflector above the object.
- Minimize shadows cast from the object.

Figure 6.1.1. Professional studio setup.

Tips for Experienced Photographers

- Experienced photographers should use their camera in manual mode. Use manual exposure and F-stop to ensure all the photographs are taken under the same conditions. (Or use a 'lock exposure' feature.)
- Use the smallest aperture (as large an F-stop) as possible in order to maximize the depth of field so that the entire object and *calibration mat* are in sharp focus.
- Experiment with the exposure settings until the correct exposure is achieved, or use a standard grey chart and light meter.
- Adjust the white balance manually and lock it for the series to prevent unevenness or shifts in *white balance*.
- If you have an even exposure and consistent white balance in a series of photos, be sure that the ***"Tone correct textures"*** checkbox is not checked in the *Strata Foto 3D Settings Window*. Also, if you upload using a third-party photo editor, disable any automatic correction features.

6.2. Taking the Right Photos

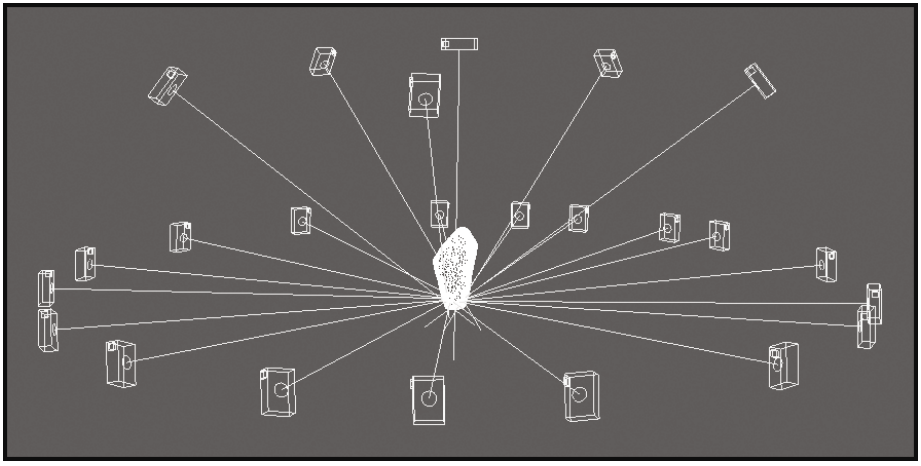


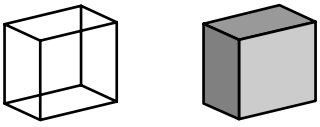
Figure 6.2.1. Generated Model with "Camera View" turned "on" to show the camera positions and angles of the "included" project photos.

In general, Foto 3D will produce very good models using the recommended pattern for photos, as shown. Exceptionally accurate models can be produced if a large number of photos (as many as 30 to 50) are taken from a range of different angles and precise masks are applied. However, you may use fewer photos and obtain equal or better results if the photos are taken from some carefully selected strategic angles.

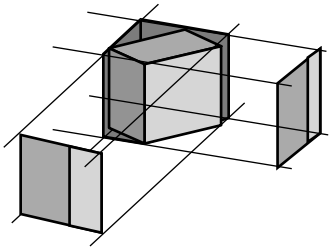
By analyzing the type of object being modeled you can determine the right number of photographs to take and which viewing angles are most suitable. This Chapter gives some examples for different types of objects.

Box-like Cubic Objects

When photographing objects that have flat faces, such as the cube shown below, it is recommended that photographs be taken from a very slight angle such that one face is minimally visible. In the case of a cube, this would require taking photographs with the front face facing directly at the camera and one side just slightly visible; and repeating for the opposite side.



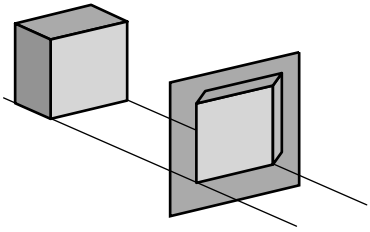
The reason for this lies in how Foto 3D generates wireframe models, and the problem faced by Foto 3D can be best illustrated in the following diagram.



The diagram shows the actual object, a cube, with two photographs shown of the cube. The actual cube is shown, along with the 'shadow'

that is hidden from view in the photographs. The region of space represented by the 'shadow' cannot be seen, and therefore Foto 3D can make no judgment regarding whether this region is filled by the object, or not.

When building a wireframe, Foto 3D works by, in effect, carving away parts of the object using silhouettes. By taking photographs that are orientated to glance down the edge of a face, Foto 3D is able to carve that face more precisely.



The following diagrams show this technique in practice. These are two examples of a rectangular box object. One was created using photographs taken at various angles around the object; the other had four additional photographs taken at glancing angles down each side of the object.

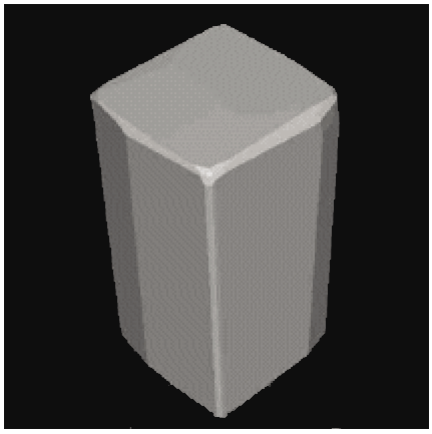


Figure 6.2.2. Results from the usual 15 equally-spaced side view photos.

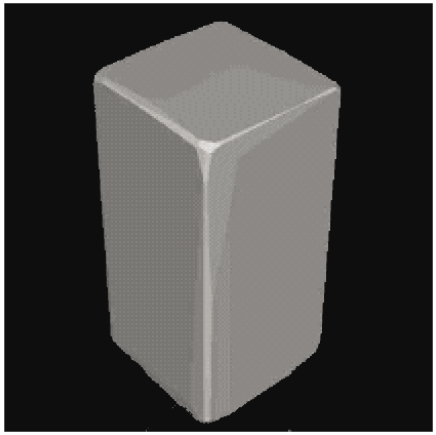


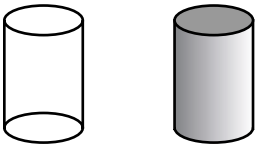
Figure 6.2.3. Results from eight glancing side-view photos.

While the model on the left appears mostly cubic in shape, there is a visible ridge on the face of each side. The faces of the cube are almost flat, but due to the angles that the photographs were taken, the ridge remains visible. Once textured with the "baked-on" textures generated by Foto 3D, these ridges will hardly be noticeable. Still, the two halves of the faces will reflect light slightly differently in a lighted scene and it will be particularly noticeable if the object is animated.

By comparison, the model on the right has very sharp edges since the photographs were taken from an angle almost parallel to each face. Their masks have allowed Foto 3D to carve very smooth faces and sharp corners.

Cylindrical Objects

When photographing objects that have a cylindrical shape, it is essential to provide Foto 3D with numerous photographs around the periphery of the cylinder.

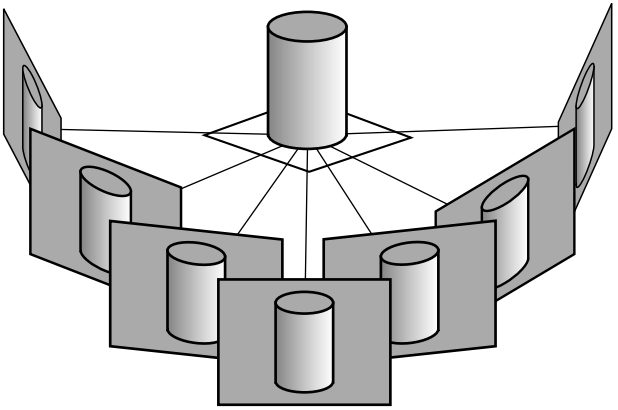


While Foto 3D can carve away at the shape with each photo, it can only do so using what could be imagined as a virtual knife. This is very good for straight edges and cubes, but when presented with a cylindrical object, the process can result in squared sides rather than round curves. This problem is alleviated using a geometry optimization tool in Foto 3D that smoothes the surface where there is no evidence of sharp edges. When the angle between two surfaces is the same as the angle the camera shifted between the two photos that formed the silhouettes that make up the two faces, this tool presumes that the surface between these two faces is a smooth curve. See Optimizing Surface Geometry in Chapter 7.

Even with the optimization tool, the user should still provide Foto 3D with a reasonable number of images, taken at various angles, around the periphery of the cylindrical shape. While Foto 3D will continue to create

the initial wireframe by slicing off straight edges, the number of straight edges may be increased to the point that when the cylindrical shape is produced, especially after optimization, it will appear round and smooth.

The following diagram shows the suggested maximum spacing between camera views taken of a typical cylindrical object.



The following two models demonstrate the difference between taking 6 photographs and 30 photographs of a cylindrical object (without optimization).

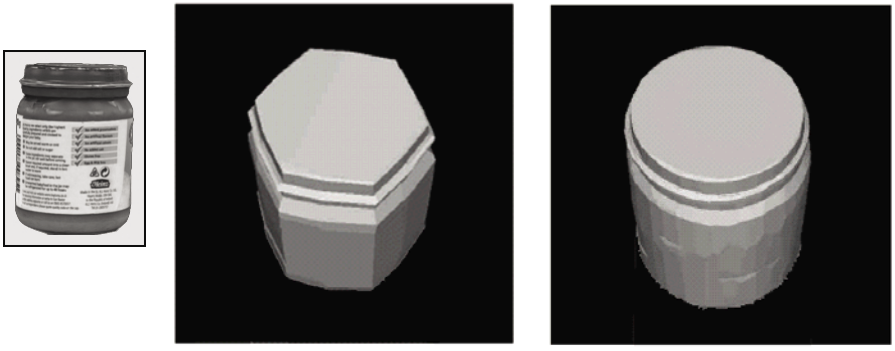
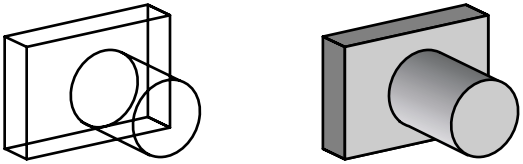


Figure 6.2.4. Difference in modeling a jar from 6 and 30 photographs (before smoothing).

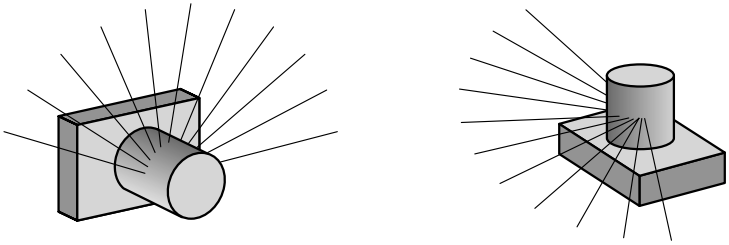
Mixed Objects - Cubic and Cylindrical

When dealing with objects that have both flat and curved surfaces, as would be the case for many objects, then care should be taken to ensure that a suitable set of photographs are taken by applying both of these principles - shoot along flat faces, shoot all around the periphery of cylindrical surfaces.



For example, if the camera illustrated above is modeled from photographs taken just from the side, then Foto 3D cannot see a correct silhouette of the camera from above, and therefore would not be able to correctly model the lens.

The flat sides and cylindrical lens need to be taken into account. The flat surfaces require photographs to be taken glancing down each of the flat surfaces to ensure a clean edge is obtained. The cylindrical lens also needs a number of photographs taken around it, to ensure that Foto 3D is able to correctly model the curved surface correctly.



TIP: An object like this camera might achieve a better result if it was shot on it's back so that the lens is pointing up, as shown in the second illustration. This would allow the usual 15 side view photos to define the cylindrical lens well. Another eight photos would make sure the flat faces were captured from each end. A bottom shot would texture the back surface.

The following models show the effects of not taking enough suitable photographs compared to a more carefully chosen set of photographs.

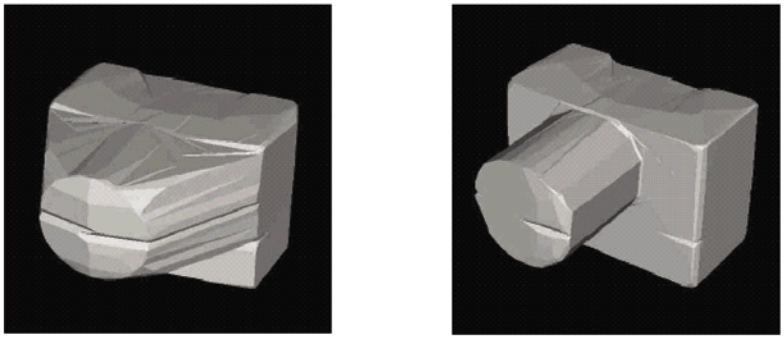


Figure 6.2.7. Models from a poorly planned and a well planned set of photos.

Figure 6.2.5. Precisely capturing the left and right edges.

Figure 6.2.6. Precisely capturing the crescent's silhouette.

These three photographs nearly completely define the shape of the crescent-shaped wood bottle holder. The left and right edge shots define the uniform thickness of the crescent. The side photo defines the inside and outside shape for much of the right-hand portion of the object.

Additional Photos for Texturing

The best photos for texturing a surface are those taken from a nearly front-on angle, perpendicular to the surface. Usually the same photos that produce a well defined silhouette also capture the surface facing the camera. For example, the photo that glances down the side of a cube also clearly captures detail on the front face of the cube.

Note that this photo for capturing the back side of a jewelry box (flat face at the right) also fully captures the texture on the side of the box facing the camera. To avoid the need for precision alignment of the camera and object as in this photo, shooting the same edge from opposite sides will ensure that the corners of the final shape are square.

Figure 6.2.8. Side View with silhouette that perfectly "slices" the back of this jewelry box.

Sometimes additional photos will improve the resulting texture for objects that have flat surfaces, but may not be cubic. For example, a triangular or five-sided object or an abstract shape like the **Oblith** example. Sometimes a slight change in camera angle will reduce the severity of objectionable reflections.

For these odd shaped or reflective objects, it helps to shoot photos from a camera angle that is front-on to each face (preferably including the calibration mat, though these photos can also be aligned manually). Additional photos taken specifically for texturing can be marked "rejected" or "texture only" until the wireframe model is completed, then used as described in Chapter 8 to improve a texture.

Chapter 7

Techniques for Improving The Wireframe Model

7.1. Fine Tuning the Auto-Masking Process

For many objects and lighting conditions, the auto-masking process produces excellent results. Sometimes the simple process of auto-masking a set of images using the default settings produces an unsatisfactory mask. Determining a single threshold to use for all the photo angles in a complete image set, or even for the entire area of a single image with uneven lighting, can require a lot of trial and error. Different thresholds may be required for different areas of an image.

To solve this problem while still avoiding the tedious and time consuming process of manual masking, a couple of interactive auto-masking capabilities are provided which allow the settings to be varied and the resulting mask to be displayed in real time. The interactive tools can also be applied to just a selected region, in addition to the entire image.

The first of these interactive tools is Auto-Masking and it uses the Mask Slider on the Model Palette.

Starting Point

After you have loaded a set of photographs of an object (including the calibration mat) and attempted using the **Mask All Images Wizard** for masking, select one of the images by double-clicking the desired thumbnail.

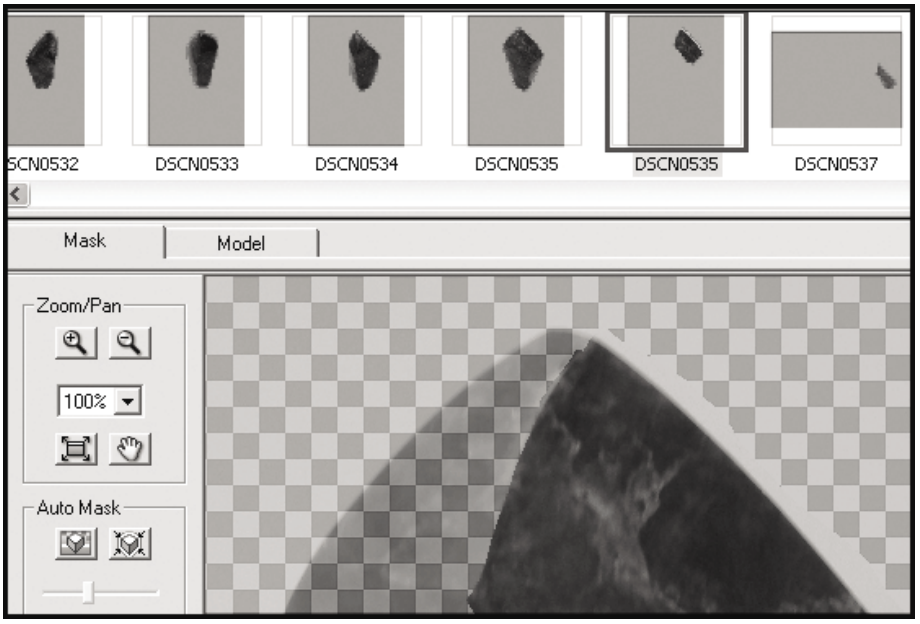


Figure 7.1.1. Double-click a thumbnail to display and edit its mask.

Step 1

Click the **Regenerate mask** button in the *Mask* palette to initialize interactive auto-masking.

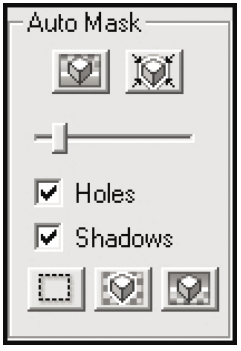


Figure 7.1.2. Mask Buttons and Interactive Slider.

TIP: If you wish to use color normalization so that shadows on a colored backdrop are more likely to be ignored, then make sure the ***"Shadows"*** checkbox is selected before initializing interactive masking.

Step 2

Drag the mask slider to vary the background detection threshold until the desired result is obtained. Move the slider to the right to increase the threshold and create more mask colored area or to the left for the opposite effect.

Figure 7.1.3. Examples of under-, proper and over-masking with the Interactive Slider.

TIP: If the mask display updates too slowly as you drag the slider for large images, try changing the mask to the solid display mode using the **Display Mask > Solid Mask** menu item. With the mask slider selected, you can also use the left and right arrow cursor keys to change the value in small steps.

Applying the masking settings to other images

If, by dragging the slider, a good result is obtained on the current image, you can try the same settings on all the other images in the project, or just selected ones, using the **Mask all images...** button. On opening, the wizard's settings will automatically be updated to the threshold set with the slider.

Step 3

Select or deselect the allow ***"Holes"*** checkbox to allow or disallow holes in the object. If this option is selected, then regions that appear similar to the background color seen inside the object boundary are treated as holes in the object and added to the background mask. Clicking this button will instantly update the mask.

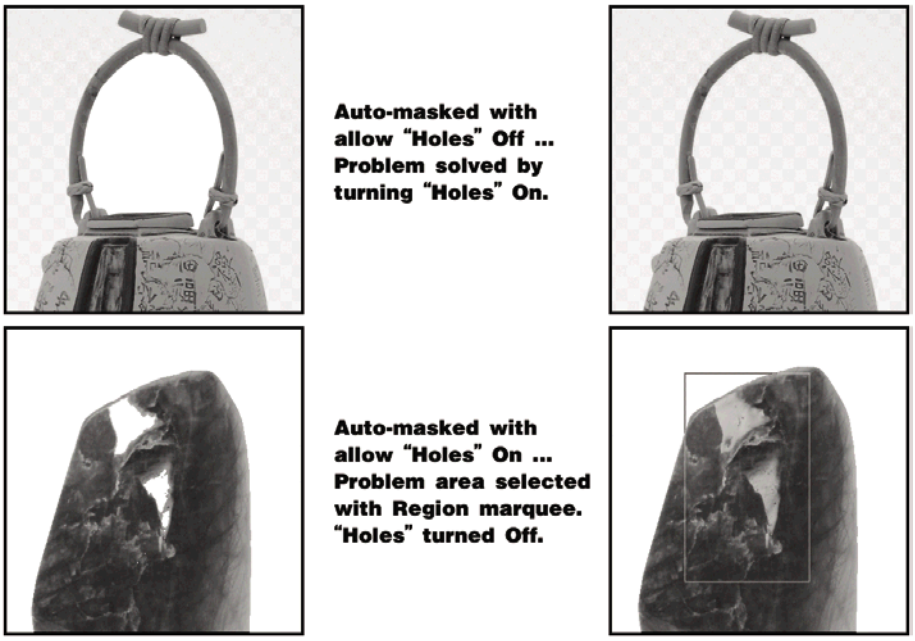


Figure 7.1.4. Examples of adjusting the allow "Holes setting for a region or entire image.

Note: If you wish to change the color normalization setting with the ***"Shadows"*** checkbox, it does not apply immediately (the way the **Holes** setting does). You will need to re-initialize auto-masking using the **Regenerate mask** button to re-mask with the new setting.

Step 4

You can use the **region select** button to drag out a rectangular marquee. The auto-masking tools and options will change just the portion of the mask that is within the selected region.

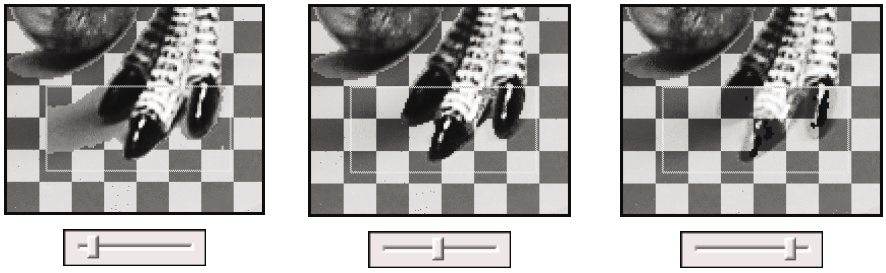


Figure 7.1.5. Examples of under-, proper and over-masking set within a region.

Move the slider to modify the masking within the currently selected region without affecting the mask elsewhere.

Like most masking tools, the ***"Holes"*** checkbox will switch the allow "Holes" attribute on and off for just the portion of the image that is within the selected region (or you can just use the Fill tool to fill a hole.)

Step 5

For finer control you can also modify the ***"background detection threshold"*** within just a rectangular region of the image. Click the **region select** button, then drag out a selection marquee around the desired portion of the image by dragging with the left mouse button. To deselect a selected region, just click on the image without dragging.

Interactive Masking Within a Selection Box
There is no feathering of the effect of any slider changes near the edges of a selected region. To avoid a jagged "stair step" in the mask edge and a resulting ridge in the model, use a combination of the following: Align the selection rectangle so that it does not cross the edge of the object in the middle of a flat face; instead, align with an existing feature in the silhouette like a groove, corner or ridge. Minimize the height of the step by avoiding a single large movement of the slider - use several selections offset from each other to make a sequence of smaller gradual changes. Increase the setting for the ***Silhouette Decimation Threshold*** in the Wireframe Generation Wizard to a number of pixels that is larger than more than half of the "step" height, probably 3 to 5 pixels, so that the jaggedness will be ignored (treated as noise instead of important detail). Use the manual masking tools, particularly the straight edge formed by drawing a polygon, or use a large diameter brush, to trim off any ridge left by using a selection box.

7.2. Masking with the Shrink-Wrap Tool

Sometimes it is difficult to set-up a suitable backdrop and stand to allow either automatic masking or interactive masking to work well (for example, the stand is a different color than the backdrop).

The Shrink-Wrap tool is another semi-automatic tool to make masking easier. To use it, simply sketch a rough outline around the object. By growing this masked area using a process of selecting contiguous areas of similar color, the mask can be "shrink-wrapped" onto the object for quick and accurate masking.

Starting Point

Load one or more photographs of the object for masking. Select one of the images by double-clicking the desired thumbnail or by dragging it into the *Mask Window* display area.

Figure 7.2.1. Selecting an image to mask by double-clicking.

Step 1

If you choose, remove any existing mask using the **Unmask image** button from the *Mask* palette. If the existing mask does not penetrate the object, there is no harm and there may be some benefit to using it as a starting point.

Figure 7.2.2. Selected image with mask removed.

Step 2

Either start with a mask that includes the background and stand, but doesn't penetrate the object, or select the **Paint mask** button to paint the mask color and select a round brush using the **Round Brush** button. Adjust the brush slider to select a thick brush (around 20 pixels). Paint a rough outline around the object that is reasonably close to but not touching the object.

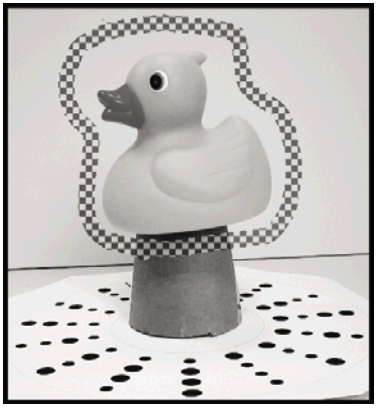


Figure 7.2.3. Selected image with outline painted using the brush

TIP: The outline can be very rough but make sure you don't touch the object you are trying to mask. If there are holes contained within the object's outline as seen from the camera's vantage point, you may paint inside these areas to initiate masking the hole.

Step 3

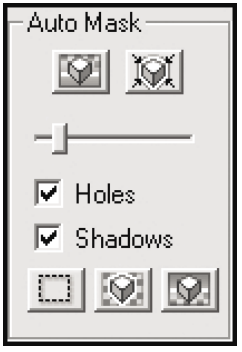


Figure 7.2.4. Mask Buttons and Interactive Slider.

Click the **Shrink-Wrap Mask** button, then drag the masking slider to interactively shrink-wrap the mask. Move the slider to the right to create more mask area and to the left to create less mask.

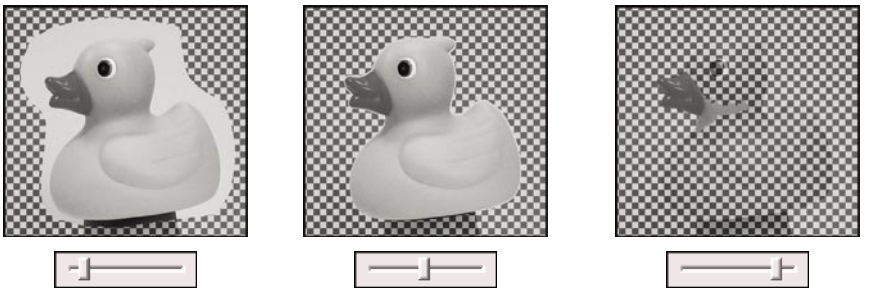


Figure 7.2.5. Examples of under-, proper and over-masking with Shrink-Wrap.

The slider has a similar effect to the tolerance setting for the magic wand in Photoshop except that there are two factors that control the shrink-wrap, similarity in color and distance from the edge of the rough mask. (The tolerance gets lower for areas that are further away from the rough mask so that similar color areas that are a long distance from the starting mask are more likely treated as if they are reflections of the background on the object and masked as object as opposed to background.)

Step 4

For finer control, you can further modify the shrink-wrap threshold in a rectangular region of the image. Click the **region select** button, then select the desired image region by dragging with the left mouse button. Once the region is selected, move the masking slider to interactively set a different threshold for just the selected region.

Note: There is no feathering of the effect of a slider change near the edges of a selected region. To avoid a jagged "stair step" in the mask, follow the recommendations in the previous section on *Interactive Masking within a Selection Box*.

Step 5

Select or deselect the ***"Holes"*** checkbox to allow or disallow holes in the object. Clicking this button will instantly update the mask. (Note: The color normalization setting has no effect when shrink-wrapping.)

TIP: At any stage, you can re-run the shrink-wrapping using the current mask as a starting point. This can be helpful for fine-tuning the mask in a selected region. The tool must be re-selected in order to reinitialize it to use any changes made to the mask since it was last initialized.

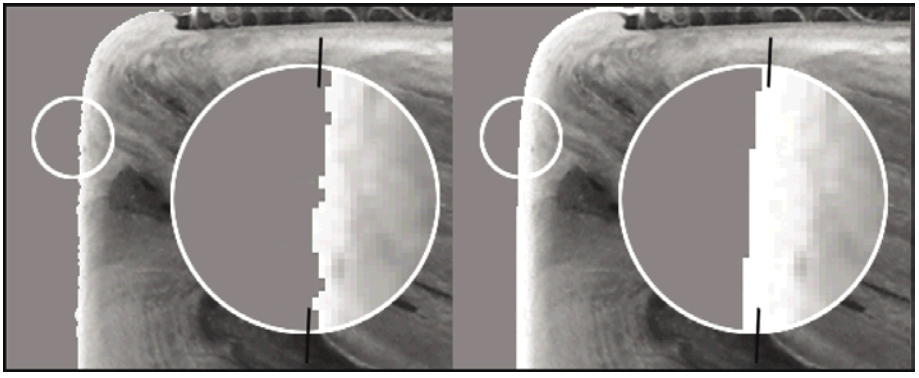


Figure 7.2.6. A reminder that a slight under-masked fringe may be preferred on larger objects or lower-resolution photos to produce a smoother model surface without causing significant texture misalignment (seams). The effect of these edge irregularities can also be minimized by a high Silhouette Decimation setting in the Wireframe Generation wizard.

7.3. Using Clean Mask with Shrink-Wrap to Mask a Set of Images

Sometimes a set of photographs will not be suitable for auto-masking for one or more of the following reasons:

- no pedestal or stand was used...
- the backdrop does not fully surround the object...
- the backdrop was not sufficiently plain...
- no backdrop was available...

If there are a large number of images, accurate manual masking could take a long time. For this situation, Foto 3D provides a number of semi-automatic tools for more rapid masking of multiple images by improving the workflow.

Starting Point

Start with a project consisting of a large number of challenging images. Remove any existing masks that penetrate the object or are otherwise inaccurate using the **Masking > Unmask Images** menu item.

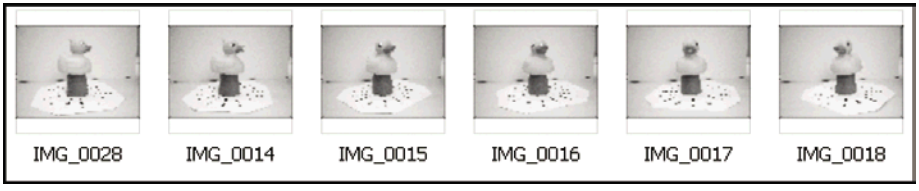


Figure 7.3.1. Photos with any masks removed.

Step 1

First, put the thumbnails in a special prioritized order called “Project Order”. View the thumbnail in details mode by clicking the **View image details** button. Click the "Order" tab so that the thumbnails are displayed sorted in "project order" which automatically sequences the images so that the first few images are from widely differing viewpoints.

Name	Type	Status	Camera	Mask Status	Order
IMG_0020	normal	included	elevation 18 rotatio...	no mask	1 [auto]
IMG_0014	normal	included	elevation 19 rotatio...	no mask	2 [auto]
IMG_0024	normal	included	elevation 19 rotatio...	no mask	3 [auto]
IMG_0017	normal	included	elevation 18 rotatio...	no mask	4 [auto]
IMG_0026	normal	included	elevation 20 rotatio...	no mask	5 [auto]
IMG_0022	normal	included	elevation 19 rotatio...	no mask	6 [auto]
IMG_0015	normal	included	elevation 18 rotatio...	no mask	7 [auto]

Figure 7.3.2. Thumbnail View in detailes mode sorted in Project Order.

Step 2

With the Mask Window displayed, double-click the first thumbnail. Create a mask using the appropriate masking tool, such as the Shrink-Wrap tool (see Masking with the Shrink-Wrap tool).

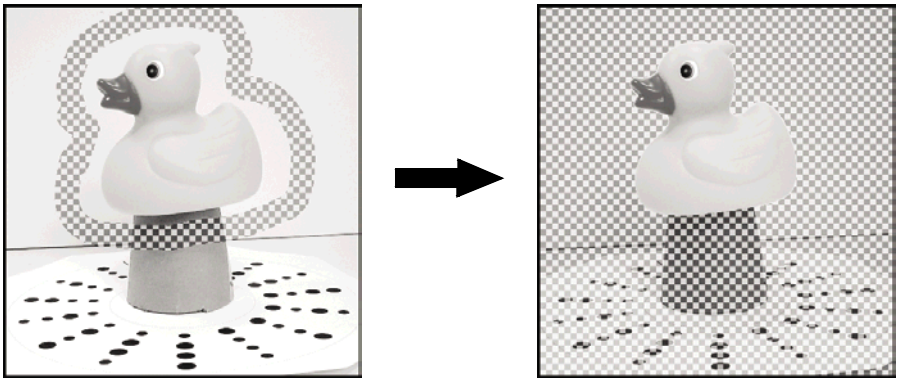


Figure 7.3.3. A hand-painted outline plus the shrink wrap tool are applied to create a mask for the first image in the "project order" list

Step 3

Repeat the process for the first 3 or 4 images in the ordered list.

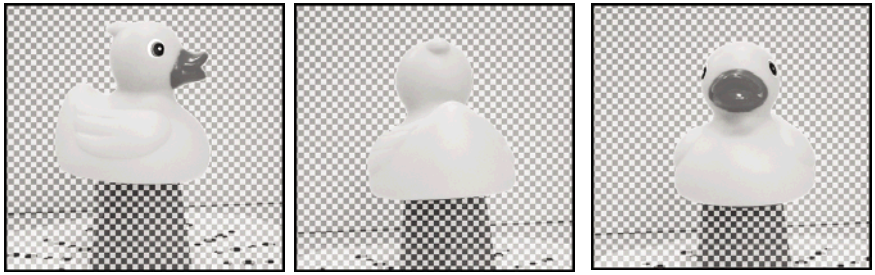


Figure 7.3.4. Masks created for the next three images.

Step 4

Generate a rough 3D wireframe model using these few images. Click the **Generate Wireframe...** button to launch the **Wireframe Generation Wizard**. Select the ***"Generate wireframe"*** option and click the **Next** button. Use the default parameters and click the **Next** button to create an initial 3D model. When finished, close the Wizard.

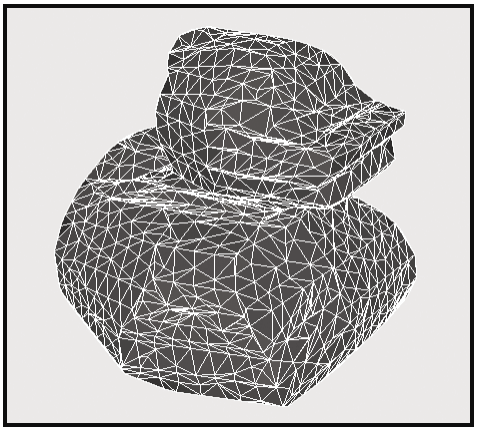


Figure 7.3.5. Rough wireframe model from four viewpoints.

Note: Don't optimize the surface at this stage - we just want a rough oversized estimate of the space in which the object must lie.

Step 5

Return to the **Mask Window** clicking the **Mask** tab.

In the Thumbnail Viewer, select and load the next un-masked thumbnail for editing by double-clicking it.

Figure 7.3.6. Selecting next thumbnail to mask.

Step 6

We can now project the 3D model into the selected image to get an initial estimate for the maskby clicking the **Clean Mask** button.

There shouldn't be any, but, if necessary, unpaint any areas of the object that have been incorrectly shown as masked. (This can happen and be of concern with a complex object if there is a slight amount of uncorrected lens distortion, the object has moving or flexible pieces, there is a slight bend or curl in the calibration mat, during the shoot there was a slight shift of the object on the pedestal and mat, the zoom setting was changed mid-project, or there are similar inaccuracies in the photographs.)

Figure 7.3.7, below, shows an initial mask derived from the wireframe model by using the **Clean Mask** tool.

Step 7

Shrink-wrap the mask to the object. Click the **Shrink-Wrap Mask** button and drag the masking slider until the desired mask is obtained.

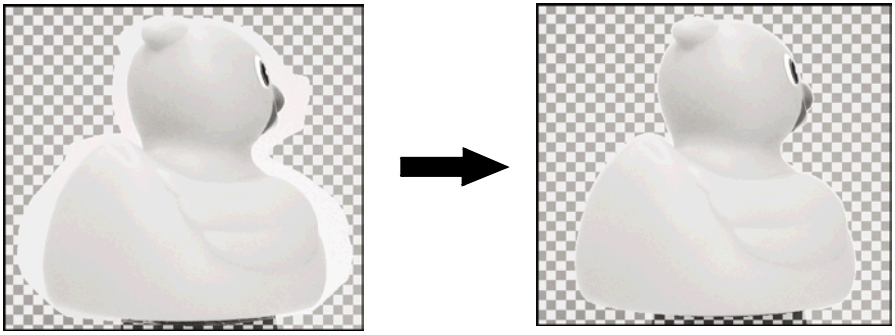


Figure 7.3.7. Mask generated by Clean Mask tool as initial silhouette.
Figure 7.3.8. Mask shrink-wrapped from the initial silhouette.

TIP: For improved workflow the last two steps can be combined. Clicking the **Shrink-Wrap Mask** button for an un-masked image will automatically perform a clean mask operation followed by shrink-wrapping.

Step 8

You can fine-tune the shrink-wrapping (see Masking with the Shrink-Wrap tool) and manually edit any remaining problem areas with the brush and it's related tools.

Step 9

Repeat for the remaining un-masked images.

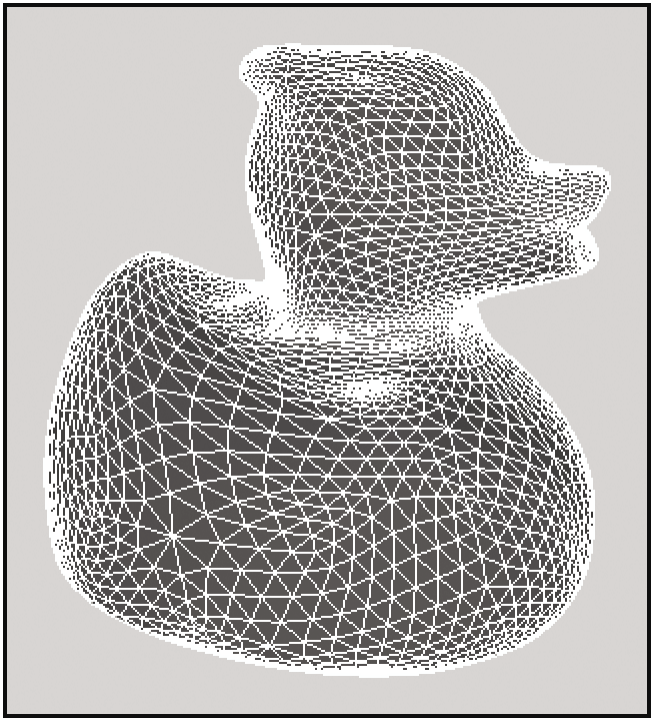


Figure 7.3.9. Optimized wireframe produced using this technique.

7.4. Editing Masks with an External Application

Foto 3D provides an extensive set of automatic, semi-automatic and manual masking tools. In addition, for users that would prefer to use any additional tools provided by their favorite image editing program, such as Adobe Photoshop, Foto 3D also provides methods for importing externally edited masks.

Using Pre-Masked Images

Images having a mask in their alpha channel can be loaded into Foto 3D in TIFF format. This is only recommended for image editors, such as Adobe Photoshop, that preserve camera setting metadata (EXIF data) found in the source files when saving the masked version of these files.

Photoshop (or similar) users can create an alpha-channel mask for all images and save them in TIFF format (4 channel RGBA). These images can then be loaded directly into Foto 3D using the **New project...** button or the **Images > Add Images...** menu item. Make sure the RGB channels have not been modified so that the calibration mat can be correctly detected and analyzed.

Note: If you find Foto 3D asking you to calibrate your lens when loading pre-masked files, it is because the EXIF data is being lost in the masking process. Use the technique in the next section to create masks keeping the EXIF data intact.

Note that if you choose to use this workflow, we recommend that all masking is performed in Photoshop. If you wish to edit a mask simply edit the TIFF image and then refresh the masks in Foto 3D using the **Masking > Load Masks...** menu item.

Preparing Images for External Masking

Alternatively, after an image file has been imported and the camera details in the EXIF metadata have already been added to the project database, an image file with mask data can be exported from Foto 3D as a 4 channel (RGBA) image in TIFF (or PNG) format for editing in a larger selection of third-party image editors without concern over whether they preserve the metadata. Edited masks can then be imported back into

Foto 3D for use in 3D model generation by using the **Images > Import Masks** menu item.

Step 1

If you are not using pre-masked images, then load a set of photos into a new project. Run the **Mask All Images Wizard** to generate initial masks.

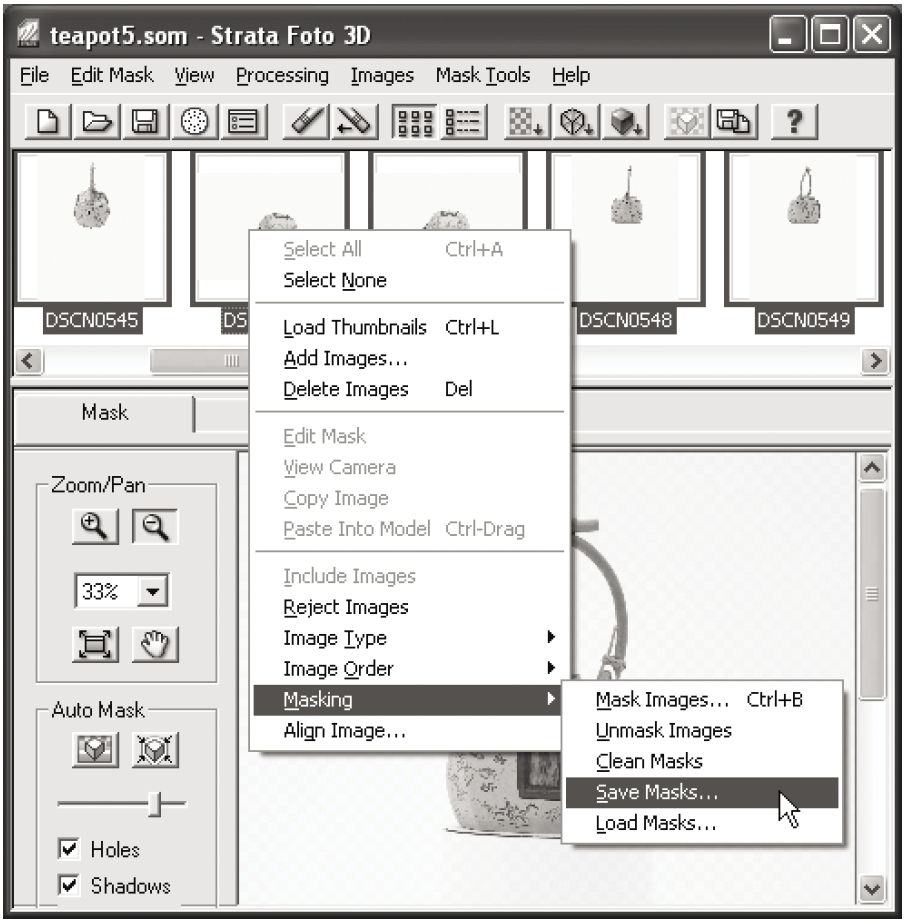


Figure 7.4.1. Save Masks context menu (right-click menu).

Step 2

In the *Thumbnail Window*, select the masked thumbnails that you wish to edit in a third-party image editor either by clicking on a thumbnail, using the Shift key to select a range, or holding down the Ctrl key to add or remove clicked thumbnails to or from the selection.

Step 3

Select the **Masking > Save Masks...** menu item to save the masks to disk as image files. You will be offered the choice of a number of mask export formats. For compatibility with most popular image editors and to limit compression losses, we recommend that you select the TIFF file format.

File formats for saving and loading masks:
Tagged Image File Format (TIFF): The lens-distortion-corrected original image will be saved with the mask saved in the alpha channel (four channels - RGB & transparency). This is the recommended format since it is read by most image editing applications, saved without compression losses and keeps the source image and it's mask in the same file. **Portable Network Graphic (PNG):** The lens-distortion-corrected original image will be saved with the mask saved in the alpha channel. If the original images were PNG files, no information is lost if the masks overwrite the original images. **Portable Gray Map (PGM):** In this format, only the mask is saved as a grayscale image. The original image is not saved as part of the PGM file. When using this format for saving masks, it is important that the original images are NOT in PGM format so that they are not overwritten. (This format is dated and is supported for compatibility with older software. It is no longer being widely used.)

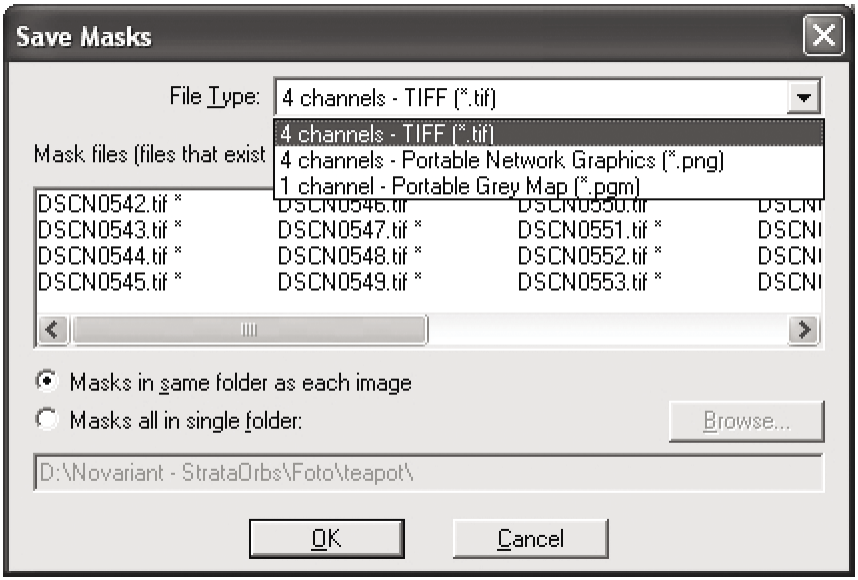


Figure 7.4.2. Save Masks dialog with File Type drop-down expanded.

It is recommended that mask files be saved in the same directory as the source photos by selecting the ***"Masks in same folder as each image"*** option and clicking the **OK** button.

The names used for mask files must match the source image files' name. Mask file names cannot be renamed or changed once the source images files have been added to a project; but mask files can always be saved into a different directory to avoid overwriting a similarly named file.

Note: In the Save dialog, files that already exist in a directory and will be overwritten by the save are marked with an asterisk.

Step 4

Open your third party image editor. Open the mask files that Foto 3D created. (Usually found in the same directory as the source photographs but having a .TIF extension.)

Step 5

The mask information is stored in the "alpha" channel which, initially, may not be visible.

To display the current mask in Photoshop, select the Channels tab (**Window > Show Channels** menu item). Then click on the checkbox next to the "Alpha" channel to turn on the visibility for this channel.

To display the current mask in Paint Shop Pro, you need to first load the mask using the **Masks > Load From Alpha Channel** menu item. Then select the **Masks > View Mask** menu item.

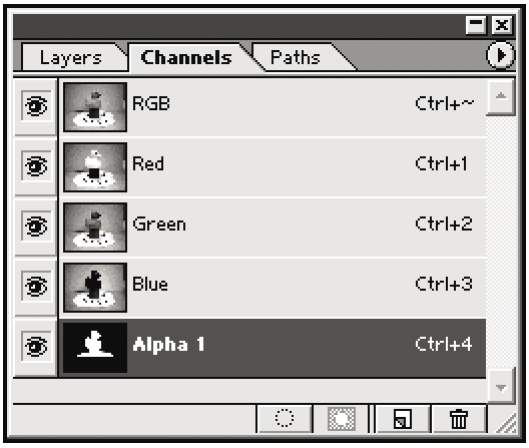


Figure 7.4.3. The Channels Tab in Photoshop

In these and other applications, it is advisable to stick to using the two colors normally used for masking in the alpha channel — white (255) for the visible object and black (0) for the invisible background.

For pre-masked objects or imported masks, Foto 3D applies a 50% luminosity threshold to separate masked from unmasked areas using the following convention...

Alpha Channel Conversion Convention		
pixel label	alpha value	color
object	127-255	white
background	0-127	black

Step 6

You can use the usual editing tools in your image editing application to edit the mask channel. When you are done editing, **Save** the file using the original filename and extension.

TIP: If you are editing a mask in Paint Shop Pro, be sure to save the result back to the alpha channel using the **Masks > Save To Alpha Channel** menu item.

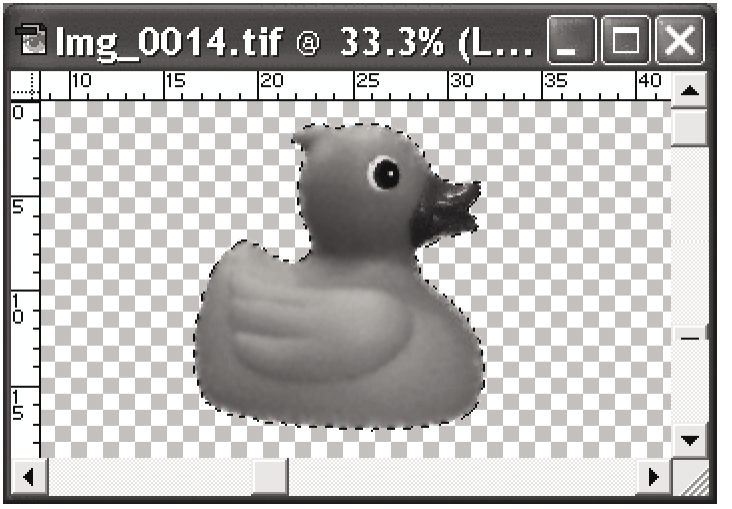


Figure 7.4.4. Mask Selected, to be transferred to Alpha Channel.

General Masking Tips

When using a Paintbrush Tool to paint in the alpha channel, make sure you use a hard edged brush. Click on the brush and drag the hardness slider to 100%. Use white for painting the object regions and black for painting the background.

- You can select part of the object (or backdrop) and update the mask using the **Select > Save Selection** menu item. Choose the "Alpha-1" channel and select "Add to Channel" to mask the selected region as object (or "Subtract from Channel" to mask as backdrop).

General Masking Tips

- Alternatively, you can select part of the object (or backdrop) and update the mask by selecting the Alpha-1 channel under the Channels tab and filling the selected area with white or black using the **Edit > Fill** menu item.
- If you are selecting an area using the **Select > Color Range** menu item, make sure you have selected the RGB channels in the Channel tab when making the selection.
- If you wish to use Photoshop's image extraction tool, click the RGB channel in the Channels tab, then select the **Image > Extract** menu item to perform the extraction of the object. This will create a transparency channel. To update the mask use the **Select > Load Selection** menu item and choose the transparency channel. Then use the **Select > Save Selection** menu item and choose to replace the alpha channel.

When you are finished, save as a TIFF file with alpha channel enabled and without layers or compression using the original filename.

Step 7

Once you have edited the mask image files, they can be loaded back into Foto 3D by selecting the corresponding image thumbnails (or all thumbnails) and selecting the **Masking > Load Masks...** menu item. This process will ignore any images that do not have a similarly named mask file in the directory; these files are displayed in the list of filenames *without* being marked with an asterisk.

7.5. Optimizing Surface Geometry

The initial wireframe generated from the silhouettes may have visual features or irregularities, such as sharp corners, that are unwanted geometry resulting from not having taken sufficient photographs from the best angles. If the model is to be lit using a virtual light source, these irregularities may introduce shading artifacts. (see Figure 7.5.1).

The surface smoothing feature of the **Wireframe Generation Wizard** can be used to optimize the mesh. This will smooth the mesh in regions where there is no information in the photos suggesting it should have sharp edges, but keeps any sharp corners that can be seen in the silhouettes.

Starting Point

Although not essential, it is usually better to have an initial surface generated from which the optimizer can start. You will also need to have all of your images masked accurately since the model will be optimized to fit every one of these masks.

TIP: You might want to use the **Automask > Clean Mask** menu item to clean up your masks - this will mask out previously unmasked portions of each image that lie outside the current geometry. More importantly, it will demonstrate any irregularities that using the ***"Constrain smoothed mesh to lie inside current geometry"*** option might produce as a result of any distortion or mis-alignment of the images due to uncorrected lens distortion, blurry photos, slight movement of the object on the mat, or any bending or curling of the mat.

The ***"Constrain smoothed mesh to lie inside current geometry"*** option produces an equivalent result, but does so by using an internal copy of the masks that cannot be viewed or edited in the masks window.

You can also create additional silhouette images and edit these if you want to capture particular features as described in the section Improving the Model By Adding Silhouettes found later in this Chapter.

Note: Optimization will discard any generated surface texture, but it will keep in place any clipping you have performed. It is better to clip away the stand before starting the optimization process.

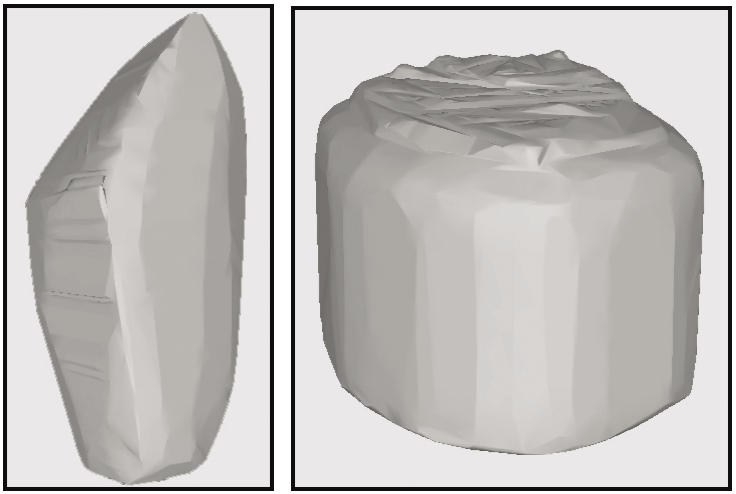


Figure 7.5.1. Two initial wireframes displayed in flat shaded mode. Note the sharp edges that are visible.

Step 1

Open the **Wireframe Generation Wizard** by clicking the **Generate Wireframe...** button and choose ***"Optimize Surface"*** then click the **Next >** button to go to the *Surface Optimization Window*.

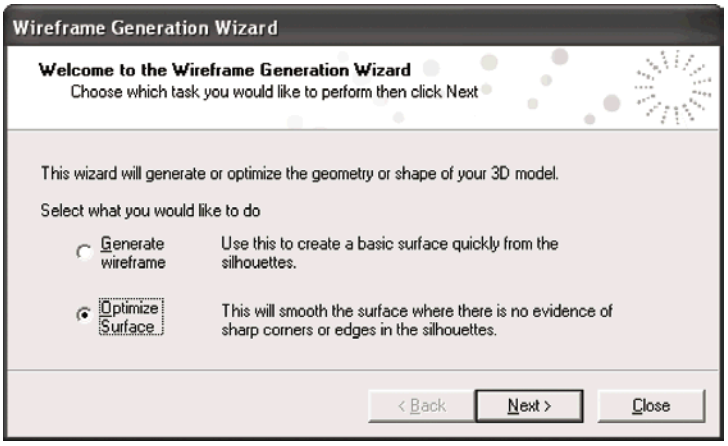


Figure 7.5.2. Launching the Wireframe Generation Wizard in Surface Optimization mode.

Step 2

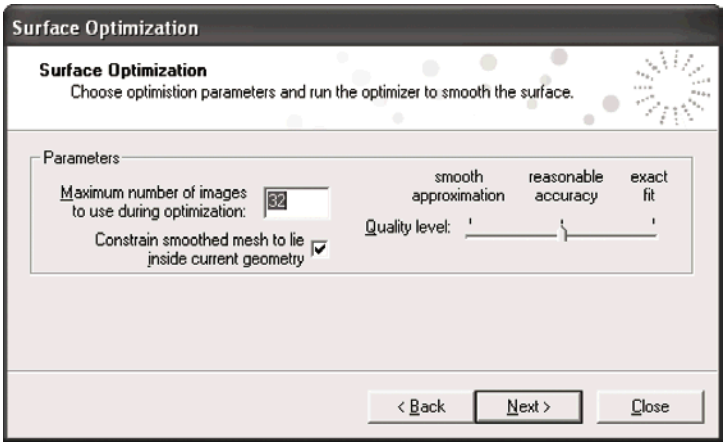


Figure 7.5.3. Setting the Surface Optimization parameters.

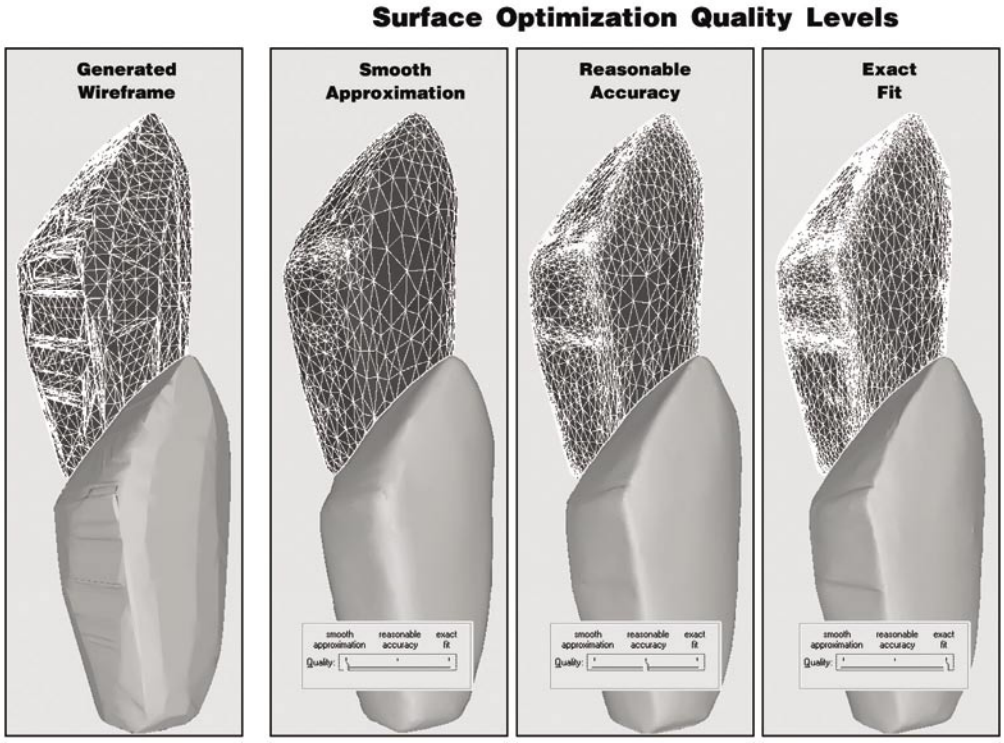


Figure 7.5.4. Effect of the Surface Optimization quality level slider.

The following Surface Optimization Parameters can be set:

Set the Quality Slider

If you have a smooth, organically shaped object, choose ***"smooth approximation"*** to generate a smoothed mesh with few corners. Otherwise, either leave the ***"reasonable accuracy"*** default setting or choose ***"exact fit"*** if you are confident that your masks are very accurate and you want the surface to fit all the details in their silhouettes.

Set Mesh Constraint

If you have edited the masks to remove unwanted regions in just *a few* of the images (e.g. the stand or a subpart of the object) you will need to make sure the ***"Constrain smoothed mesh to lie inside current geometry"*** option is selected. This will prevent the non-edited masks affecting the geometry (and growing back any portions of the mesh removed by another mask in the set).

Set Image Limit

If you have a lot of images in your project or the silhouettes are particularly complex, optimization can be slow, so it is a good idea to limit the number of images used at each optimization step by setting the ***"Maximum number of images to use during optimization"*** parameter.

Click the **Next** button to start the optimization process.

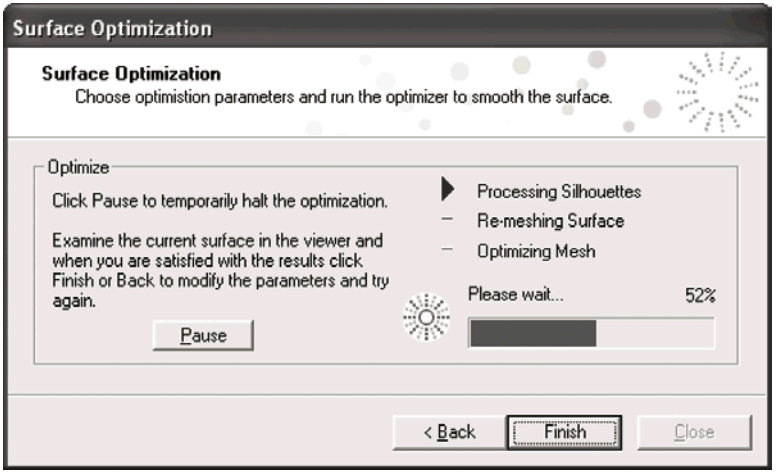


Figure 7.5.5. Surface Optimization progress window.

Step 3

After some initialization, Foto 3D will start to modify the surface, gradually smoothing it while ensuring the features on the silhouettes are captured.

During this process, you can see the current geometry and look around the model by rotating it in the *Model Window* as usual. At this stage, the mesh will be displayed with the maximum number of triangles, and will not be displayed reduced to the selected decimation level until optimization finishes.

Use the **Pause** button to halt the optimization while you look at the results and then click the **Continue** button to resume optimization.

If you want to change the parameters, click the **< Back** button at any point to return to the previous step and edit them (for instance if the optimization is proceeding too slowly, you could reduce the number of images being used).

Step 4

You can either allow the optimization to finish completely, or interrupt it if the current surface appears sufficiently optimized. Click the **Finish** button to leave the *Surface Optimization Wizard*, keeping the partially optimized mesh as it is currently displayed.

When the Wizard is closed, *decimation* will be initialized, which may take a few seconds. The model will be re-displayed with the number of triangles previously specified by the "***Number of Triangles***" decimation setting.

7.6. Improving the Model By Adding Silhouettes

Sometimes, after taking the photographs and starting to build the model, you may realize that, to improve the final geometry, you needed to use an image from a different angle.

Three options are available in this situation:

- If you have not moved the object and it is still aligned with the calibration mat, you can simply take additional photographs and add them to the project using the **Images > Add Images...** menu item.
- If you have moved the object, you can still take more photographs, but you would need to align each new image as described in the section on Adding Texture to the Bottom of an Object in Chapte 8.
- If you no longer have access to the object, do not want to take any more photographs, or simply want to refine an area of the model, you can create a *synthetic view* as described below, edit the mask to correct the silhouette from this viewpoint, and then re-generate the wireframe using this silhouette.

TIP: See the preceding section on Optimizing Surface Geometry for another automatic tool for improving the surface, which might be just as effective or which would produce further enhanced results with the benefit of an additional silhouette.

Starting Point

Before creating a *synthetic view*, a 3D wireframe model has to be generated and it is highly recommended that you also generate an initial texture map.

Step 1

In the *Model Window*, rotate and position the model until you are looking at it from an angle that shows as much of the unwanted geometry on the edge or silhouette of the model as possible.

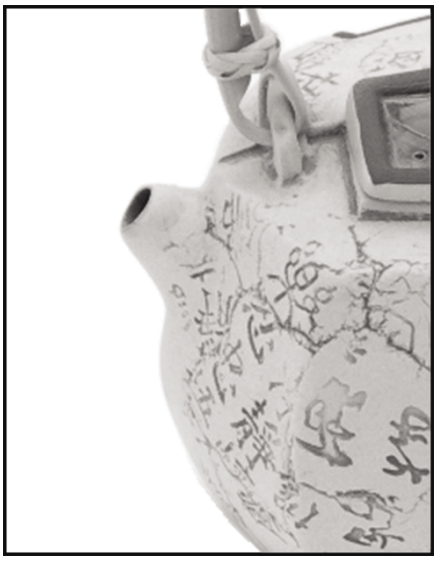


Figure 7.6.1. The model rotated to show as much unwanted geometry as possible.
Figure 7.6.2. A photo from another angle showing intended shape.

Note: If you cannot find a single view angle from which all of the unwanted geometry is visible, you may need to repeat this procedure to create silhouettes from several viewpoints.

Step 2

Click the **Create silhouette** button. If you have a texture map generated, you will be prompted whether to save the virtual image of the model as an image file for editing the mask. Choose a filename for the synthetic image and save it in the project folder.

Note: Make sure that the entire object is visible in the new image, otherwise your geometry may get clipped. If the image is clipped, delete the new image, zoom out a bit and create the image again.

Figure 7.6.3. Thumbnail View showing new synthetic images.

The new synthetic image will appear in the *Thumbnail Window* with an initial mask generated from the current geometry. Synthetic images are not used for texturing and are indicated as type ***"silhouette"***.

Step 3

Load the new mask into the *Mask Window* by double clicking on its thumbnail. Edit the mask so that the geometry is corrected.

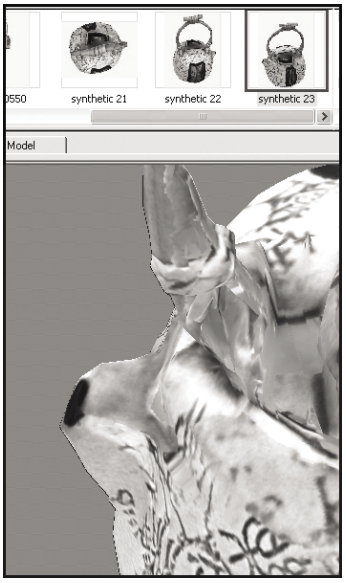


Figure 7.6.4. The synthetic image and mask ready for editing.

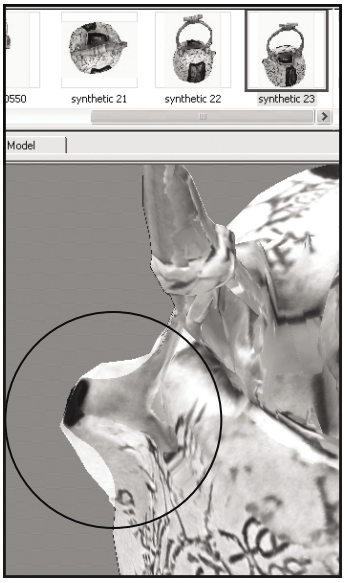


Figure 7.6.5. The mask after editing to improve the shape.

Step 4

Re-generate the wireframe model by clicking the **Generate Wireframe...** button and following the normal procedure.

Figure 7.6.6. The model after being regenerated, showing the corrected geometry.

7.7. Modeling Parts of an Object

For a complex object, or one that you may wish to animate as separate pieces or assemble with other parts in a 3D modeling application like Strata 3D CX, it can be helpful to build a separate textured 3D model of a single part of an object. This can also result in improved modeling accuracy.

Foto 3D allows you to build a 3D textured model of just part of an object by manually editing selected masks.

In our example we will model just the lens from images of a camera with attached lens. The lens model can then be assembled to the camera body and placed into a 3D scene and rendered using 3D modeling and animation software such as Strata 3D CX.

Starting Point

Load in the photographs of a complex object (in this case a camera).

Step 1

Using the automatic masking tools, build a set of masks of the combined object. These will be used later to build masks for just the lens.

Figure 7.7.1. Masked images of a camera.

Note: It is a good idea to save the project at this point. In our example we will call this project "camera_with_lens.som".

Step 2

Next, concentrate on building the geometry for the lens. To do this, select a number of *key images* and edit the corresponding masks so that they only include the lens and not the body. The *key images* should ideally show the entirety of the lens portion of the camera without any other parts partly obscuring it.

Figure 7.7.2 shows suitable key images and their edited masks. Figure 7.7.3 shows an unsuitable image where large areas of the lens are hidden behind the body and hence the mask of the lens outline would have to be a very rough estimate; inadequate for determining the silhouette of the hidden portion of the lens.

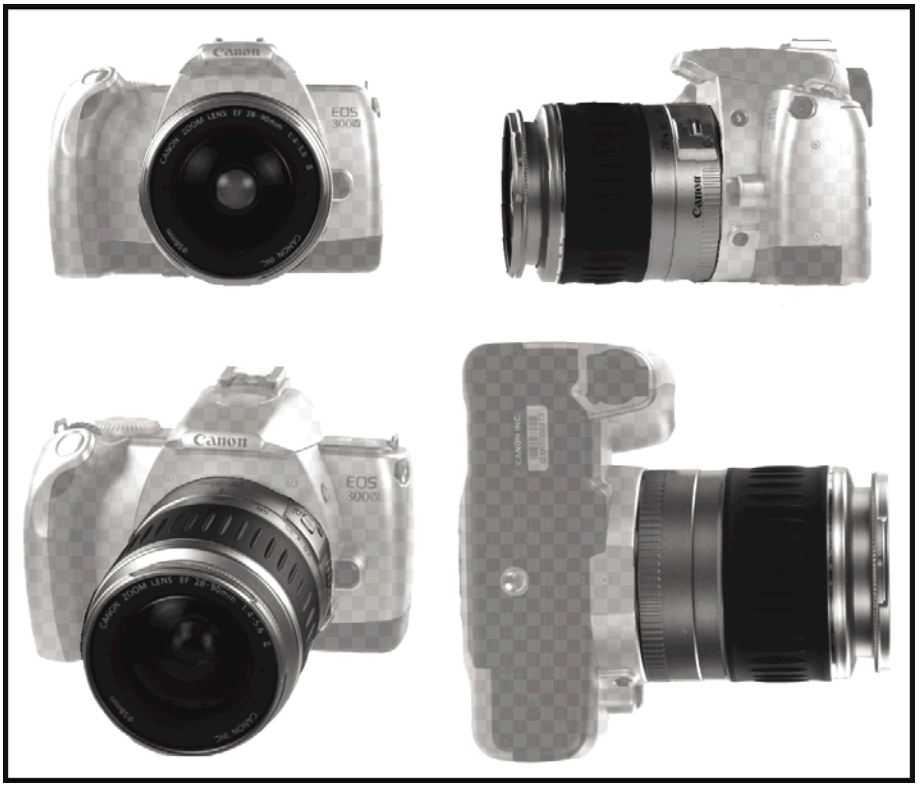


Figure 7.7.2. Key masks for modeling the lens.

Figure 7.7.3. Unsuitable views for modeling the lens – major portions are obscured.

TIP: In general, only a few key masks need to be edited in order to isolate a sub-part. The remaining masks should still be included as they still help define the shape.

Step 3

Now save the edited masks in a new project. Use the **File > Save As...** menu item to save and rename the project. A good name in this case would be "lens_only.som".

Step 4

The next step is to build the texture map for the lens. Care needs to be taken here as you will need to ensure that image data from the camera body is not incorporated into the textures.

Select a subset of the images that you wish to use to texture the subpart and reject the remaining images (or set to ***"geometry only"***). Then, for each included image, edit the masks to ensure that any portions of the camera body that obscure areas of the lens are masked out so that they are not included in the texture.

Figure 7.7.4 shows the initial mask for the top-down view and the edited mask used prior to building the textures.

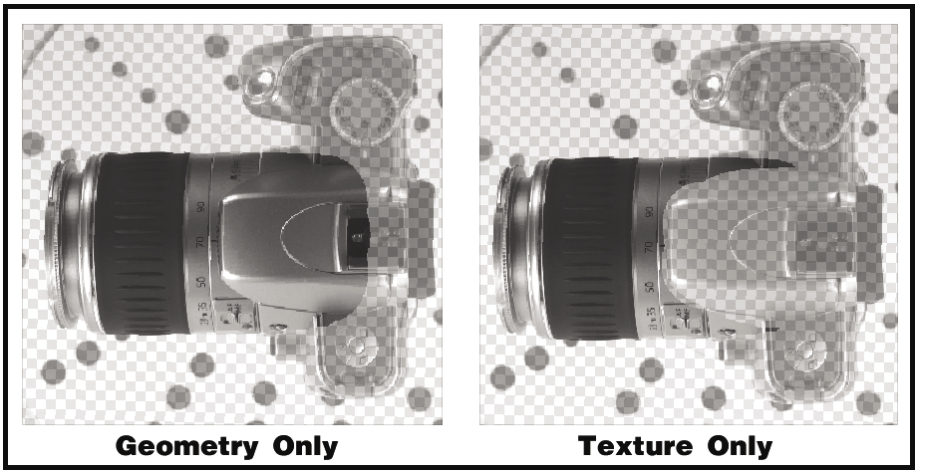


Figure 7.7.4. Initial edited masks for geometry (mask excludes hidden parts of lens covered by other overlapping camera pieces) and for texturing (mask excludes overlapping pieces that are not part of the lens itself).

Step 5

Once the masks have been edited, the wireframe model and texture map are generated as usual by clicking the **Generate Wireframe...** button and then the **Generate texture map...** button.

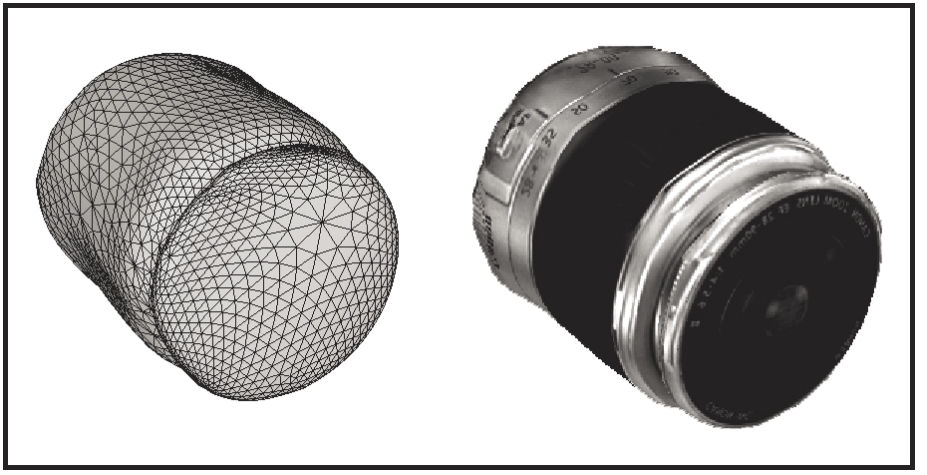


Figure 7.7.5. Smoothed wireframe and final textured part.

The texture mapped 3D model of the lens can now be exported for use in a larger model or a 3D scene.

Chapter 8

Techniques for Improving The Surface Texture

8.1. Adding Texture to the Bottom of an Object

Because the object is placed on a stand and pictures are taken with the *calibration mat* visible in the frame, normally the bottom of the object is not included in any of the usual photos. When you build the textured model, by default the bottom of the model is textured with a plain color fill copied from the surrounding geometry.

In many cases the plain texture (as seen in Figure 8.1.1) is adequate since you may not be concerned with the bottom of the object or it may be plain. If you want to add texture detail to the bottom surface, the simplest solution with Foto 3D is to turn the object over or on it's side and take one or two images of the bottom of the object, preferably with the calibration mat in the frame, and add these to the project.

Figure 8.1.1. Model with no bottom images.
Figure 8.1.2. Final texture using an aligned bottom image.

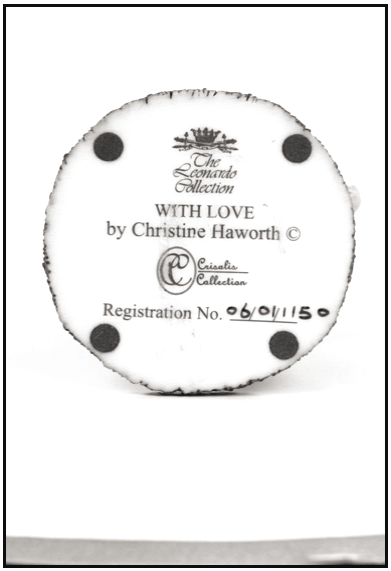


Figure 8.1.3. An additional image from underneath the "doll" figurine.

Since Foto 3D cannot locate the camera position for these shots, the *Align Wizard* is used to manually position and align each of these additional images relative to the wireframe model so that they can be used when generating the *texture map*.

TIP: Experienced users have found that after they have their lighting optimized, it is helpful to shoot the bottom shots first so they are available for use, and then position the object on the pedestal and calibration mat to shoot the rest of the photo set. This allows the object and mat to remain aligned as a unit for the remainder of the project in case additional photos are needed to refine the geometry or texture from another vantage point.

Try It Out!
To try out aligning an image, follow the instructions in the Starting a New Project section to create a new project from the images in the **Examples\Doll** directory included with your installation. Loading all images will include bottom photos that will be marked "rejected".

Starting Point

When you create a new project and load in all the photographs, any images, such as bottom photos taken without the calibration mat will automatically be marked as ***"rejected"***. Alternatively, you can select and load all the images except the bottom ones, and then add them to the project later, after the wireframe model is complete.

Note: If bottom photos do include the calibration mat (or any shots were taken after the object was accidentally moved on the mat,) remember to mark them as "rejected" before generating a wireframe to avoid corrupting the generated mesh.

Generate masks and build the geometry as normal. Generate an initial surface texture (excluding the bottom photos) to help with the alignment.

Step 1

If the bottom images have not been loaded, load them using the **Images > Add Images...** menu item

Select the first image that needs to be aligned (it doesn't matter if it is currently marked as rejected) and choose the **Images > Align Image...** menu item. This will open the *Align Wizard* and update the *Thumbnail Window*.

Note: Each additional image will need to be aligned separately by repeating this process.

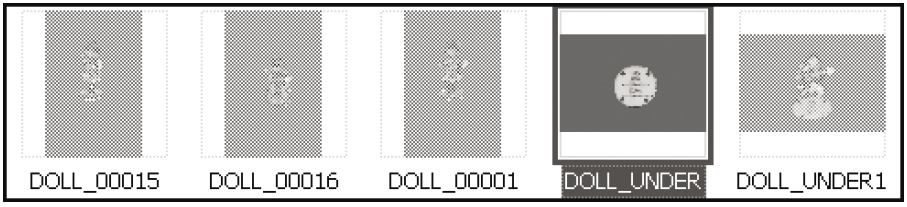


Figure 8.1.4. Bottom photo found in the Thumbnail Viewer, masked and ready to align.

Step 2

The Model Display in the *Model Window* now displays the current model semi-transparently over the selected additional image.

TIP: It might help to use the wireframe display mode and change the color of the wireframe using the *Strata Foto 3D Settings Window*.

Using the **Rotate model**, **Move model**, **Zoom model** and **Spin model** buttons, position and orient the model so that it aligns with the image displayed behind it.

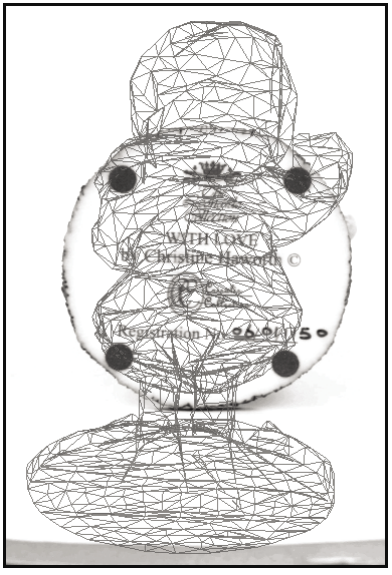


Figure 8.1.5. Wireframe before aligning to the image.

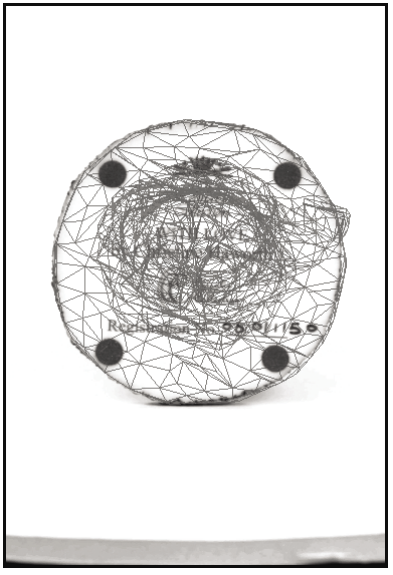


Figure 8.1.6. Wireframe after aligning to the image.

Step 3

Once the model is roughly in position, fine tune the positioning in one of two ways.

- One method is to use the *Alignment Wizard*, which attempts subtle shifts of position, rotation, spin and zoom to get the bottom photo's mask to better align with the wireframe's silhouette. The wizard may

be confused by subtle inaccuracies in masks. If the Wizard is unsuccessful, simply **Undo** the change and use the manual method.

- The second method is to manually zoom in on the detail in the image and try subtle shifts of position, rotation, spin and zoom to improve the visual alignment. Use the **Magnify View** button and **Pan View** button to zoom in on and move the background image while you position the model. These two buttons move the model and background as a synchronized unit so that you can check all edges of the alignment without throwing the alignment off.

Using *"Optimize Alignment"*

You can use the automatic alignment feature of Foto 3D as a shortcut for final fine-tuning of the alignment of an image. In order to do so, you will need to have created an accurate mask for the additional image before opening the *Align Wizard*. Ideally this mask is made with the same thresholds and settings as the rest of the model so that the amount of anti-alias fringe is consistent.

TIP: The Interactive Mask process will not work on additional images that do not include the calibration mat in the frame. It does not matter that the object does not align with the mat (it is positioned on it's side or upside down), Foto 3D still uses the mat to identify where the object is located in the image and to select regions of background. Without the calibration mat in the frame, the only semi-automatic masking tool available is Shrink-Wrap starting from a hand-drawn rough outline.

Figure 8.1.7. Masking a bottom view photo that does not include a calibration mat.

During *Optimize Alignment*, the mask is used by the Alignment Wizard to test whether slightly rotating or scaling the wireframe mesh will produce a better alignment of the silhouettes of the mesh with that of the new photo. It attempts to find a best fit of the two silhouettes, but inconsistent masking or unusual geometry can confuse the wizard.

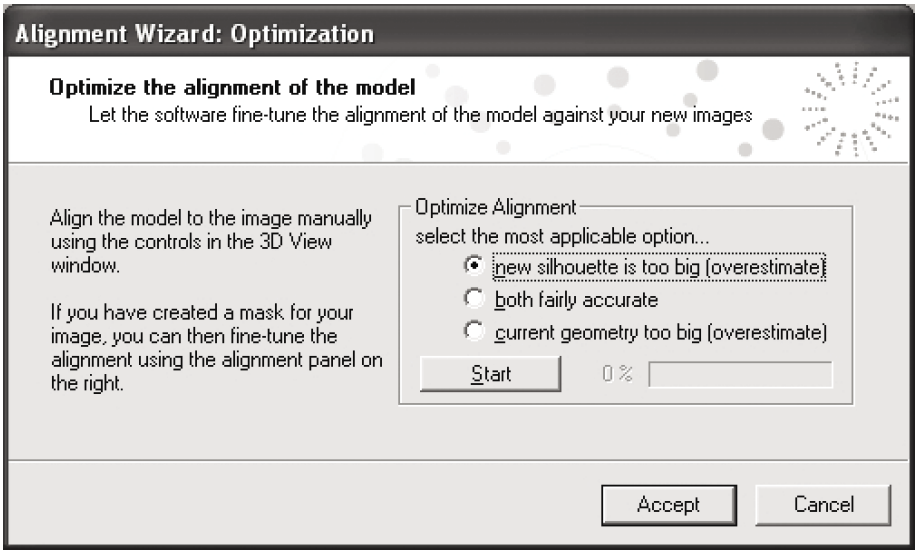


Figure 8.1.8. Alignment Wizard settings.

The Alignment Wizard has three options for alignment. Use the "both fairly accurate" setting when the masks have been made consistently.
If the masks for the bottom image is more closely masked than the masking method used to make the masks used to construct the wireframe, then choose the "current geometry too big" option.
If the opposite is true, that the new photo's silhouette has a shrink wrap fringe when the rest of the model is more tightly masked, then choose the "new silhouette is too big" option. At the conclusion of the masking process, if the alignment is only lightly off, try the scale tool to lightly enhance or reverse the effect of this option setting.

After rough positioning the model and selecting your alignment option, click the **Start** button and wait for the model to be adjusted.
(Click the **Stop** button at any point to abort without finishing.)

Step 4

If you are satisfied with the new alignment of the image, click the ***"Accept"*** button to commit and use the new alignment.
Click the **Cancel** button to return to your initial alignment.

Step 5

After repeating the alignment process for each additional image, repeat the Generate Wireframe and Generate Texture processes as desired to produce improved geometry and textures using these images.

TIP: If you have already created an edited texture map, you can merge in the additional aligned images without losing your revisions by selecting the new images in the *Thumbnail Window* and pasting them into the texture using the **Images > Paste Into Model** menu item. (Alternatively, hold down the Ctrl key while dragging the thumbnail onto the *Model Window*).

8.2. Editing the Surface Texture

The automatically generated texture may need to be edited to clean up minor artifacts and blemishes, or to remove supporting structures used to hold the object in place when taking photographs. The texture editing tools allow you to touch-up the surface texture using your preferred 2D image editor. The texture can also be edited to paint a new color onto a region or, as in the following example, to superimpose a company logo onto the model. An easy-to-use intuitive interface is provided utilizing the Windows clipboard to transport images to and from an image editor.

Starting Point

Create or open a textured 3D model from a set of photographs.

Step 1

In order to make a company logo appear as a decal on the model surface, orient the model so that the face you want to edit is centered in the display window. In this example, rotate the model by using the  **Rotate model** button until the face to edit is fully "front-on" visible.

To ensure accurate editing without loss of resolution, make sure the model is filling most of the Model display area by zooming in using the **Zoom model** button.

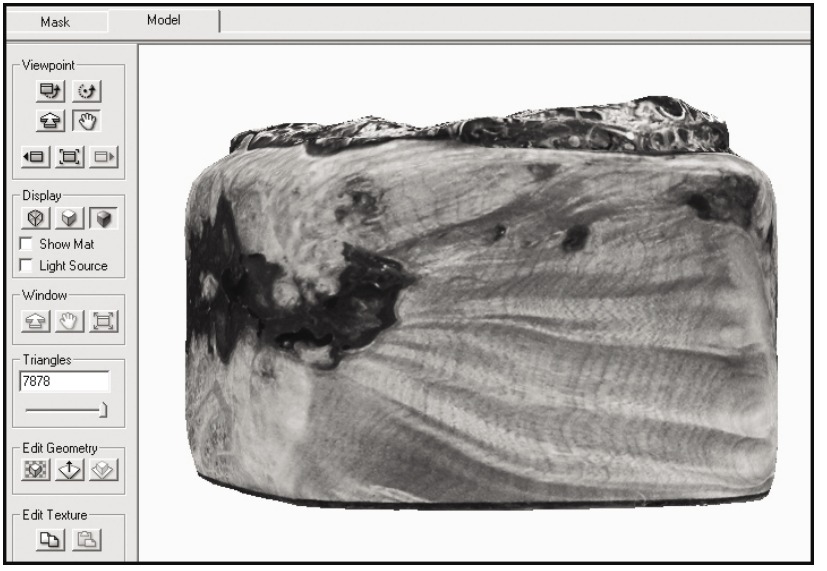


Figure 8.2.1. Rotated and zoomed model clearly showing the area to be edited.

Step 2

Click the **Copy View** button from *Model* palette to copy the image of this view of the textured model onto the clipboard.

Step 3

Paste the clipboard image as a new image into your preferred 2D photo and image editor such as Adobe Photoshop or Corel Paint Shop Pro.

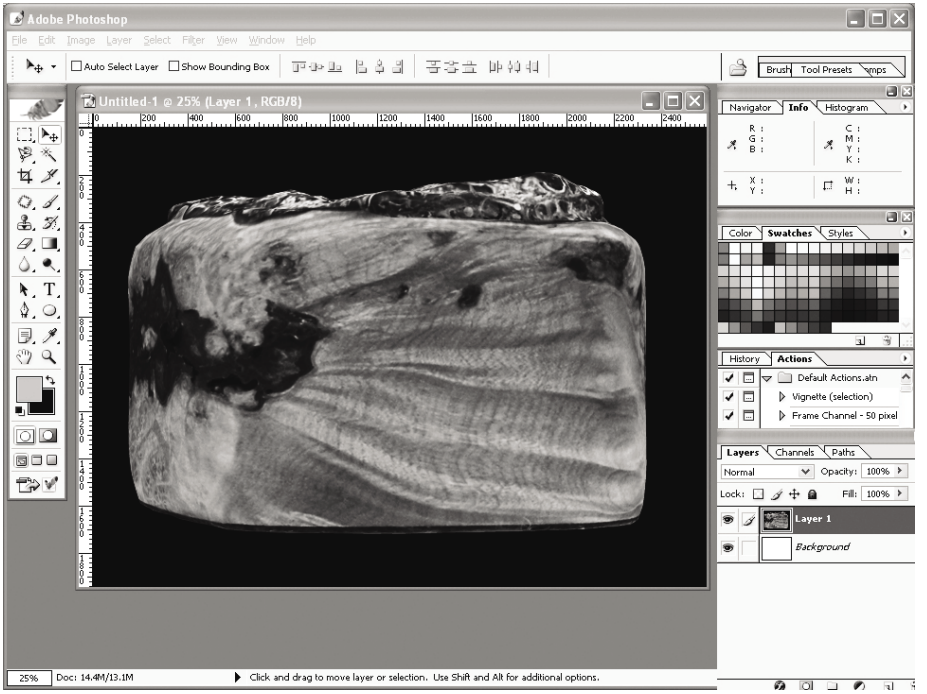


Figure 8.2.2. Opening New Image and Pasting texture into Photoshop.

Note: Be sure the image is not resized in the process.

Pasting into Adobe Photoshop
In Photoshop, care is required to ensure the image dimensions are preserved when pasting from the clipboard. First, copy the image onto the clipboard as described. Then, create a new image file using the **File > New** menu item. The width and height fields will be automatically filled-in by default with the dimensions of the image currently on the clipboard. These should not be changed. Click OK to create the new image, then select the **Edit > Paste** menu item.

Step 4

Locate and open an image of the logo into the image editor. Select the desired region, copy and paste it as a new layer onto the image of the textured model. Scale and position the logo as desired.

Figure 8.2.3. Final edited texture with logo ready to drag from Photoshop onto Foto 3D.

Step 5

When the revisions are complete, the modifications can be incorporated into the texture map in Foto 3D. To do this, select the edited image using the **Select All** menu item and copy the merged layers onto the clipboard as a single layer. Make sure the edited image is a single layered image. In Photoshop either select **Edit > Copy Merged** menu item and then **Paste** the merged image as a new layer, or select the **Layer > Flatten Image** menu item. In Paint Shop Pro use the **Layers > Merge > Merge All** menu item.

Return (Alt-Tab) to Foto 3D and paste the copied image using the **Paste View** button.

Note: Photoshop users may experience difficulty using the clipboard for this step and may need to use drag and drop instead. (see below)

Pasting an Edited Image from Adobe Photoshop

Photoshop will not place large images onto the clipboard. Instead you can use "drag and drop". Flatten the image, select the entire image area with the **Select All** menu item, select the "Move" tool from the toolbar, then simply drag the image from Photoshop into the *Model Window* in Foto 3D. (Do not click the Paste button.)

Note when using "drag and drop" you can drag over the Foto 3D icon in the Windows Taskbar to bring up the Foto 3D application and then drop the image onto the *Model Window*.

Figure 8.2.4. Edited view pasted back into Foto 3D

Step 6

Once the edited image is pasted (or dropped) into Foto 3D the textures will be updated. Foto 3D will examine the differences between the copied and pasted images and will only update areas (triangles) that have had pixels changed by the editing. This helps preserve the texture image quality on surfaces not affected by the edit.

Important Note: There is no requirement to rebuild the textures and, in fact, doing so would replace all your previous texture edits.

Editing Oblique Views

The texture paste function has a protective mechanism that prevents you from accidentally editing the surface textures from very oblique viewpoints (where model surfaces tilt steeply away from the viewpoint and resolution would be poor due to foreshortening). It is preferable to rotate the model so that the surface being edited is nearly parallel with the viewpoint. If you are nevertheless trying to edit the surface texture using a very oblique view (e.g. if the desired surface region is hidden or steeply angled when viewed front-on) then you will need to turn off this protection mechanism before pasting your edits. From the right-click context menu in the *Model View* display area, select the **Texture Editing > Protect oblique triangles** menu item to toggle the protection state "Off". For highest quality, we recommend that you leave this feature "On" whenever possible.

You can rotate the model to see how your edits look from new viewpoints. If you are not satisfied with the changes, simply use the **Undo model or mask change** button to restore a previous texture.

Figure 8.2.5. Two Views of edited model texture.

In this example we chose to edit the side of the model. However the same process can be used to edit or paint the textures from any viewpoint and repeated for several view angles.

8.3. Removing Texture Artifacts

Sometimes there are artifacts in the textures that are generated by the automatic texturing process. This can be due to:

- inaccuracies in masking and the resulting geometry of the wireframe mesh
- camera registration errors / movement of the object on the mat
- uneven lighting causing changes in brightness or color on surfaces as an object is rotated
- reflected environments appearing on shiny objects

Avoiding Seams

Depending on the settings used, in a well masked project producing good geometry, automatically generated textures will generally not have noticeable seams. Seams occur when an area of the mesh is not directly in front of the camera in any of the photos used for texturing, so two different photos are blended using a technique called 'feathering' to fade from one photo to the next where the angle of the surface shifts away from one photo and toward the next. This fade can be noticeable on large smooth surfaces or reflective objects where the two photos have significantly different lighting or different reflections on the same faces. Turning on *color normalization* is the first step to minimizing lighting related issues. Seams also appear when there is some inaccuracy in the photography such as the object shifting slightly on the pedestal during the shoot, an errant change of zoom setting during the shoot, or a slight lens calibration error.

The default setting to use *Texture Boosting* usually helps to eliminate seams by attempting to texture the object using as few photos as practical to reduce the number of blends or seams. For shapes that tend to be cubic, this can be highly effective as, for example, only six photos are needed to paint the six sides of a cube and with sharp corners, the blend area is on the extremely narrow bend of each corner. For shapes that have flat faces, but those faces may not be square to one of the side views, such as an abstract shape like the oblith, or faces that are reflective and

the reflections are less objectionable in some photos than they are in others, it helps to have taken additional photos just for texturing as described in Chapter 6 and then to help the software know to use those photos instead of others when texturing.

For cylindrical surfaces, it may help to have several smaller photos blending together around the periphery so that there are many slight transitions instead of fewer major transitions. This is particularly true if there are lighting hotspots and surface tonality changes as the object is rotated. For these smooth shapes, particularly if even lighting is a problem, it may be best to leave *Texture Boosting* off so that all of the images are used according to which image has a camera angle closest to surface normal at that point (perpendicular to the surface of the mesh.) If there was any movement of the object on the mat or similar camera registration problems, this setting can make the object look blurred due to extensive feathering of several slightly mis-registered images.

Steps to Minimize Seams

If seams are apparent, here are some techniques to try:

- **Use Color Normalization** - If it's not on, turn it on and regenerate.
- **Try Texture Boosting Off** - If an object was textured with Texture Boosting on, try turning it off to see if blending more photos will re-texture the problem area.
- **Try Texture Boosting On** - If an object was textured with Texture Boosting off, try turning it on to see if having fewer feathered edges eliminates the problem feather.
- **Disable Problem Photos** - Look at the photos that are being used to generate the texture (either the first six or so, or all of them). If one of the photos has an area of objectionable reflections or the surface is out of focus, mark that photo "**geometry only**" and regenerate the texture. (Foto 3D will identify another photo to use for texturing from that camera angle.)

- **Prioritize Better Photos** - If Texture Boosting is on and the first six photos are just not the best ones to use because of lighting effects, reflections or sharp focus, change the Order to increase the importance of other photos that would be better to use.
- **Spot Repair Problem Areas with a Better Photo** - If you need just a spot repair for one or two faces of the object and it otherwise looks good, try looking through the images for a photo that would produce a better result for the face (less reflection / better lighting) and use that photo to repair the face as described below.

Performing Spot Repairs

Sometimes a texture needs to be spot edited to remove a seam from a face or to restore structured features such as lines and text that were broken up by two images being feathered in the middle of the feature.

A powerful suite of texture editing tools is provided that allow users to eliminate most texturing artifacts. These tools allow image data from a single photograph in your project to be used to replace the texture for a problematic region on the object.

Three techniques are available to do this:

- Simple Overlay
- Overlay Using a Mask
- Using an Image Editor for Spot Editing

For all three techniques the starting point is the same.

Starting Point

Create a textured 3D model from a set of photographs. Identify any problematic regions where the texture could be improved using one of the original photographs. Try the suggestions in the preceding section to get to the best starting texture attainable.

If the problem still persists, find a good view of the problem area from the photographs in your project. This should ideally be close to a "front-on" view of the region that needs touching up. Double-click the selected thumbnail to verify the best image has been found.

Figure 8.3.1. Textured model with a seam along the front edge.

Figure 8.3.2. Textured model with an artifact circled.

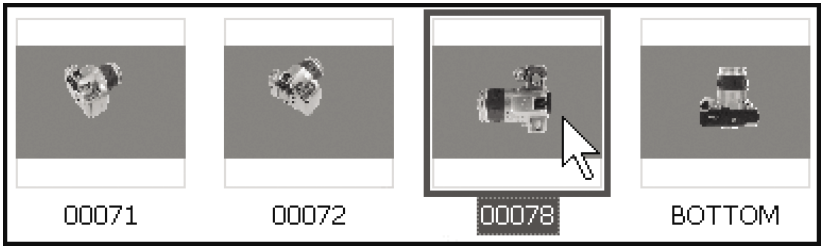


Figure 8.3.3. "Best View" thumbnail being selected.

Simple Overlay

The simplest solution, assuming

1) no other edits will be overwritten and

2) the selected image does not have any problem areas of it's own,

is to overlay the area with the selected photo. Instead of selecting a specific region in the selected photo, this method uses the entire photograph. Simply control-drag the selected thumbnail image onto the 3D view (i.e. while holding down the Ctrl key, drag the thumbnail with the left mouse button down) or select the **Images > Paste Into Model** menu item and the texture will be updated by this photo.

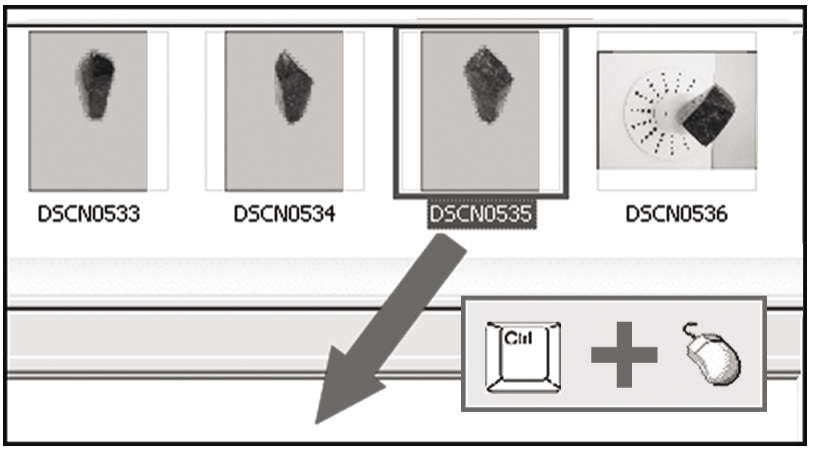


Figure 8.3.3. Using Ctrl-drag to paste the masked image onto the model.

TIP: You can even Ctrl-drag a thumbnail onto an untextured model!

On oblique surfaces (ones that tilt away from this front-on view), some feathering will be applied to try to avoid noticeable seams. Turning on the feature to protect oblique surfaces may prevent the reflection on the lower side of the oblith from appearing in the final texture because the surface tilts steeply away. To turn on the oblique triangle protection feature, open the right-click context menu in the Model Display area and select the **Texture Editing > Protect oblique triangles** menu item to toggle the protection state to "On".

Concerning the new reflection appearing on the ridge in the upper left of Figure 8.3.4, it would have to be masked out of the image before this image was pasted onto the texture. As in this case, if the result is not to your satisfaction use the **Undo model or mask change** button or press Ctrl-Z to Undo it and try the next technique.

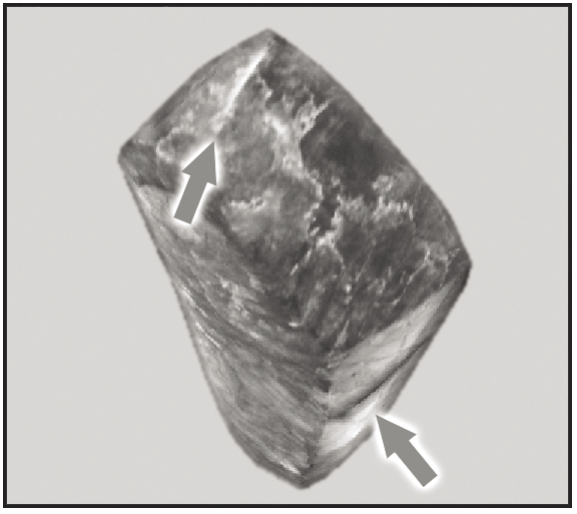


Figure 8.3.4. Overlay Repair of Seam - Repaired, but reflections added.

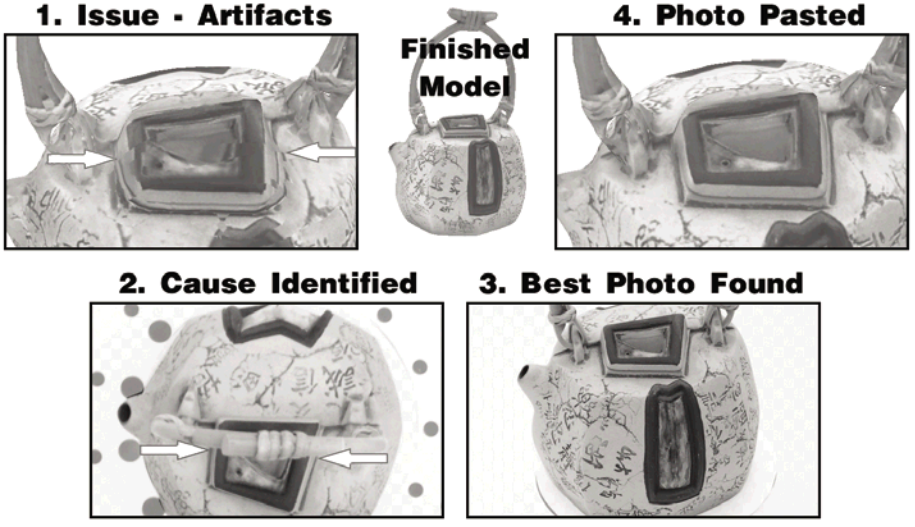


Figure 8.3.5. Simply Overlay Repair of Artifact - Successful repair.

In this second example, artifacts are found in features on the lid of this teapot. The top-down photo shows that the handle of the teapot covered this area of the top surface. The software naturally determines that the top-down photo is the best one to use to paint the many upward-facing

surfaces of the teapot, so it is used everywhere on the top surface and lid except where the handle blocks the view. Because Foto 3D has to fill in the covered area from another photo and viewpoint and the remaining photos are not that high angle, it's easy to understand why a slight mismatch between the mesh and the object would cause the patched area across the lid to be misaligned. The easy solution is to locate the photo that can patch the covered area and use it to simply texture the entire top surface. The fourth image shows the entire lid "repainted" and the feathered transitions now occurring in less noticeable areas of the surface.

TIP: This repair could have easily been avoided with another top-down photo strategically shot just a few degrees to the side so that, between the two of them, the entire top surface was visible despite the handle. Their viewpoints would be so similar that any mis-registration would be at most an unnoticeable pixel or two of offset. Also, increasing the importance in Project Order of the photo used for this repair might avoid the need for a repair if the texture is regenerated.

Overlay Using a Mask

The next solution is to overlay the area with only a portion of the selected photo. Start by loading another instance of the selected photo so that you can apply a different mask. If you don't need to save your masks for use in another project, simply use the menu item to load an additional instance of this image and than set it's **Image Type** to ***"texture only"***. Select the **Mask** tab to display the Mask View and double-click the thumbnail to display the photo. If it is not already masked, create an initial mask with the Auto-mask button. Now, using the mask painting tools, set the mode to paint mask, select a brush shape and a brush size, and paint a mask that reveals only the portion of the photo you wish to use as a patch to spot repair the problem area.

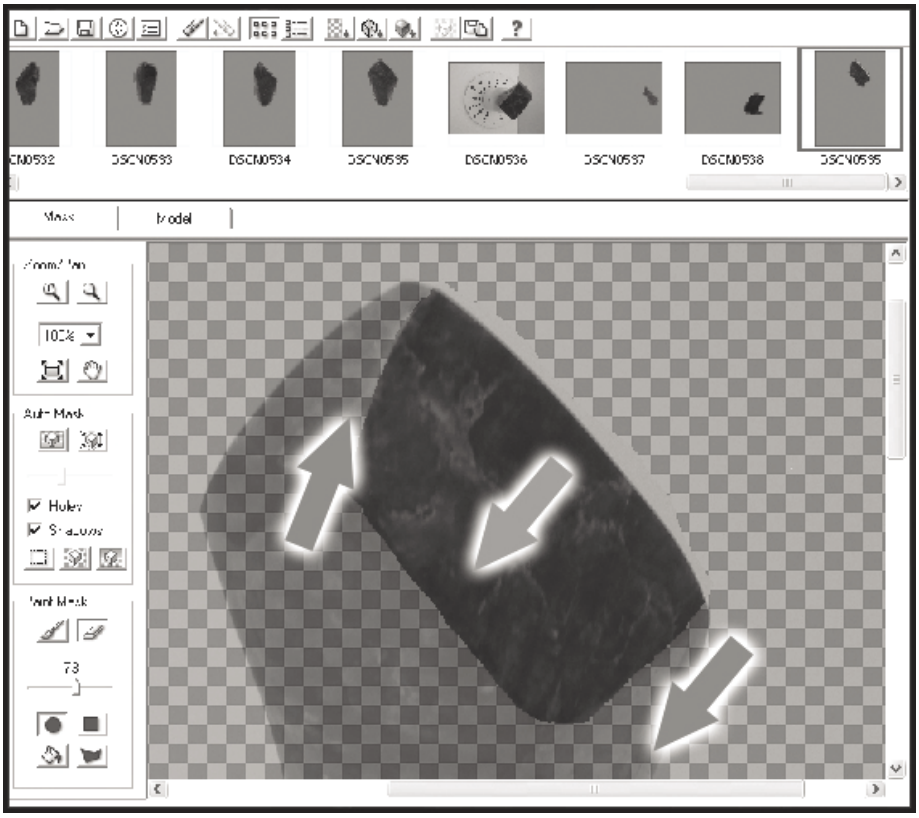


Figure 8.3.6. Photo masked to allow image to cover seam but not add new reflections.

When being used, all of the mask tools produce a hard edge, but when pasting onto a texture, Foto 3D feathers the area just inside the mask edge to avoid producing a seam. You may find it best to paint the mask in such a way that the edges of the mask are in dark or recessed surfaces, or align the mask edges just inside the nearest edges of features in the image so the features are not feathered. (If more precise control is needed, use the external editor technique described in the next section.)

Once the image is masked, switch back to **Model View** and simply Ctrl-drag the selected thumbnail image onto the Model display window, or select the **Images > Paste Into Model** menu item, and the texture will be updated by this photo.

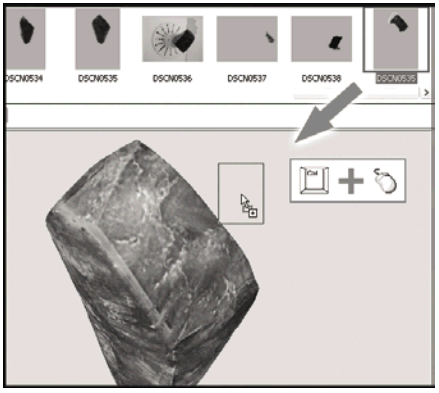


Figure 8.3.7. Masked copy of photo being Ctrl-dragged onto texture.

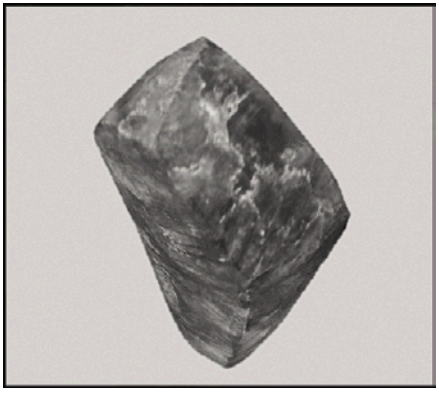


Figure 8.3.8. Result: Seam repaired; no reflections added.

If the result is not to your satisfaction, Undo it and try the next technique. (This technique does not give you the fine control you might achieve using an external 2D image editor, but it can be very useful for quickly fixing problem regions.)

TIP: If you expect you will want to save this new mask as a file to use in another project, then instead of loading a second instance of the same image file, make a copy of this photo's file in the project folder using Windows Explorer and give it a different file name. Once you are done, use the **Images > Add Images** menu item to load this image file and proceed as above to set it to **"texture only"**, mask this additional photo as desired and Ctrl-drag it onto the texture map. The mask for this copy of the photo can then be saved using the **Images > Masks > Save Masks** menu item.

Using an Image Editor for Spot Editing

In this case, we will show how spot editing can be achieved using the "Layers" capability of standard image editing tools such as Corel Paint Shop Pro and Adobe Photoshop.

Step 1

As before, identify the best photo to use as a source for spot repairs. Transfer the selected photo into a 2D image editor application. This is best achieved using the clipboard so that a properly distortion-corrected, color-normalized and/or downsampled image, that is ready to be patched into the texture map, is used for editing. To do this, right-click on the thumbnail and select the **Images > Copy Image** menu item.

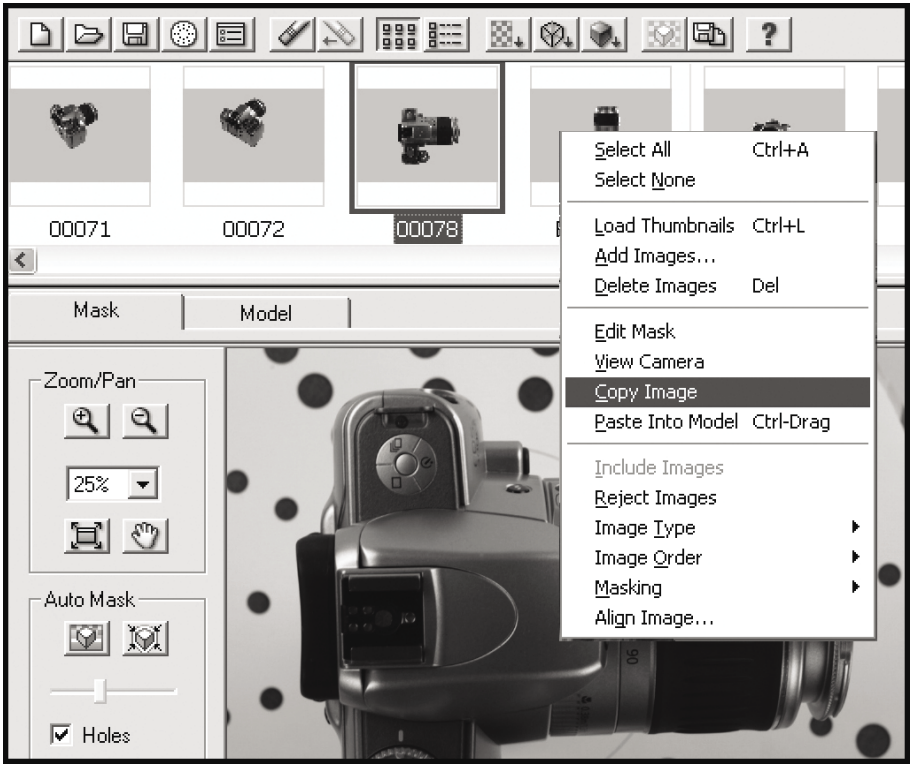


Figure 8.3.9. Copying a source image to the clipboard by using Images > Copy Image.

Paste the clipboard image as a new image into your 2D image editor application. (In Photoshop, create a new image while the copied image is on the clipboard to make sure the copied image's size is used as the

dimensions of the new image, then Paste.) Take care that the image is not resized (See Photoshop techniques in Editing the Surface Texture).

Step 2

Switch to **Model View** by clicking on the **"Model"** tab. Change the viewpoint of the 3D model to match the copied photo. Drag the selected thumbnail image into the 3D view and the model will be rotated so that the correct viewpoint is automatically displayed.

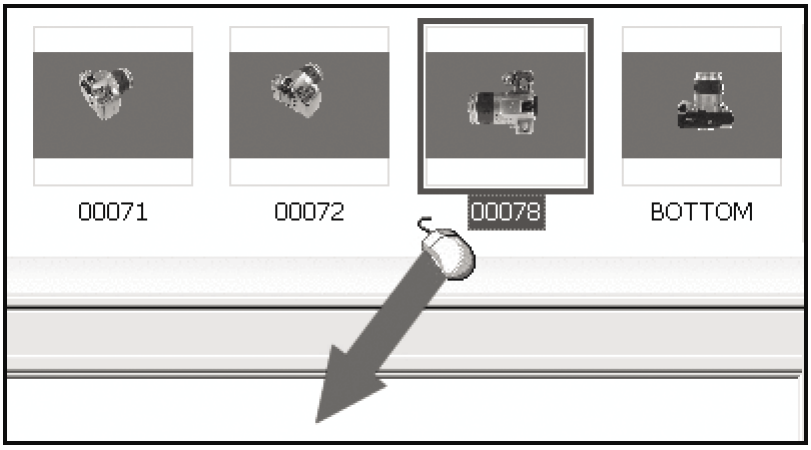


Figure 8.3.10. Drag Thumbnail onto Model View display area to rotate and scale the model to match the camera's viewpoint.

Now copy this view of the textured model onto the clipboard using the **Copy View** button found on the **Model Palette**.

Step 3

Return to the 2D image editor (Alt-Tab) and paste the clipboard image as a new "Layer" on top of the existing image.

In Photoshop simply select the "Paste" option from the "Edit" menu. In Paint Shop Pro select the "Paste" option from the "Edit" menu and click on "As New Layer".

Note: Since the viewpoint was aligned to match the selected photo, the clipboard image and the image already in the 2D image editor should be perfectly aligned.

Figure 8.3.11. Pasted as base layer is the selected source photograph.

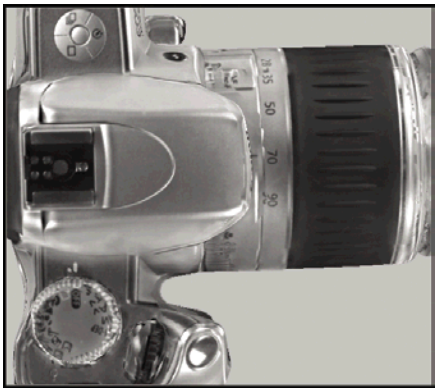


Figure 8.3.12. Pasted to a new layer is the textured model from same viewpoint.

Step 4

To replace the problem region, we will create a mask for the new layer and mask out the problem area to reveal the underlying original image.

Create an opaque mask for the layer. In Photoshop select "Add Layer Mask" from the "Layer" menu and click "Reveal All". In Paint Shop Pro select "New" from the "Masks" menu and click "Show All".

Step 5

By carefully editing the mask we can mask away the problem areas to reveal the pixels from the original photograph. A soft brush is recommended to ensure there are no obvious seams.

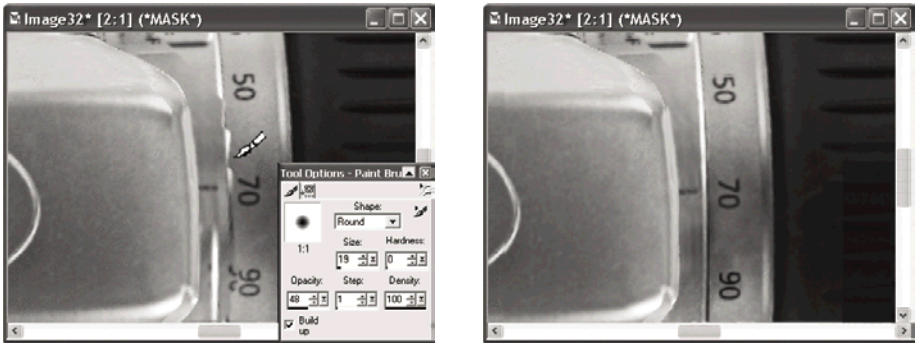


Figure 8.3.13. Mask painted to reveal underlying photo layer with clearer features.

TIP: To edit the mask in Paint Shop Pro, select the "Edit" option from the "Mask" menu. In Photoshop make the mask active. Then select black as the foreground color and the "Paintbrush" tool. From the tool options choose a suitably sized brush and select a low value for "hardness". Paint over the problem areas to reveal the underlying photo. Switch the paint color to white to undo or restore areas of the upper layer.

Step 6

The edited image can now be transferred back via the clipboard or "drag and drop". Before you do so, the image needs to be a single layer. In Paint Shop Pro the flattened image can be copied on to the clipboard and pasted into Foto 3D using the **Paste View** button.

In Photoshop, either choose the **Flatten Image** menu item or, to keep your layers intact for further editing, use the **Edit > Select All** menu item to select the entire image, the **Edit > Copy Merged** menu item to place the flattened image on the clipboard, and then the **Edit > Paste** menu item to insert the flattened image as a new layer. With this new flattened layer active, select the "Move Tool" and drag the flattened image onto the *Model Window* in Foto 3D.

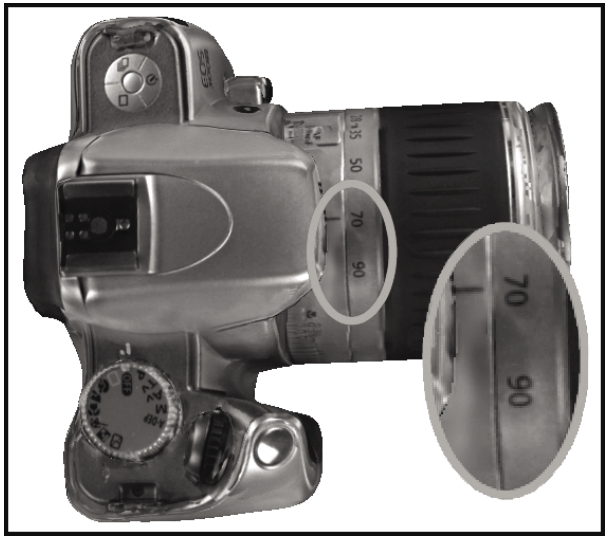


Figure 8.3.14. Completed spot repair to Foto 3D model.

Chapter 9

Displaying and Using The Final Model

9.1. Using Foto 3D's VRML Exports

Now that your Foto 3D model is completed, this section suggests a few ways to display and use your model outside Foto 3D.

Figure 9.1.1. A completed model displayed on a web page using Strata Live 3D.

Displaying VRML Models and Worlds

Follow the steps in Chapter 5 to export your model as a VRML (.WRL) file. This "Virtual Reality Markup Language" file and its companion texture map comply with the industry standard VRML 97 / VRML 2 specification for defining 3D objects and textures. Any VRML 2 compliant browser plug-in or application should be capable of importing and displaying your model. If you exported your model with the "Launch Viewer" option enabled, you will discover whether you already have a suitable viewer or browser plug-in available on your computer. If you don't, perform an internet search for the latest VRML plug-ins and viewers; many are free. (One open source browser plug-in we have used is Cosmo, found at **http://cic.nist.gov/vrml/cosmoplayer.html**)

Displaying in Strata Live 3D

Figure 9.1.2. Several completed models displayed using Strata Live 3D.

Strata provides an exciting product, Strata Live 3D, that will open, light, and display your Foto 3D models either locally or on the web with an elegant set of interactive controls that allow your model to be rotated, moved and even zoomed to see the fine details.

Strata Live 3D also has a new feature that allows these interactive models to be embedded in an Adobe PDF file and displayed using the new 3D features built into Adobe's free Acrobat Reader (version 7.0 or higher) without the use of plug-ins. This powerful combination allows one PDF document, such as a product catalog, to be printed with beautifully rendered 3D models on the page, and also viewed on a computer with your choice of interactive controls on the PDF page that allow the user to rotate and zoom into each of the products on the page.

If the object has been modeled with moving parts, such as a cell phone flipping open, or the camera has been animated to follow a specific fly-by path, controls for replaying these movements can be included as well. Combining Strata Live 3D with other Strata products allows very effective marketing graphics and impressive displays to be prepared.

TIP: To best prepare your models for Live 3D, orient them to what would be considered "front" view in the Foto 3D software (similar to a side view photo) and save them with the **"Use Current Orientation"** checkbox turned on. This orientation helps the drop shadow produced in Live 3D to be correctly oriented from the outset. You can then reorient to the preferred display angle for the initial view when the model is first displayed and add any desired lighting.

Photo Realistic Renders and Animations

The ultimate in combining ease of use with sophisticated photo-realistic 3D modeling comes from joining together Foto 3D, to quickly create models of parts with photo-realistic textures, with a 3D modeling software package, such as Strata 3D CX, to create the rest of the scene.

Putting together a set of parts modeled in Foto 3D, in Strata 3D CX you can form a very detailed and complex final assembly. Apply a simple kinematic skeleton and those parts move and rotate as if they were hinged together. A myriad of tools can be used to place these models in an environment such as a living room and add lights and views out the window. An entire scene can be crafted and rendered with one of the fastest and most sophisticated rendering engines available in the personal computer market, producing stunningly realistic renders.

TIP: The performance of all modeling software, including Strata 3D CX, is affected by the complexity of the modeling tasks it is asked to perform, which is dictated in part by the complexity of the models placed in the scene. If several complex models are being combined in a scene or a Foto 3D model is being positioned far from the camera, you do not need the processing overhead of providing very precise and complex models with lots of polygons and large texture maps with more detail than can be seen from that distance. The excess detail only slows down the software as you setup the scene and increases rendering time. Use the ***Decimation slider*** to minimize the number of triangles to a few thousand or even into the hundreds, and set the texture map size to 1024 or 768 instead of 1280 or 1600.
(Note that a perfect cube is made with only 12 triangles!)

Putting It All Together

As a final note, remember the first tool mentioned; the  **Make all** button. With a controlled lighting environment, using Interactive Masking to find the conservative side of the 'just right' ***Background Detection Threshold***, and setting an optimum default ***Number of Triangles for Decimation*** appropriate to your display media, you can be producing sophisticated photo-realistic models for use in virtual scenes and renders or online catalogs and galleries with minimal effort.

Enjoy Foto 3D

The folks at Strata hope you are pleased with the models you make with Foto 3D and are satisfied with this product. If you have questions or suggestions, please contact us at **support@strata.com**.

Thank you for purchasing Strata Foto 3D.

Appendix

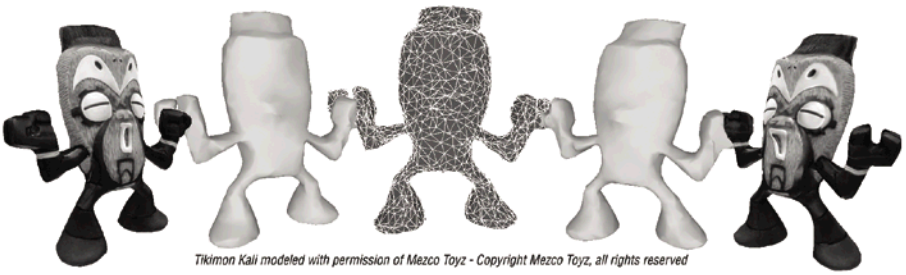
Troubleshooting and Support

Strata is proud of its exceptional support. Help is just an e-mail away.

As a quick first step, look at the many support resources available in the support section of Strata's website at **www.Strata.com**

Also visit our user community site, the Strata Cafe at **www.StrataCafe.com** and register to participate in the Strata User Forums. Chances are, others in the Strata community have come across the same issue. Some very experienced graphic artists, 3D designers and animators frequent the Strata Café's forums and are quick to respond with suggestions and solutions to your modeling challenges.

If a review of the Forums and FAQs don't solve the problem, drop us a note. To keep our support free, it is limited to e-mail requests only. Send your questions and requests to **support@strata.com** and please put "Foto 3D" in the subject line with your topic. If you are experiencing errors, please include details of your computer, including CPU, memory and, most importantly, your graphics card. We'll get back to you quickly.



Tikimon Kali modeled with permission of Mezco Toyz - Copyright Mezco Toyz, all rights reserved

Upgrading to Pro

Strata is very excited and proud to be collaborating with **3DSOM** and adapting their patented technologies to compliment and extend the Strata Suite of 3D modeling software products.

This edition of Foto 3D is designed to meet the needs of most online, catalog and photo-realistic model creation requirements; however there are some applications that would benefit from even more advanced features that are available in the **Professional Edition**.

The Professional Edition offers:

- Up to a six times increase in Texture map resolution - Texture files can be saved at 4096x4096 pixels instead of 1600x1600 pixels.
- An unlimited number of triangles in the undecimated wireframe (Foto 3D is limited to 16,000)
- The ability to merge models and textures from two photo sets of the same object - you can turn it over and model the bottom.
- The ability to export the mesh to a modeling program like Strata 3D CX to enhance shapes and import the result for texturing.
- Improved modeling power and usability, including additional advanced modeling tools such as subdivision surface modeling.
- Improved texturing tools, including View Dependant Textures.
- A Java based browser for displaying models (similar to Live 3D).
- Additional export formats including Macromedia Shockwave 3D and HI Corp. Mascot Capsule.

Additional features and details are listed on the product web page.

Strata is proud to offer a discounted upgrade through it's website at **www.strata.com**. While at the Strata store, don't miss the opportunity to upgrade to the full suite of Strata 3D modeling products. These include Strata Live 3D for displaying your Foto 3D models in an elegant online viewer or in PDF documents, and Strata's flagship product, Strata 3D CX for creating and animating scenes that incorporate your Foto 3D models, and rendering with Raydiosity, Strata's powerful rendering engine that includes soft shadows and reflections, powerful lighting options and a whole host of tools for creating photo-realistic renders.

Calibrating the Lens

Standard zoom and wide-angle lenses can produce significant distortion of an image. Straight lines at the edges of an image can become curved. These lens distortion effects can impact the accuracy of the model.

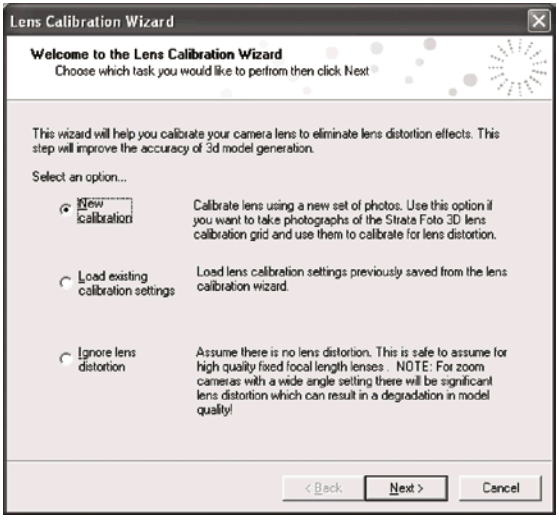
Foto 3D can automatically recognize many standard cameras and their lenses using "EXIF data" found in TIFF and JPEG images.
This information, sometimes called "metadata", is included in the image file by the majority of digital cameras and identifies, among other things, the camera and its lens settings. For lenses found in the database, Foto 3D will automatically correct for lens distortion. There is no advantage to manually calibrating a lens if Foto 3D is successful at automatically calibrating the lens from the EXIF data and a set of photos.

For unrecognized cameras, older cameras that do not write EXIF data, cameras with changeable lenses, and some zoom lenses, Foto 3D provides a Lens Calibration Wizard for automatically calibrating the lens based on taking additional photos of a special lens calibration target. Once the lens has been calibrated, new photos will automatically be distortion-corrected when they are loaded in the software.

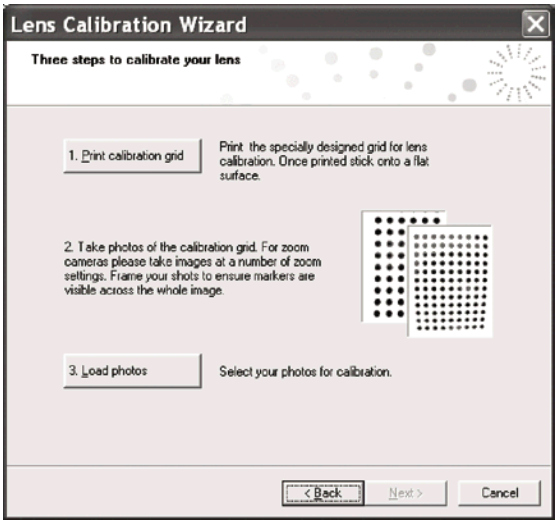
Here is the calibration procedure.

Step 1

Launch the Lens Calibration Wizard using the **File > Calibrate Lens...** menu item. When the *Lens Calibration Wizard Window* opens, if you have already profiled your lens, then select the second option to load your saved profile. Otherwise, choose the first option, ***"New calibration"***, to calibrate from photos.



Step 2



The first step is to print out the lens calibration grid (a regular grid of dots) onto a plain sheet of white paper. Click the **1. Print calibration grid** button to open the print dialog.

Ideally, you should try to print out a lens calibration grid roughly the same size as a typical object and mat you will be modeling. That way you can take photos of the grid at a similar distance and zoom setting as you will use with your objects. (However, this is not essential.)

Click the "Change..." button to modify the page setup and margins, allowing you to print larger grids over multiple pages. Generally, selecting a paper size and selecting "Fit to Page" is most convenient. Click the **OK** button to print.

Step 3

Place the lens calibration grid onto a flat surface such as a rigid piece of card stock. If the grid is printed over multiple sheets, be careful to line up the sheets accurately using the guides.

To calibrate a fixed focal length lens you need to take up to three “front-on” shots from slightly different angles (at an angle less than 10 degrees off of surface normal / nearly perpendicular to the surface).

To calibrate a zoom lens you need to take “front-on” shots of the grid at a range of zoom settings.

Note: If your camera does not export JPEG or TIFF images with EXIF data, you will need to calibrate for and use a single fixed zoom setting for all photos and treat it as a fixed focal length camera.

General points to note...

- Use a tripod if available.
- Make sure the grid pattern is flat.
- Make sure the camera view is reasonably front-on or perpendicular to the target so that there is minimal perspective distortion.
- Make sure the dots fill the whole image.
- You don't need to see the whole grid but make sure each visible row or column includes at least 6 dots.
- To calibrate a zoomed-in lens setting, you may need to move the camera away from the grid pattern.
- Take one shot for each zoom setting you plan to use (for cameras that do not allow you to set a repeatable zoom setting, try using it's power-on default setting, it's fully zoomed setting, or it's fully wide angle setting for all projects; or reshoot the calibration grid with each session's lens setting.

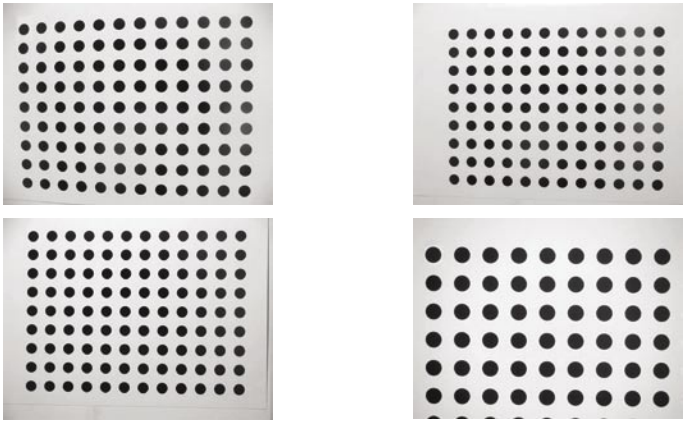


Figure 10.3.1. Photos of the calibration grid taken at different zoom settings with focal lengths of 5.8mm, 9.2mm, 18.4mm and 58.0mm.

Step 4

Once you have taken the calibration photos, transfer them to your computer and load them by clicking the **3. Load photos** button.

Step 5

Once Foto 3D has processed the photos you will see the following page.

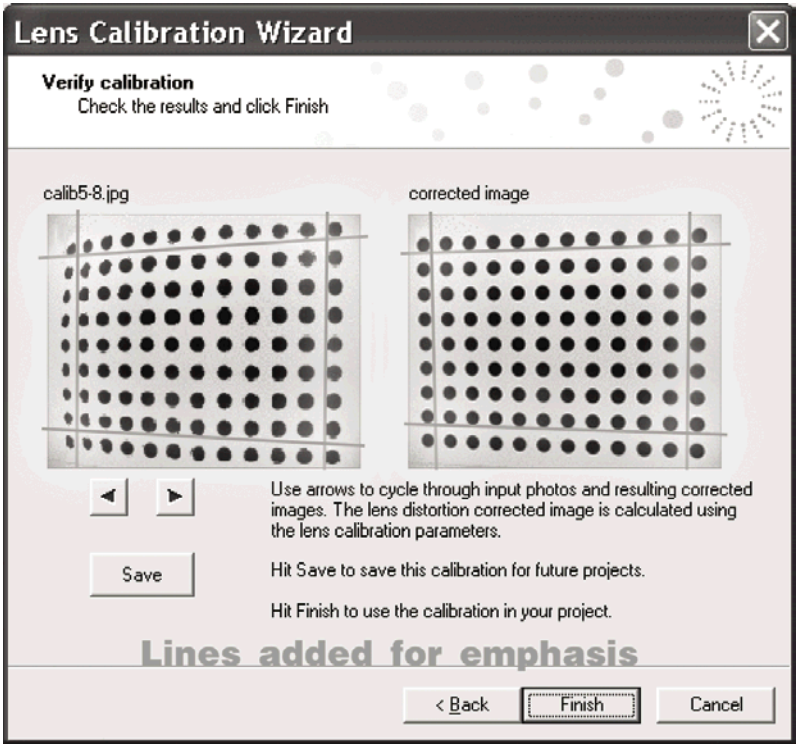


Figure 10.3.2. Successful calibration - Lines added to show dots are now on straight rows.

You can see the input photos and the distortion-corrected images resulting from lens calibration. The dots should now appear in precise straight lines. (The lines may be tilted as this reflects any off-axis perspective of the camera.)

You can save the calibration data for future projects using the **Save** button. To reload a calibration you can use the ***"Load existing calibration settings"*** option when the wizard is launched.

Click the **Finish** button to continue with your project. Imported photos (using the **New project...** button or the **Images > Add Images...** menu item) will now be automatically corrected using the results of this calibration.

Glossary of Terminology

alignment

If an image is loaded into Foto 3D that doesn't include the *calibration mat*, then Foto 3D cannot use it until the camera location has been defined. This process is called "alignment" and can also be used to adjust the camera position for other images that do include the mat but the object has accidentally been moved or has been turned upside down to photograph the bottom.

backdrop

A plain colored sheet of roll paper, card stock or foam core placed behind the object in each photograph to help Foto 3D automatically separate the object from its background.

calibration mat

The mat is a flat surface with special pattern of dots that is placed under the object to be modeled when it is photographed. This mat allows Foto 3D to automatically determine the exact position of the camera relative to the object in each photograph.

clipping

Clipping is used to remove unwanted geometry from the stand under the base of the model. A horizontal “clipping plane” can be moved up and down to choose the cut-off point and then all wireframe geometry below that plane is removed, leaving the model with a flat bottom surface.

decimation

The number of triangles in a triangle mesh can be reduced continuously by a technique known as "decimation". At each stage, a single vertex is removed from the mesh and the surface re-triangulated around the missing vertex to produce a closed mesh with one fewer triangles. Which vertex to remove is carefully selected by the software to minimize the impact on the shape of the surface. The level of decimation to be used is a compromise between having a sufficient number of triangles to define the fine details in the surface of an object, and minimizing the

complexity of the exported model, which in turn reduces file size, loading time, memory requirements, and rendering time when displaying the model online or using the model in a scene.

mask

Each image in the project usually needs an associated mask that defines where the object lies within the image. Foto 3D uses the boundary between the masked and unmasked regions of an image to define the outline or silhouette of the object as seen from that vantage point. The outlines from all the images in the project are combined to define the shape of the object in 3D space. A mask can also be used to control which areas of a photo are to be used to texture the surface of the model.

model

The virtual representation of your object in the computer as opposed to the real physical object you photographed. A model is composed of a wireframe mesh wrapped with a photo-realistic image or texture map.

object

The physical item that will be photographed and modeled. In contrast, the "model" is the computer- generated likeness of the object created by Foto 3D.

pedestal or stand

A pedestal or stand is highly recommended to raise the object up above the calibration mat when taking photographs, so that the bottom portion of the object appears fully surrounded by the backdrop in most views.

rejected

Images can be marked as ***"rejected"*** which means that they will not be used for subsequent operations such as creating the geometry or textures. Images automatically marked as rejected by Foto 3D can nevertheless be used to add texture to the bottom of the model, or for other purposes, by aligning them to the model using the alignment process.

synthetic view

A photo-realistic view created from a snapshot of the virtual model rather than by taking a photograph of the object – this image is useful for editing the shape of the geometry as seen from viewpoints which were not originally photographed or were inaccessible.

texture map

A texture map reproduces the appearance and texture of the original object. It is a color image that is, for the most part, wrapped around the model surface. It is called a "map" because portions of the image are mapped to specific triangles of the mesh using coordinates in "U-V space" which are surface coordinates for the model. Foto 3D textures are considered "baked-on" in that they visually simulate the effects of small surface contours, undulations and roughness that are too fine to be captured in the wireframe mesh by capturing the light and shadow normally seen on the surfaces of an object.

triangle mesh

Foto 3D creates a 3D model as a continuous surface (possibly in several disconnected pieces) made up of triangles, called a "triangle mesh" (see “wireframe”.)

VRML

An acronym for Virtual Reality Markup Language, VRML is an industry standard format for files that construct 3D objects and scenes using vector models . Many software packages support and display VRML.

wireframe model

The 3D model that Foto 3D creates before the texture is applied is often referred to as a "wireframe" model or mesh. It is a mathematical representation of the object’s shape consisting of points or vertices, lines connecting those vertices, and resulting polygon surface faces that are collectively expressed as vectors in 3D space. For Foto 3D, all faces are triangular and so the wireframe model is also called a “triangle mesh”.

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