UZR 3D Professional Manual

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About this Manual

UZR 3D Professional is a software product that enables you to reconstruct 3D models from 2D object images. The *UZR 3D Professional* workflow is as simple as possible:

- The desired object is placed on the object pattern. This pattern can be printed on standard paper with every printer.

- Photographs are taken from all sides of the object.

- The object images are loaded into *UZR 3D Professional*.

- The 3D model is automatically reconstructed and textured.

- The 3D model then can be exported into other 3D modeling software or for usage in the internet.

The third part of this introduction features a *UZR 3D Professional* workflow description. We also included a tutorial. With the tutorial files included on your *UZR 3D Professional* CD ROM, you can follow the tutorial step by step and get to know the software.

The *UZR 3D Professional* Reference features lists of all *UZR 3D Professional* functions and shortcuts that will make working with *UZR 3D Professional* even easier for you.

Additionally, we included some hints dealing with the proper image acquisition. If you take the advice to heart, you will be able to reasonably improve your 3D results.

Notation

Caution *Under this header you will find hints to what has to be considered/prevented while working with UZR 3D Professional.*

Tip *Under this header you will find useful hints on how the UZR 3D Professional workflow is improved.*

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2.2 UZR GMBH & CO KG License Agreement for *UZR 3D Professional*

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UZR GMBH & CO KG Eiffestraße 422 D-20537 Hamburg Germany

What's New in 1.4?

This section will give you an overview on the new features implemented in version 1.4 of *UZR 3D Professional*.

You have suggestions on what to realize in future versions of *UZR 3D Professional*? Great, we are looking forward to your comments! Simply write an email to *support@uzr.de*.

3.1 New Calibration Engine

You are used to the fact that *UZR 3D Professional* produces great results, but these results have even been improved with the new image calibration engine.

Manual Calibration

The opportunity to control the calibration manually allows you to directly interact with the reconstruction process and even use images that could not be calibrated during the automatic calibration.

Calibration accuracy display

The calibration accuracy display allows a better analysis of the calibration results. This way, you are able to improve your 3D results.

3.2 New Texture Reconstruction

The new and improved texture reconstruction generates optimal maps from the object images.

You receive large texture parts perfectly suited for further usage with other 3D software. Addi-

tionally, you can export these textures at any resolution providing you with great rendering results - even at the highest level of detail. A number of different parameters enable you to directly influence your texture results.

3.3 New Masking Tools

New masking tools improve the *UZR 3D Professional* work flow:

- *Fill/Erase Mask*: This tool fills/erases the whole object mask.

- *Invert Mask*: This tool inverts the existing object mask.

- *Shrink/Grow Mask*: This tool enables you to increase/decrease the mask pixel by pixel. This way, especially the edges of the mask can easily be edited.

- *Import/Export Mask*: This tool enables you to edit masks with an external image editing software. This way you can use tools you are used to and that are not provided in *UZR 3D Professional*.

- *Import/Export Image*: This tools enables you to directly export a single object image from the image list to your hard drive. This image then can be edited and directly imported back into the image list.

3.4 New GUI Elements and Functions

The user interface of *UZR 3D Professional* version 1.4 contains new features that will improve your work flow even further:

- *Positive/Negative Mask Display*:

  The mask can be set to positive (the masked object is colored) and negative (the image background is colored) display using the corresponding icons. This way, the mask edge editing is improved.

- *Render-Toolbar*:

With the render toolbar, fast and easy access to the 3D display settings is provided.

- *Deactivating Object Images*:

By deactivating the corresponding icons underneath each object image in the image list, you easily exclude single

object images from the voxel or texture reconstruction process. This way, you do not have to delete them from the image list. An overview on all existing object images is kept in the image list.

- *STL Export*: With the *STL* export, *UZR 3D Professional* now supports the prevalent rapid prototyping format.

- *PSD and PCD Import*: Photoshop and Kodak Photo CD files can now directly be imported in *UZR 3D Professional* without having to convert them to another image file format.

- *Import of an Existing Alpha Channel*: If you import *PNG*, *PSD*, *TGA* or *TIF* object image files containing an alpha channel, this alpha channel is detected and automatically used for masking the object. This way, images can directly be edited with an image editing software and its mask information is saved within the object image.

3.5 Improved *UZR* Export

UZR export with javascript controls

The *UZR* export has been improved: exported camera positions can directly be controlled with javascript commands. This way you will be able to create interactive web pages pointing on special details of the model to the user. Additionally, the java applet display can be reset without having to refresh the page.

Printing the Object Pattern

UZR 3D Professional reconstructs a textured 3D model from a number of object images. In order to acquire proper object images, you need to print out the so-called object pattern. This pattern can be printed with any printer using standard paper.
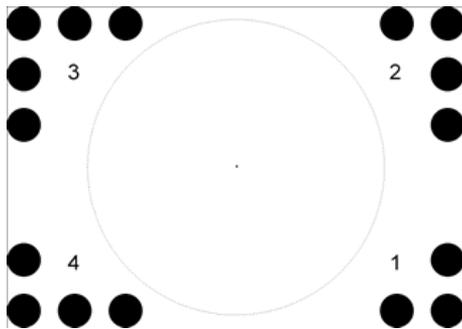
The object pattern

To print out the object pattern, choose *Print Pattern* from the *File* menu. You can choose from different sizes or create your own format.
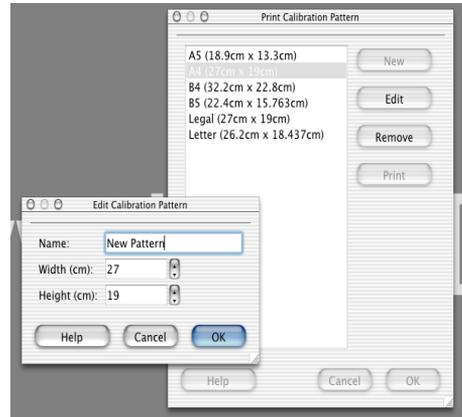
Printing the object pattern

The object pattern can be changed to any desired size. Be sure to adjust the object pattern size to the size of the object you want to reconstruct. The bigger the object is compared to the object pattern, the better details of the object will be reconstructed.

Caution *Make sure that you selected the corresponding paper size in the setup menu of your printer. If you want to print out an A3 object pattern, you have to select the A3 paper size.*

Object Image Acquisition

5.1 Basics

The quality of a 3D model created with *UZR 3D Professional* directly relates to the quality of the object images from which the model is created. If you are using faulty object images, you will hardly be able to reconstruct an appealing 3D model. That is why it is recommended to exercise care during the object image acquisition. Be sure to get sharp and unshaky object images. Additionally, pay attention to the following basic rules.

5.2 Object Image Acquisition Rules

If you take the following image acquisition rules to heart, you will be able to noticeably improve your 3D results and the convenience of the 3D reconstruction process.

5.2.1 Object Pattern Size

Print out the object pattern on a white sheet of paper.

Adjust the pattern size to the size of the object.
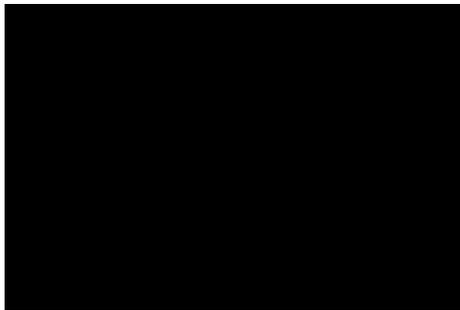
Wrong

The pattern size should be as small as possible compared to the size of the object. Make sure, though, that, from every camera position, three of the four pattern's corner points are visible.


Wrong

5.2.2 Preparing the Object Pattern

In order to achieve exact results, the object pattern has to lay as flat as possible.
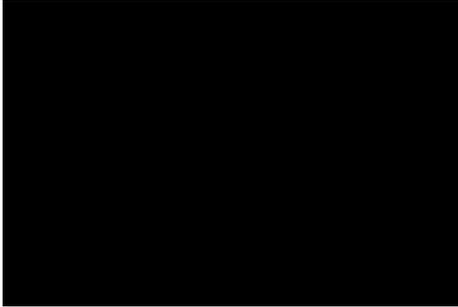
Wrong

If the object pattern is undulated, the camera position reconstructiojn will not be as exact as required. You will not receive high quality results.
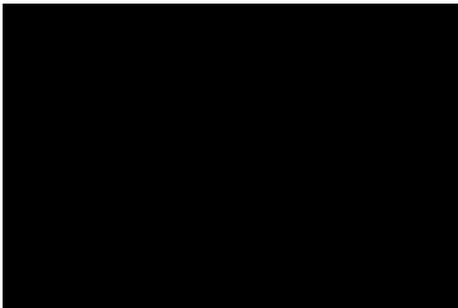
Wrong

We recommend that you tape the pattern to a flat piece of plastic, glass, or cardboard. Or you tape the pattern directly onto a white table - this way you will simultaneously receive a uniform image background.

5.2.3 Placing the Object on the

Object Pattern

Place the object on the object pattern to acquire the object images.
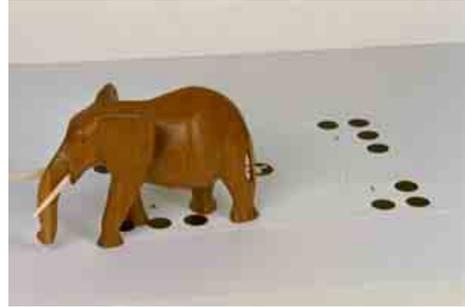
Wrong

The object pattern has to lay as plane as possible and should not show an>y waves sharp bends. The object should not cover any of the object pattern's calibration points.
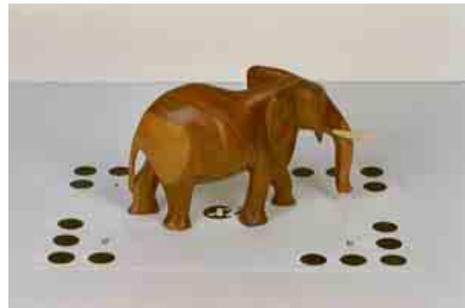
Correct

Caution *The object's position should not be changed during the object image acquisition process. Ideally, move around the object taking between 10 and 20 images from different positions. If that is not possible, carefully rotate the object and the object pattern without moving the object.*

5.2.4 Uniform Illumination
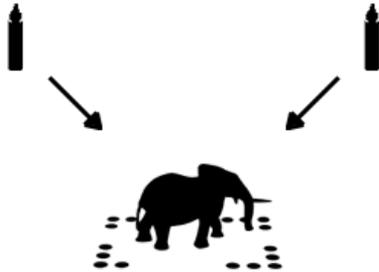
Try to illuminate the object as uniformly as possible. Use more than one light source to illuminate the object. The less shadows the object casts, the brighter the object colors will be captured and the better the object separation process will work.

5.2.5 Uniform Image Background

The more uniform the image background, the easier it will be to separate the object from the object image background.

Wrong

Ideally, the object will be masked automatically as in the tutorial included on your *UZR 3D Professional* CD ROM.
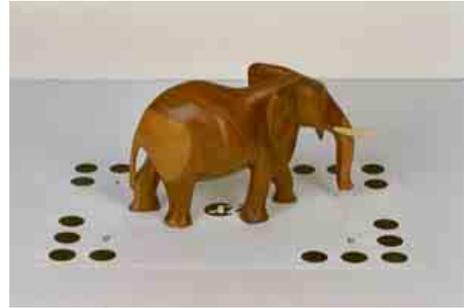
Correct

In most cases it is sufficient to place a white blanket or large sheet of paper under to object pattern to receive a very uniform image background.

5.2.6 Ideal Camera Angle

The best results are achieved if the images are taken from an angle of about 45 degrees.

Wrong

Take some additional images from other angles (e.g. from above) in order to reconstruct parts of the object texture that would otherwise not be visible in the object images.
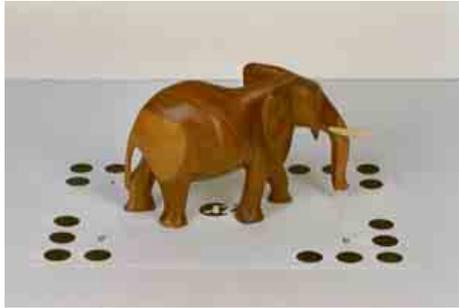
Correct

Caution *Be sure not to fall below an angle of 30 degrees. If the camera angle is to plane, UZR 3D Professional will not be able to detect the calibration points of the object pattern.*

5.2.7 Taking the Images

Take images from all sides of the object to record all of the object's details. There have to be three corner points visible in every object image in order for *UZR 3D Professional* to calibrate the image. The more points are visible in an object image, the better the camera position can be reconstructed.

Always make sure that the whole object is visible in every object image and that parts are cut off. If a part of the object is not visible on one of the object images, this part will be cut away by the 3D reconstruction process.

As soon as all images are taken, save the image files to disk and start *UZR 3D Professional*.

Tip *It is recommended to take more pictures than normally required. This way you can choose from a wider selection and do not have to restart the object image acquisition process if some of the images can not be calibrated.*

5.3 Tips and Tricks

5.3.1 Sharpening the Image

Some digital cameras feature image sharpness improvement. If you maximize this value, the images do not become more focused. Instead, the images' contrast is increased. This might lead to faulty colors and frayed object edges.

Tip *If you want to enhance your object image quality it is recommended you use an image editing software product of your choice (e.g. Adobe Photoshop). Most image editing software offers a wide selection of tools to improve color, sharpness or illumination of your image. Plus, the results are easier to control than on the small LCD display of your digital camera.*

5.3.2 Manual Alignment

Different illumination leads to different image colors. The camera's alignment can be adjusted to the prevailing illumination. The automatic alignment feature of most digital cameras works quite all right, although the quality of the object images can in most cases be improved if the alignment is adjusted manually. This applies especially if contrasting color dominate

the scene. To adjust your camera's alignment manually, choose the corresponding menu item from the "settings" menu of your digital camera. Focus on a white area. This "white" will then be the reference color that all other colors will be adjusted to.

Tip *Use the object pattern as the alignment reference.*

5.3.3 The Camera's Flash

The camera's flash frontally sends out a strong light impulse on the object. This might lead to different colors and shades on the single object images. That is why it is recommended to resign the camera's flash. You will get better results if you illuminate the scenery with a constant light source.

5.3.4 Considering the Release Delay

Especially with cheap digital cameras there is a considerable delay between the moment the release is pressed and the moment the picture is taken. You should take that into account by persisting in your position after pressing the release. This way, you make sure that you receive focused images.

Tip *Improve your images by using a tripod.*

5.3.5 Camera Display

If you are not using a digital reflex camera or a camera equipped with a digital viewer, the image you see through the viewer might differ from the image recorded. This might lead to unusable object images since parts of the object or the object pattern might not be visible. The image shown on the camera's LCD display is the 'right' image.

Tip *Aim at the object and control the image on the LCD display before recording.*

5.3.6 The Ideal Image Resolution

The higher the image resolution, the better the results of the texture reconstruction will be. You should adjust the object image resolution depending on two things:

*   *Size of your memory card:*

    Always keep in mind that *UZR 3D Professional* requires between 10 and 20 object images to reconstruct the object. Highly resoluted images use up a lot of space. If your camera is equipped with only a small memory card, its memory might be used up before all required object images are taken.

*   *Power of your Computers CPU:*

    The higher the object image resolution, the bigger the calculating effort. If you are using a rather old home computer, it is recommended to resign on highly resoluted object images.

Tip *The lowest recommended resolution , is 640 x 480 pixels. If you are using lower resoluted images you won't be able to reconstruct a satisfying object texture.*

5.3.7 Immediate Image Control

A big advantage of digital photography is that the images are instantly ready without a film having to be developed. Improve your results by instantly checking the object image quality on the LCD display of your camera. It is also recommended to play around with your camera's parameters since faulty images can be deleted in a second.

5.3.8 Adjusting the Light Exposure

Most digital cameras automatically adjust their light exposure values depending on the given scenery illumination. The brighter the focussed object is illuminated, the more the image is automatically darkened. You will improve your image quality if you adjust the light exposure of your digital camera. Raise the value if the object is brightly illuminated and vice versa.

Tip *It is recommended to experiment with your camera's settings at the beginning of the image acquisition process. If you control the results instantly and adjust the settings, you will soon receive optimised results. Finish taking the object images with these settings and start the 3D reconstruction with UZR 3D Professional.*

Working with *UZR 3D Professional*

6.1 Starting *UZR 3D Professional*

To start *UZR 3D Professional*

•   double click the *UZR 3D Professional* icon on your desktop or

•   double click an existing *U3D* file which will then automatically be opened.

After starting, the writing *www.uzr3d.com* appears in the user interface. By double click-ing this writing, an Internet Explorer window is opened and you are connected to the *UZR 3D* discussion forum in the internet. Here, you get support and have access to discussion threads and current downloads.

The *UZR 3D Professional* user interface

6.2 The *Adjust* Mode

Command	Shortcut
Open Images...	Apple+I
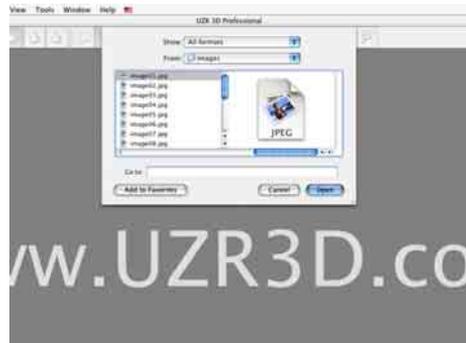
Opening the object images

To open the object images with *UZR 3D Professional*, choose *Open images...* (Apple-I) form the *File* menu. The images are successively loaded into the image list on the left side of the user interface. Due to the fact that *UZR 3D Professional* is a multithreaded application - meaning that numerous actions can be performed within the software at the same time - you can start working with the object images rightaway as soon as the first image appears in the image list. The other object image files are loaded in the background.
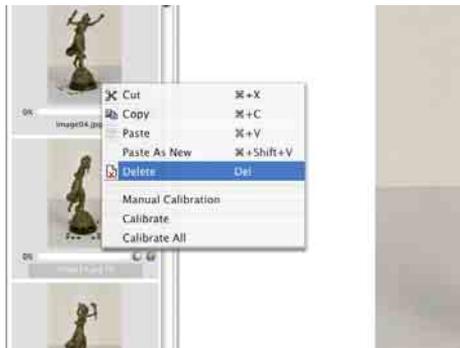
Editing the object image selection

You start your project in the *Adjust* mode. Use this mode to check if you loaded the correct object images and if the quality of the loaded images is sufficient for the work with *UZR 3D Professional*.

UZR 3D Professional uses all object images in the image list to generate the 3D model. If you loaded wrong images by accident, it is recommended that you delete these images from the image list. Use the commands from the *Edit* menu or the image list context menu to edit the image selection.

In order to receive a uniform 3D model texture, you should make sure that the images' quality is as consistent as possible. If some of the object images reasonably differ from the others, you can use the *Adjust Brightness/Contrast...* and *Adjust RGB...* tools from the *Tools* menu to enhance the images' quality.

If you wish to edit some of the loaded images with an image editing software of your choice, you can directly export them from *UZR 3D Professional*, edit them and then import them again. Use the commands *Import image...* and *Export image...* from the *Tools* menu.

An additional image can be inserted directly from the clipboard into the image list by using the *Paste as new* command. This way, you do not have to externally save images that you just edited with another software before using them with *UZR 3D Professional*. Simply copy the whole image and paste it into the image list.

If you finished all the required changes, you can activate the *Calibrate* mode (*Calibrate* index or Apple-F2).

6.3 The *Calibrate* Mode

Automatic Image Calibration

In order to reconstruct a 3D model from the

object images, *UZR 3D Professional* needs certain information about the camera that was used

to take the images: information about the position of the camera as well as its zoom and focal length are required. This information is resonctructed from the calibration pattern.

Calibrating the images

If you activate the *Calibrate* mode, *UZR 3D Professional* detects visible pattern ellipses in the object images. This information is then used to reconstruct the required camera information, a process called *image calibration*.

Calibrated image

If a sufficient number of ellipses was detected, the image is automatically calibrated. In the image list, this image is then marked with green

crosses in the corner points of the calibration pattern.

Not calibrated image

If the image calibration failed, the image list marks these images with a red cross. This way, a quick overview on the calibration results is provided.

Caution *Always make sure that a sufficient number of object images is correctly calibrated. On these images, the captured object should be visible from every side and, if possible, from above, in order to receive a satisfying 3D reconstruction result.*

6.3.1 Analysing the Calibration Results

In the work view, *UZR 3D Professional* circles all detected ellipses with red color. The calibration results - the reconstruction of the object pattern - are circled in green color. The better the red and green ellipses fit, the better the calibration results are. If the distance between the ellipses is large, the calibration accuracy is low. If an ellipse is yellow colored, *UZR 3D Profes-*

sional detected an ellipse which then was not used for calibration.

The calibration display

The accuracy of the image calibration results is displayed in the image list. Under each image object, a colored bar represents this accuracy: The wider this bar - the larger the calibration value on the left -, the better the result of this image's calibration. The color of this bar additionally indicates the calibration accuracy through its color: a red bar represents a deficient calibration, a green bar represents good calibration results.


The calibration accuracy display

Calibration results can be deficient due to a number of reasons. If only a small number of ellipses is detected in the image or if some of the detected ellipses are partly covered by the object, the calibration results will be faulty. You can try to improve such results by using the manual calibration.

6.3.2 Manual Calibration

In most cases, the automatic calibration leads to good results if the object images were taken with care. However, you can adjust the calibration results manually to even out any mistakes of the automtaic calibration routine.

In order to manually calibrate an object image, activate this image in the image list. Then choose *Manual Calibration* from the *Tools* menu or the context menu of the work view.
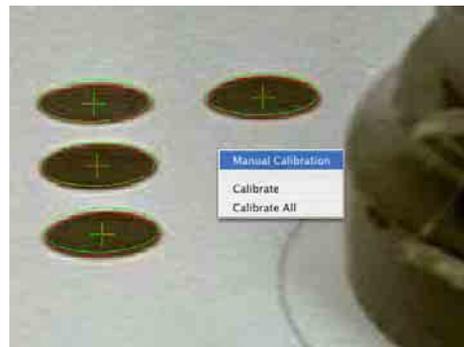
Manual Setting of Calibration Points

Use the left mouse button to click into the center of all visible ellipses of the calibration pattern. If *UZR 3D Professional* detects an ellipse close to the defined center, this ellipse then is circled with red color. If no ellipse is found -

due to bad lighting conditions and cut off ellipses - the software draws a red cross into the work view.

If, by accident, a set ellipse has to be removed, simply click it again: it will be deleted immediately. If you want to move a set point, hold Apple and the left mouse button and move the point to the desired location.

As soon as you marked all visible ellipses, you can try to calibrate the object image: choose the *Calibrate* command from the *Tools* menu or the context menu of the work view. If the indicated ellipses and their accuracy are sufficient, the image is calibrated.

Calibrated image

If the manually detected ellipses were successfully used for calibration, the indicated ellipses are displayed as green crosses in the image list.

Uncalibrated image

If the number of indicated ellipses and/or their accuracy are insufficient, the image can not be calibrated. The indicated ellipses will then be displayed as red crosses in the image list. This way, you will get a quick overview on which images were reworked manually.

If a sufficient number of object images was successfully calibrated, you can start with the object separation: activate the *Mask* mode (*Mask* index or Apple-F3).

6.4 The *Mask* Mode

The *Mask* mode features three different masks that identify certain areas of the object images:

Display of the different object masks in the image list.

- *Object*: Use this mask to separate the object from the image background.

  The *Object* mask is active per default as soon as the *Mask* mode is activated. The object masks are automatically painted using a flood fill routine. Black-and-white miniatures of these object masks are displayed in the image list.

- *Texture on*: This mask defines parts of the object images which, in the later texture reconstruction process, will definitely be used to reconstruct the model's texture. Use the *Texture on* mask to enhance parts of the texture that have to be very detailed (e.g. writing, faces etc.). You will find more hints on how to use the *Texture on* mask in the section *Improving the 3D Model's texture* of this manual.

  The *Texture on* are displayed in the image list in green color. If the *Texture on* mode is active, the images in the image list are of green color.

- *Texture off*: This mask defines parts of the object image which, in the later texture

reconstruction process, will definitely not be used to reconstruct the model's texture. Use the *Texture on* mask to definitely exclude parts of object images which lack quality from the texture reconstruction process.

The *Texture off* masks are displayed in the image list in red color. If the *Texture off* mode is active, the images in the image list are of red color. You will find more hints on how to use the *Texture on* mask in the section *Improving the 3D Model's texture*.

6.4.1 Separating the Object

If you activate the *Mask* mode, the *Object* mask is active. Begin with separating the object from the image background.

In the *Mask* mode, the object is separated with a colored mask layer. All parts of the images that are painted are then used to reconstruct the object.

Caution *The object has to be separated on every calibrated object image in order to reconstruct the 3D model.*

As soon as you activate the *Mask* mode, an automatic fill routine is used to mask the object in the images. This works well if the object's color contrasts with the image background and if you provided a uniform image background. In the separate mode, the image list features black and white miniature masks. This way it is easy to see which masks have to be reworked.
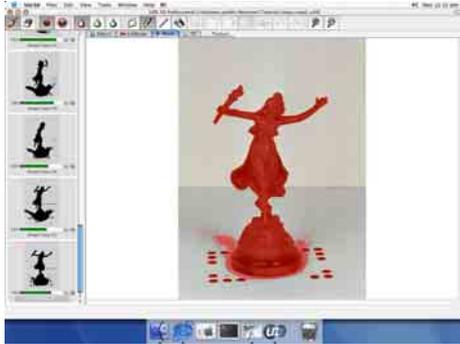
Automatically generated object mask
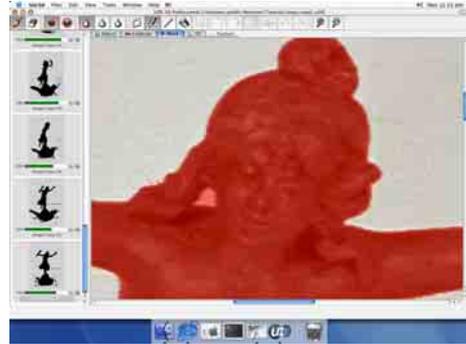
Zooming allows precise work

The outcome of the automatic separation routine is disturbed by irregular image backgrounds or deficient illumination of the object. If the object mask has to be reworked manually, a number of handy drawing tools is provided.

If you zoomed far into the object image you only see a small part of the object image. Use Shift-LeftMouse , the cursor keys or the scrollbars on the right and bottom of the work view to move the object image.

6.4.2 Separation Tools

The Painting Mode

Image Zoom

Command	Icon	Shortcut
Zoom 100%		=
Zoom Fit%		?
Zoom In	🔍	.
Zoom Out	🔍	,

Command	Icon	Shortcuts
Paint Mode	🖌	Space
Erase Mode	🧽	

To work as exactly as possible, it is required to zoom very far into the object image. UZR 3D Professional provides a number of comfortable zoom functions. If you are using a wheel mouse, use the wheel to zoom in and out the object image.

While manually reworking the object masks, you can switch between the *paint* and *erase* mode. The mode setting defines if the mask is painted or erased by using some of the separation tools (*Rectangle*, *Pen*, *Line*, *Polygon* and *Fill* tool).

Mask Display

Command	Icon	Shortcut
Positive Mask Display		Apple-M
Negative Mask Display		

You can switch between a positive and a negative mask display.

Positive mask display

By default, the positive mask display is enabled. In the positive mask display, the painted mask is colored. Areas that have not been masked are diaphanous.

Negative mask display

The negative mask display works vice versa: areas which were not masked are displayed colored. Parts that have been masked are displayed diaphanous.

Use the positive and negative maks display to easily work on the mask edges. In the positive mask mode, you can roughly paint the object with the *Pen* tool, while in the negative mask mode you can then use the *Fill* tool to work on the mask edges.

Caution *Do not mistake the positive/negative mask display command with the Invert Mask command. While switching the mask mode only alters the mask's display, the Invert Mask command alters the existing mask attributes: masked parts will become unmasked and vice versa.*

Tip *Always keep an eye on the mask display in the image list. Here, the masks are always displayed "as-is".*

Drawing Tools

Rectangle Tool

Command	Icon	Shortcut
Rectangle Tool		Apple-R

This tool draws a rectangle. When the *Erase* mode is activated, the mask outside this rectangle is erased. When the *Paint* mode is activated, the rectangle is filled.

Rectangle tool in the paint mode

The rectangle tool is suitable for the beginning of the separation process. It erases most of the non-required mask parts.

Press the left mouse button and use the mouse to draw a rectangle around the object. If you release the mouse button, the mask outside the rectangle is erased.

Pen Tool

Command	Icon	Shortcut
Pen Tool		Apple-P

Use the pen tool to paint and erase the mask as if using a real pen.

Pen in paint mode

In order to paint or erase with the pen tool, hold the left mouse button and move the mouse.

Pen in erase mode

Changing the Pen Size:

The pen size can seamlessly be changed by pressing Alt and the left mousebutton and moving the mouse. The number displayed on the edge of the cursor corresponds to the pixel size of the current setting.

Tip *If you use the pen tool, it is recommended to suspend the drawing process from time to time by releasing the mouse button. This way it is possible to undo small work steps. In case of a mistake you then do not have to do the work all over again.*

Line Tool

Command	Icon	Shortcut
Line Tool		Apple-L

Line tool in paint mode

The line tool is perfectly suited to separate objects with straight edges. It works similar to the pen tool. Press the left mouse button and move the mouse to paint or erase a line.

Line tool in erase mode

Chaning the Line Tool's size:

Similar to the *pen* tool, the line tool's size is adjusted with Alt and the left mouse button.

Polygon Tool

Command	Shortcut
Polygon Tool	Apple-G

The polygon tool is used to quickly surround an area and fill or erase it. It is suited to easily seize complex objects.

Anwendung des Polygonwerkzeugs

The polygon tool draws a line with any desired number of corner points. As soon as the line forms an enclosed polygon, this polygon is filled. The polygon can be closed manually by connecting any two cornerpoints or by choosing *Close* from the polygon tool's context menu.

Mask filled

A corner point's position can be changed by holding Apple and clicking the corner point with the left mouse button. Now, the corner point can be moved to any desired position without having to redraw the line. This way, mistakes are easily evened out.

Caution *Corner points can only be moved as long as the area has not been filled yet.*

Fill Tool

Command	Icon	Shortcut
Fill Tool		Apple-F

The fill tool paints or erases the object mask in similar colored areas. With this tool, large parts of the object mask can be edited with a single mouseclick. Switch to *Paint* or *Erase* mode and use the fill tool to paint or erase large or edgy parts of the object mask by clicking into the object image with the left mouse button.
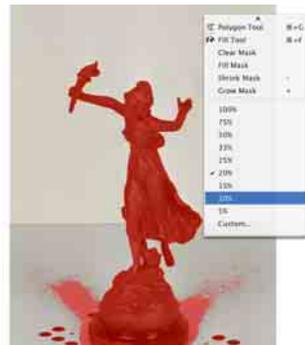
Fill tool context menu

The area of the object mask that is filled or erased by the fill tool is defined by the pixel color of the object mask. Similar colored pixels form a region that is then filled or erased.

Reworking the mask with the fill tool

Sometimes parts of the object mask are affected that should not be erased or filled. Thus, the tolerance of the fill tool can be adjusted. Open the fill tool context menu by clicking into the object image and choose any desired tolerance value. The bigger the tolerance value, the more pixels will be filled. If you select *Custom* from the fill tool context menu, a custom tolerance value from 1 to 100 percent can be set.

Tip *The fill tool can be used to precisely mask the object outlines. Roughly paint the object with the pen tool. Set the fill tolerance according to the object contrast and erase the mask where it overlaps the object edges.*

Clear Mask / Fill Mask

With these tools, the whole mask can easily be erased and filled.

Invert Mask

This tool inverts the existing mask.

Import Mask.../ Export Mask...

With these tools, existing masks can be imported that have been created with any image editing software (e.g. Adobe Photoshop).
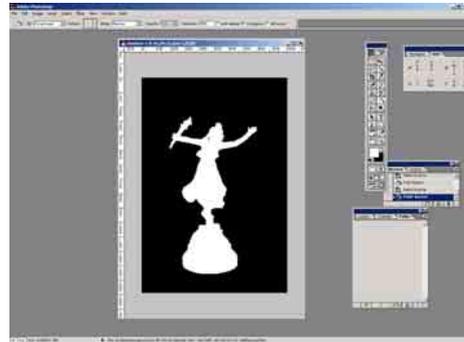
Black-and-white mask

To create a mask with another image editing software, open the image you wish to mask. Paint the image background black and the object white.

Imported mask

Now, activate the object image in the image list and import the mask directly into *UZR 3D Professional*.

Masks created with UZR 3D Professional can be exported with the *Export Mask...* tool.

Caution *Use only black and white to create the mask. Grey values, depending on their brightness, are either interpreted as black or white.*

Tip *It is recommended to save this mask separately; this way you won't lose any existing object image data.*

Grow/Shrink Mask

Command	Shortcut
Grow Mask	+
Shrink Mask	-

These tools enable you to grow and shrink the object mask pixel by pixel.

Mask Color

Command	Shortcut
Red Mask Color	Apple-Shift-R
Green Mask Color	Apple-Shift-G
Blue Mask Color	Apple-Shift-B

UZR 3D Professional displays the mask in three different colors (red [default], green and blue).

Depending on the color of the object, it is recommended to adjust the color of the object mask. Always choose a contrasting mask color.

This way it is easier to tell which parts of the object are already separated and which have to be reworked.

Using an image's alpha channel

Many image editing software products offer the opportunity to directly paint an image's alpha channel. If an image with alpha channel information is opened, *UZR 3D Professional* will detect this information and use the alpha channel to mask the object.
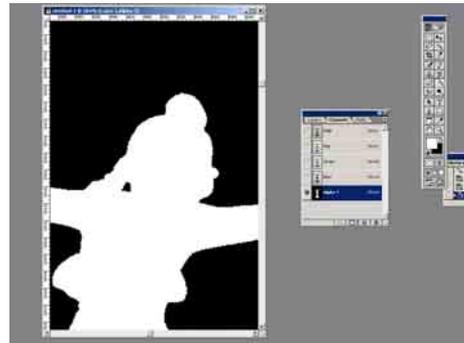
Using the alpha channel (e.g.: Adobe Photoshop).

Use black and white to paint the image's alpha channel. The object has to be painted white. Make sure that the alpha channel is included when you save the object image. Alpha channels are supported in PNG, PSD, TIFF, and TGA image files.

Selecting certain Texture Parts with Object Masks

After masking the object, you can use the *Texture on* and *Texture off* mode to define certain parts of the object images, which definitely have to be or definitely will not be used during

texture reconstruction. You can change the mask mode in the *Edit* menu.

Texture on mode.

You can mask the texture the same way you masked the object. All masking tools are available.
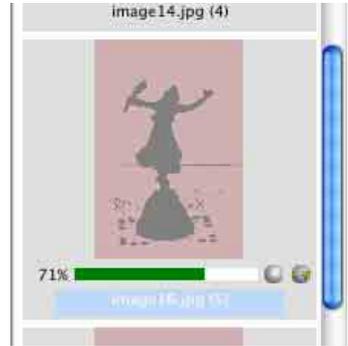
Texture off mode.

Caution *It might happen that certain areas of the single object images are masked in the Texture on as well as the Texture off mode. Parts that are masked in both modes will definitely be used to reconstruct the texture.*

Tip *Before you start masking some of the images in theTexture on or Texture off mode, create a 3D model first. Then you will immediately see which parts of the texture have to be improved.*

6.5 The *3D* Mode

If the object is separated in every object image, the 3D model can be created. Activate the *3D* mode with the *3D* index or Apple-F3.

The Plain Model

With information about the camera positions and the object silhouettes, *UZR 3D Professional* is able to reconstruct a realistic 3D model. This model is then provided with the textures also extracted from the object images.

The 3D reconstruction process starts automatically as soon as you activate the 3D mode. If this process fails you should check if the object is correctly separated in every object image and if all object images have correctly been calibrated.

Use the mouse to rotate the 3D model in the work view. With Shift and the mouse button, you can change the 3D model's position. With Shift and the mouse button, you can zoom in and out the 3D model.

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Plain Model

First, the object's shape is reconstructed creating a so called *Mesh*. This plain model is displayed in the work view.

3D Display Settings

The 3D Mode features various information that can be displayed in the work view. The 3D display can be adjusted in the *View* menu.

- *Wireframe*:

Displays the 3D model's wireframe.

- *Flat*:

Displays the plain 3D model.

- *Smooth*:

Smoothes the 3D model.

- *Textured*:

Activates the 3D model's texture display.

- *Show Cameras*:

Activates the reconstructed camera positions display.

Mesh Resolution

Low mesh resolution

The mesh resolution can interactively be changed. Use the slider on the bottom part of the work view to change the number of polygons of the 3D model in realtime. You can also directly enter the desired number of polygons in the window on the right side of the slider.

High mesh resolution

Caution *The more polygons a 3D model features, the larger is the model's data size. If you want to use your 3D model in the internet, you might want to avoid large amounts of data since they lead to longer download times. Check if the model can be displayed with a smaller number of polygons without losing too much quality. A maximum of 1000 polygons is recommended if you want to export a model for internet usage.*

Tip *You will recieve the maximum number of polygons if you open the Preferences dialogue and set the Voxel resolution to 512. Then close the dialogue with OK. As soon as the 3D model is calculated, move the slider the the right end of the scale. The maximum number of polygons differs from object to object.*

Texturing the 3D Model

As soon as the mesh of the model is reconstructed, *UZR 3D Professional* automatically starts the texture reconstruction process. This process is automatically restarted everytime the mesh resolution is changed.

Textured 3D model

UZR 3D Professional extracts the texture information directly from the object images. This, on the one hand, provides a fast and stable solution. On the other hand, the quality of the gener-

ated object texture directly corresponds to the quality of the object images. The whole texture is displayed in the workview when the *Texture* mode is activated. Use the *Texture* index or press Apple-F5. to activate the work view.

 Tip *If you first want to work on the 3D model's shape, the reoccurring texture calculation might disturb your work flow. If that is the case, it is recommended to deactivate the texture rexonstruction in the Preferences dialogue. As soon as you are satisfied with the object's shape, the texture reconstruction can be activated again which will cause the software to immediately calculate the texture.*

6.6 The *Texture* Mode

UZR 3D Professional reconstructs the optimal object texture from small parts of the single object images. The whole texture is displayed in the work view when the Texture mode is activated.

Reconstructed object texture

The texture is divided in a number of parts; these parts are called *texture charts*. Each chart contains a number of triangles which are highlighted on the texture.

Texture chart display

Use the *Texture* mode to check the texture quality before you export the 3D model. You can

make adjustments in the *Preferences* dialogue and achieve customized results.

Caution *The Texture mode is only available if a texture was reconstructed. If the texture reconstruction is disabled in the Preferences dia-* *logue, the Texture mode can not be activated.*

If you are satisfied with the results of the reconstructions process, you can export the 3D model.

6.7 Exporting the 3D Model

The finished 3D model can now be exported. Choose *Export* from the *File* menu. Here you can choose from a number of different export formats.
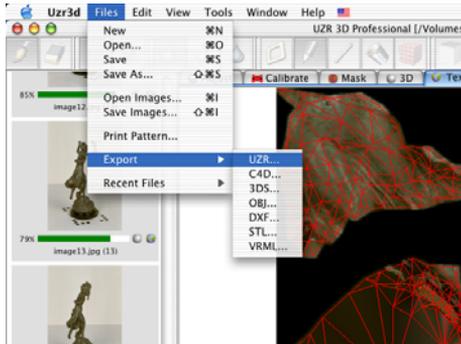
The *Export* menu

- *UZR*: The *UZR* format is perfectly suited for internet use. It can be streamed and seamlessly be integrated in existing data base infrastructure. The 3D model is included in HTML pages by a java applet. Export the UZR file separately or in combination with the applet and a complete HTML file.

- *C4D*: The *C4D* format saves the 3D model for further editing with Cinema 4D. The mesh information is saved in a

C4D file. The texture information is saved separately.

- *3DS*: The *3DS* format saves the 3D model for further editing with 3D Studio Max . The mesh information is saved in a *3DS* file. The texture information is saved separately.

- *OBJ*:If the 3D model is exported as an *OBJ* file, three separate files are saved to disk. The *MTL* file contains material information. The mesh information is saved in an *OBJ* file.The texture information is saved separately.

- *DXF*: The *DXF* export writes a *DXF* file to disk. This file contains mesh information. The *DXF* export does not feature any texture information.

- *STL*: The *STL* export saves an *STL* file to disk. This file contains the mesh information. The *STL* export does not feature any texture information.

- *VRML*: *VRML* is a common 3D file format for internet use. When exported to *VRML*, two separate files are saved: A *WRL* file containing the mesh information, and a separately saved texture file.

Caution *In order to capture the physical size of the 3D model, the size of the object pattern used has to be specified.*

6.7.1 Der 'Export'-Dialog

If you chose one of the available export formats, you can enter any desired file name in the appearing explorer window.

After entering the 3D file name, the export dialogue appears (exception: *DXF* and *STL* export). In this dialogue, different export parameters can be edited that effect the model's quality and file size.
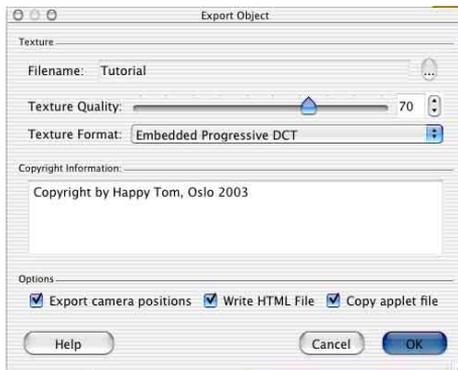
The *Export* dialogue

Depending on the chosen 3D file format, different export options are activated:

- *Texture Filename*: Here, the filename of the texture file is defined.

- *Texture Quality*: This slider defines the quality of the exported texture. *0* represents the lowest, *100* the highest quality.

- *Texture Format*: Here, the format of the exported texture is defined.

  — *Embedded Progressive DCT (Discrete Cosinus Transformation)*: This texture format is opted for internet usage. If the 3D model is saved using this texture format, the texture information will be streamed. First, the plain model is downloaded. As soon as a small part of the texture information is downloaded, a rough model texture is displayed in the browser. The texture resolution will increase while the rest of the texture data is loaded in the background. The Progressive DCT texture format provides the internet user with a quick representative impression of the 3D model.

  — *Embedded JPEG*: The texture will be embedded in the 3D model file as a *JPEG* file.

  — *Embedded RAW*: The texture will be embedded in the 3D model file as a *RAW* file (large amounts of data)

  — *JPEG File Interchange Format*: Saves the texture as a spearate *JPG* file.

  — *Portable Network Graphic*: Saves the texture as a separate *PNG* file.

- *Copyright Information*: When exporting to UZR or VRML, you can enter any copyright information in this window.

This copyright text is then saved within the exported file.

- *Export Camera Positions*: If this checkbox is activated, the 3D model will be provided with information about the camera positions reconstructed by UZR 3D Professional (VRML and UZR export only).

- *Write HTML file*: When exporting to UZR, activate this checkbox to write a complete HTML file to the chosen destination. This file contains the model as well as a javascript camera navigation.

- *Copy Applet File*: If you are exporting a UZR file, you can additionally save the required java applet file (uzrviewer.jar) to the same destination by activating the *Copy Applet File* checkbox.

If you selected a file name that already exists in the designated folder, UZR 3D Professional will ask if you want to overwrite this file. This way it is made sure that you do not lose any important data by accident.

6.8 Saving

Command	Shortcut
Saving a *U3D* file	Apple-S
Saving the object images	Apple-Shift-I

UZR 3D Professional saves the project as a *U3D*-file on your hard disk. This file includes the object image files as well as all separation and calibration data.

The image files can be saved on your hard disk directly from within the *UZR 3D Professional* interface. You can open the image files directly from your digital camera. If you want to save them to disk, simply choose *Save Images* from the *File* menu. Here you can indicate the directory in which you want to save the object images.

6.9 Making Adjustments

6.9.1 The *Preferences* Dialogue

The *Preferences* dialogue features all reconstruction parameters of *UZR 3D Professional*. Changing these parameters will influence your 3D and texture results.

The *Preferences* dialogue

Large voxel number
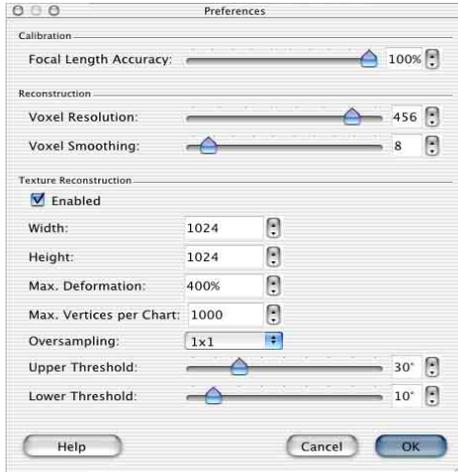
Use the *Preferences* dialogue to adjust the reconstruction quality of your 3D model and the 3D model's texture. The *Preferences* dialogue is featured in the *Edit* menu.

The higher the voxel's resolution, the more detailed the 3D model will be. An increasing voxel resolution will take *UZR 3D Professional* longer to reconstruct the 3D model. If you need a highly detailed 3D model, increase the *Voxel Resolution* value.

• *Voxel Resolution*: The 3D model, the so called *voxel*, can be reconstructed in different resolution. Use the *Voxel Resolution* slider to adjust the voxel resolution to your individual needs.

• *Voxel Smoothing*: A voxel a cubic object. Thus, the 3D model is built from a number of small cubes.

Unsmoothed 3D model

Small voxel number

A low *Voxel Resolution* will lead to an undetailed, rather rough 3D model.

But most objects though feature smooth surfaces instead of cubic surfaces. Thus, the model surface built from voxels can be smoothed.

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Smoothed 3D model

Recalibrating the object images

If the surface is smoothed, details of the 3D model might be lost - especially, if the model is built with a small voxel resolution. Coordinate the *Voxel Smoothing* and the *Voxel Resolution* values in order to obtain the desired 3D model quality.

- *Focal Length Accuracy*: *UZR 3D Professional* reconstructs the focal length from the object images. With this information, the camera position is reconstructed. The more precise the focal length is determined, the more precise results will be achieved. If you increase the *Focal Length Accuracy* value, you will get better results while the reconstruction process will take longer. If you prefer quick results, decrease the focal length accuracy. If you are interested in precise results, increase the value. Keep in mind that the focal length reconstruction has to be done for every object image and that the calculation time will increase with the number of object images.
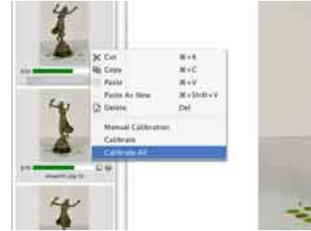
If you reconstructed a 3D model and are not satisfied with the result, adjust the *Focal Length Accuracy* value. Then you have to recalibrate the object images. Close the *Preferences* dialogue and choose either *Calibrate* to recalibrate one object image or *Calibrate All* to recalibrate all object images.

Tip *If you want to maximize a model's detail quality e.g. to export it to other 3D modeling software, separate this detail in the object images. Open the Preferences dialogue and maximize the Voxel Resolution value. Adjust the Voxel Smoothing value and create the 3D model. You will get a highly resoluted and detailed model of the object's detail.*

- *Texture Reconstruction enabled*: If this check box is activated, *UZR 3D Professional* reconstructs the 3D model's texture as soon as the model's shape is calculated. If you do not need texture information or if you want to optimize the shape of the object before calculating the model's texture, it is recommended to deactivate the texture reconstruction. This especially applies if you work with a highly resoluted model since, depending on you computer's system, the texture reconstruction can be time consuming.

- *Texture Width*: This value defines the width of the exported texture.

- *Texture Height*: This value defines the height of the exported texture.

- *Maximal Deformation*: This value defines the maximal deformation of the generated texture charts. The texture chart consists of a number of triangles. The higher the *Maximal Deformation* value, the larger the maximal size of single triangles will be.

- *Max. Border/Area Ratio*: The higher this value, the larger the maximal border size of a chart will be in comparison to the chart's area. If you raise this value, you will receive larger charts with more frayed edges.

- *Oversampling*: This value defines how the color of a pixel is determined. If e.g. *1x1* is selected, *UZR 3D Professional* checks the center of the pixel area to define this pixel's color. If *4x4* is selected, the same area is checked at four different parts, and the color is defined by the average value of the four detected color values. With a higher *Oversampling* value, you will receive better texture reconstruction results.

6.9.2 Generating Object Images

UZR 3D Professional uses the object separation information to reconstruct the shape of the 3D model. Parts of the object that are not visible on any of the image files thus can not be reconstructed. In some cases, this leads to deficient results because some parts of the voxel are not cut off. In order to optimize the 3D model's shape, additional object images can be generated.

Deficient 3D model

To generate additional object images, activate the *3D* mode. Now, rotate the 3D model in the work view so the deficient part of the model is visible. Then, generate an object image by pressing the *Generate Image* button or by choosing *Generate Image* from the *Edit* menu. The generated image is displayed in the image list.
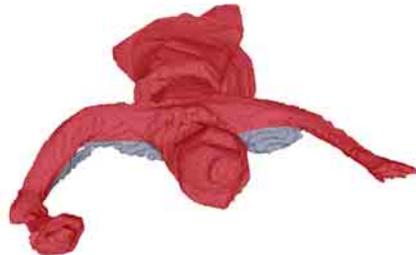
Generated image

Now, activate the *Separate* mode and rework the object mask of the generated object image

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cutting off the deficient parts of the object. As soon as this separation is done, go back to the *3D* mode. The improved model is reconstructed and textured.

Improved 3D model

Tip *Use the Generate Image command to generate object images that normally would be unusable because the object pattern would not be visible (e.g. view from the bottom).*

Caution *If you generate artificial object images to improve the model's shape, you should set the Voxel Resolution value to 512 and the Voxel Smoothing value to 0. This way, you obtain the highest model detail and make sure that no required parts of the object are cut off.*

Caution *Always make sure that the generated images show the whole object. Even if parts of the object are cut off only in a single object image, they will not be reconstructed. Additionally it is recommended to exclude generated images from the texture reconstruction process.*

6.9.3 Considering the Calibration

Results

The quality of the single object image's calibration is displayed by the calibration accuracy bar underneath every object image. The higher the displayed value, the better the result of the calibration.

If you receive a low calibration value for an image, using this image might worsen your 3D result. You should think about excluding this image from the reconstruction process.

Deactivating an object image

Use the calibration information to improve your results. The required process is a "trial-and-error"-one: Click the *3D* icon underneath the object image. This image will then not be used for the reconstruction of the voxel. The model will automatically be calculated and you can immediately see if deactivating the object image worsened or improved your 3D result without having to delete the image from the image list and losing valuable calibration and separation data.

6.9.4 Improving the 3D Model

Texture

The object texture is directly extracted from the object images. This is a fast and comfortable solution but on the other hand implies that the texture quality can only be as high as the object images' quality. If some of the images are blurred or differ in color, the object texture will be afflicted. This also applies for parts of the object that can not be seen on any of the object images. Here, a precise texture reconstruction is impossible.

That is why it is recommended to pay attention to the object image acquisition. If you acquire high quality object images, you will be able to reconstruct a high quality model texture.

If some of the images are blurred or feature different colors, the texture reconstruction will not lead to satisfying results. The same applies to parts of the object that are not visible on any of the object images. An exact reconstruction of these texture parts can not be expected.

Keep this in mind and take the object images with care. If high quality object images are used, you will get a high quality model texture.

UZR 3D Professional also offers functions to improve the object texture's quality:

- *Using Selected Texture Parts*: Use the different masks (see *The Mask Mode* for details) to force or exclude some parts of the object images.

Faulty Texture

This is especially recommended if you have to have higher detail in some parts of the model's texture, e.g writing on the object.

Texture on mode

If you mask this part in one of the images, it will be reconstructed from this single image instead of being composed from a number of images. This way, the texture result is improved.

Improved Texture

Vice versa, faulty parts of the images can be excluded from the texture reconstruc-

tion - e.g. if a cast shadow distorts the image quality. Use the *Texture off* mode to exclude these parts from the texture reconstruction.

- *Select the images used for texture reconstruction*: *UZR 3D Professional* uses all object images to reconstruct the object texture. You can exclude object images from the texture reconstruction process. This is recommended if some of the images differ in color or focus.

  Activate/Deactivate object image textures by using the image list context menu or instead use the *Texture* icon underneath every object image.

- *Adjust Brightness/Contrast and RGB Values*:

  If some of the images differ in contrast, brightness or color values, you should adjust these. Activate the *Adjust* mode and adjust the image quality values.

Brightness/Contrast Dialogue

If you then activate the *3D* mode, you can check if the texture has been improved.
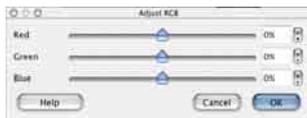
RGB Dialogue

Tip *If object images can not be calibrated because they turned out too light or dark, use the brightness and contrast adjustment to emphasize the ellipses on the object pattern. Now you can try to recalibrate the object image and undo the image quality changes without losing the new calibration data.*

- *Adjusting the Texture Reconstruction Preferences*: Use the *Preferences* dialogue to adjust the texture reconstruction values to your individual needs.

- *Enhancing Generated Object Images*: Parts of the texture that are not visible on any of the object images are artificially generated through mathematical interpolation. This also applies to the object's undersurface.

  You can work on the object undersuface's texture using a simple trick: First, generate an artificial object image showing the object's undersurface. Then, export this image.

  Open the generated image with any image editing software. Here, you can paint the undersurface of the object or map an image on the undersurface. Save your changes and reimport the image into the image list replacing the originally generated object image. Now, activate this image for texture reconstruction.

- *Improving the Object Image Quality using Image Editing Software*: Faulty images can be improved using any image editing software (e.g. Adobe Photoshop). Here, all parameters can easily be changed.

UZR Files on the Web

If you want to export the finished 3D model for internet usage, you can export it to the *UZR* format. The *UZR* format is perfectly suited for internet usage. *UZR* files are streamed; this way, the user does not have to endure long downloads and instead gets an immediate visual impression. Additionally, *UZR* files can be used commercially without charge and, like standard image files, can seamlessly be integrated in existing database infrastructure. *UZR* files can be viewed with every browser (Internet Explorer, Netscape, Opera) and on any system including Linux.

7.1 Integrating *UZR* files in HTML

Like standard image files, *UZR* files can easily be integrated in HTML web pages. To view the 3D models in a browser window, the *UZR* files plus the required java applet (*uzrviewer.jar*) have to be supplied. The java applet is saved to disk when *Copy Applet File* is activated during the *UZR* export.

If you activate the parameters *Export Camera Positions* and *Write HTML File* during *UZR* export, the following HTML file is written to disk:

```
<HTML>
<HEAD>
<META HTTP-EQUIV="Content-Type" CONTENT="text/html; charset=UTF-8">
<TITLE>UzrViewer</TITLE>
</HEAD>
<BODY>
<p>
 <applet name="Viewer" archive="uzrviewer.jar" code="uzrviewer.Viewer.class" width="600"
height="400">
  <param name="scene" value="xy.uzr">
  <param name="nocamrt" value="true">
 </applet>
</p>
<script type="text/javascript">
<!--
function setCamera(s)
{
  document.Viewer.setCamera(s)
}
function toggleLight(s)
{
  document.Viewer.toggleLight(s)
```

```
}
function startAnim()
{
  document.Viewer.startAnim()
}
function resetNodes()
{
  document.Viewer.resetNodes()
}
</script>
<table border="1">
 <tr>
  <th>
  Camera
  </th>
  <th>
  Lights
  </th>
  <th>
  Control
  </th>
 </tr>
 <tr>
  <td>
   <form>
    <input type="radio" checked="checked" name="Camera" onclick="setCamera(this.value)" val-
ue="Camera 1"> Camera 1<br>
    ...
   </form>
  </td>
  <td>
   <form>
   </form>
  </td>
  <td>
   <form>
    <input type="button" name="Start" onclick="startAnim()" value="Start">
    <input type="button" name="Reset" onclick="resetNodes()" value="Reset">
   </form>
  </td>
 </tr>
</table>
</BODY>
</HTML>
```

You can adjust this file for your individual purposes. Three parts of this file are of special interest.

In the first of these parts, the model is defined which will be loaded into the applet window. Additionally, some model display parameters can be defined:

```
<applet name="Viewer" archive="uzrviewer.jar" code="uzrviewer.Viewer.class" width="600"
height="400">
  <param name="scene" value="xy.uzr">
  <param name="nocamrt" value="true">
  <param name="bgcolor" value="#XXXXXX">
  <param name="bgimage" value="xy">
```

```
   <param name="spinx" value="xy">
   <param name="spiny" value="xy">
   <param name="spinbrake" value="xy">
   <param name="camdist" value="xy">
   <param name="s_cameras" value="xy">
   <param name="s_lights" value="xy">
   <param name="s_reset" value="xy">
   <param name="s_start" value="xy">
</applet>
```

- *'width'/'height'*: The size of the applet window that shows the 3D model can be set with the *width* and *height* parameters.

- *'scene'*: This parameter defines the model which is loaded into the applet window. Enter the name and location of the desired *UZR* file.

Caution *Keep in mind that this definition is case sensitive!*

- *'nocamrt'*: The *nocamrt* parameter has two possible values: *true* (default) und *false*. It defines if a camera rotation is allowed. If the parameter is set to "false", the camera position can be moved if you click in the image background and move the mouse.

Caution *This camera navigation is quite difficult to handle. The user might "lose" the object somewhere in the object window. It is recommended to leave the parameter value set to "true".*

- *'bgcolor'*: The *bgcolor* parameter defines the color of the java applets background. Enter the code of the desired color after the term "value" (e.g.: "#FFFFFF" for a white, "#000000" for a black background). You will find an overview on all available so called hexadecimal colors in every HTML documentation.

- *'bgimage'*: The *bgimage* parameter defines an image file that can be displayed in the java applet's background. This way, *UZR* files can seamlessly be integrated in HTML web pages. Enter the name of the desired *JPG* or *GIF* file after the term "value".

- *'spinx/spiny'*: The *spinx* parameter defines an initial vertical rotation of the 3D model. If you enter a positive number behind the term *value*, the 3D model rotates clockwise. A negative value leads to a counterclockwise rotation. Correspondingly, the *spiny* value defines an initial horizontal rotation. A positive value rotates the 3D model from top to bottom, and vice versa.

- *'spinbrake'*: The *spinbrake* parameter defines, how long this initial rotation lasts. Enter any value from 0 (no rotation) to 1 (infinite rotation). If this parameter is left undefined, its default value is set to 0. If no initial rotation but the spinbrake parameter is set, the 3D model's rotation initiated by the user lasts according to the spinbrake parameter value.

- *'s_cameras'*: This parameter defines the name of the applet's context menu which lists all available camera positions. If the parameter is not explicitly set, the default value "Cameras" is used.

- *'s_lights'*: This parameter defines the name of the applet's context menu which lists all available light sources. If the parameter is not explicitly set, the default value "Lights" is used.

- *'s_reset'*: This parameter defines the name of the applet's context menu which resets the 3D model display to its original position. If the parameter is not explicitly set, the default value "Reset" is used.

- *'s_start'*: This parameter defines the name of the applet's context menu which starts an animation if existing. If the parameter is not explicitly set, the default value "Start" is used.

In the second part, the camera positions that are controllable by javascript are listed:

```
<input type="radio" checked="checked" name="Camera" onclick="setCamera(this.value)" value="Cam-
era 1"> Camera 1<br>
...
```

The camera names can easily be edited to improve the navigation. For example, you can delete some of the camera positions and name the others "front", "back" and so forth.

Finally, you can also edit the button names:

```
<input type="button" name="Start" onclick="startAnim()" value="Start">
<input type="button" name="Reset" onclick="resetNodes()" value="Reset">
```

Simply edit the name input or delete them if not needed.

Tip *If you activate the option Write HTML file during UZR export, you can copy the required HTML source code directly from this file and paste it into any other HTML page (View source from the context menu of your browser window).*

7.2 Viewing *UZR* files in the Browser
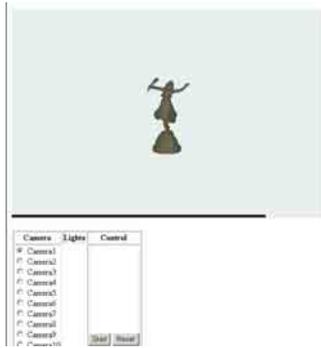
Mesh Data

The *UZR* files are automatically loaded into the browser window. First, the plain mesh data is displayed. The texture data is streamed, meaning that first a low resolution texture is visible.

Fully textured model

This texture will become higher and higher resoluted until the whole texture data is loaded. This way the user does not have to bear up long download times and gets an immediate visual feedback - even with a slower modem connection.

You can move the camera around the object by dragging the object with the left mouse button. If you hold Alt and the left mouse button, you can zoom in and out the object by moving the mouse back and forth.

Caution *This functionality is not available on Macintosh. Use the applet context menu (Apple/ Mouseclick) to control the 3D display.*

7.2.1 Controlling the 3D Display Using Javascript Controls

The 3D model display can be controlled with the javascript controls under the applet window or with the applet window context menu. Click the window with the right mouse button to open the context menu.

- *Start*: Starts an animation if existing

- *Reset*: Resets the 3D model position

- *Cameras*: Lists the camera positions if existing

- *Lights*: Lists the light sources if existing

- *About this file*: Displays the copyright information included during *UZR* export

- *About UZR Viewer...*: Displays a browser window with information on the UZR Viewer

UZR 3D Professional Reference

8.1 Basics

8.1.1 Starting *UZR 3D Professional*

There are two ways to start *UZR 3D Professional* after a successful installation:

- Open *UZR 3D Professional* by double clicking the *UZR 3D Professional* icon on your desktop.

- Open *UZR 3D Professional* by double clicking an existing *U3D* file.

It is also possible to drag and drop existing *U3D* files onto the *UZR 3D Professional* icon or the *UZR 3D Professional* work view.

8.1.2 Exiting *UZR 3D Professional*

To exit *UZR 3D Professional*, choose *Quit* from the *UZR 3D* menu. Or simply close the *UZR 3D Professional* program window with Apple-Q or the mouse. Before exiting, you are asked if you want to save your changes on the current project.

8.1.3 *Undo/Redo*

Command	Icon	Shortcut
Undo		Apple-Z
Redo		Apple-Y

UZR 3D Professional features an *Undo/Redo* function that enables you to undo/redo any realized project changes (*Undo* and *Redo* in the *Edit* menu or the corresponding icons in the document bar). The Undo/Redo is working mode comprehensive. If, for example, you edited one of the object masks and activate the *3D* mode, the changes can be undone with the *Undo* command without having to change the working mode.

8.1.4 The *Personalize* Dialogue
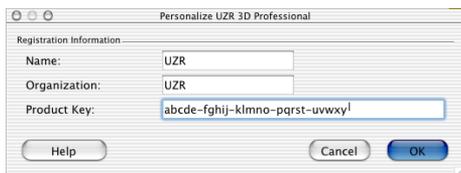
Use the *Personalize* dialogue (*Help* menu) to edit your registry information.

The *Personalize* dialogue

Caution *Any changes will take effect the next time you start UZR 3D Professional.*

8.2 The User Interface

8.2.1 The *UZR 3D* Menu

The *UZR 3D* menu features *UZR 3D Professional* copyright information, allows you to edit the 3D reconstruction settings and to exit the application.

Command	Function	Shortcut
About	Displays UZR 3D Professional copyright information.	
Preferences...	Changes the 3D reconstruction settings.	
Quit	Exits *UZR 3D Professional* after asking you to save your changes on the current project.	Apple-Q

8.2.2 The *Files* Menu

The File menu features all functions you need to administrate your image and 3D files.

Command	Function	Shortcut
New	Creates a new project.	Apple-N
Open	Opens an existing *U3D* file.	Apple-O
Save	Saves the current project.	Apple-S
Save as...	Saves the current project at a scheduled destination.	Apple-Shift-S
Open images...	Opens the object images.	Apple-I
Save images...	Saves the object images.	Apple-Shift-I
Print Pattern...	Defines and prints the object pattern.	Ctrl-P
Export	Exports the 3D model.	

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Command	Function	Shortcut
Recent files Apple+1,2,..., 5	Opens the recently used *U3D* files.	

8.2.3 *Edit* Menu

The *Edit* menu features functions that simplify working with *UZR 3D Professional*. Any mistakes can be corrected in a second.

Command	Function	Shortcut
Undo	Undoes the last work step.	Apple-Z
Redo	Redoes the last work step.	Apple-Y
Cut	Cuts the selection and copies it into the clipboard.	Apple-X
Copy	Copies the selection into the clipboard.	Apple-C
Paste	Pastes the clipboard into the selection.	Apple-V
Paste as new	Pastes the clipboard as a new image into the image list.	Apple-Shift-V
Delete	Deletes the selection.	Del
Paint Mode	Activates the Paint Mode.	Space
Erase Mode	Activates the Erase Mode.	

Command	Function	Shortcut
Object Mask	Activates the object mask which is used to separate the object from the image back-ground.	
Texture On Mask	Activates the *Texture On* mask. This mask defines parts of the object images that will definitely be used for texture reconstruction.	
Texture Off Mask	Activates the *Texture Off* mask. This mask defines parts of the object images that will definitely not be used for texture reconstruction.	
Use Image for Voxel Reconstruction	Activates/Deactivates the current object image for the voxel reconstruction process.	
Use image for texture reconstruction	Activates/Deactivates the current object image for the texture reconstruction process.	

8.2.4 *View* Menu

The View menu features all functions to adjust the view mode of the *UZR 3D Professional* work view.

Command	Function	Shortcut
Next Image	Switches back to the previous object image in the image list.	PgUp
Previous Image	Jumps to the following object image in the image list.	PgDown
Zoom 100%	Displays the actual image size.	=
Zoom Fit%	Adjusts the image to the current work view size.	?
Zoom in	Zooms into the object image.	.
Zoom Out	Zooms out the object image.	,
Red Mask	Activates the red mask color (default).	Apple-Shift-R
Green Mask	Activates the green mask color.	Apple-Shift-G
Blue Mask	Activates the blue mask color.	Apple-Shift-B
Wireframe	Activates the wireframe display.	Apple-W

Command	Function	Shortcut
Flat	Displays the plain 3D model.	
Smooth	Smoothes the displayed 3D model.	
Textured	Activates the 3D model's Texture display.	
Show Cameras	Displays the reconstructed camera positions.	

8.2.5 *Tools* Menu

The *Tools* menu features all functions to adjust the view mode of the UZR 3D Professional work view.

Command	Function	Shortcut
Adjust Brightness/ Contrast...	Enhances the current object image's quality.	
Adjust RGB...	Enhances the current object image's quality.	
Import Image...	Imports an object image and replaces the current object image.	
Export Image...	Exports the current object image.	
Manual Calibration	Enables the manual image calibration tool.	

Command	Function	Shortcut
Calibrate	Calibrates the current object image.	
Calibrate all	Calibrates all object images in the image list.	
Rectangle tool	Activates the Rectangle Tool.	Apple-R
Pen Tool	Activates the Pen Tool.	Apple-P
Line Tool	Activates the line tool.	Apple-L
Polygon tool	Activates the Polygon Tool.	Apple-G
Fill Tool	Activates the Fill Tool.	Apple-F
Clear Mask	Clears the existing object mask.	
Fill Mask	Fills the current object mask.	
Invert Mask	Inverts the existing object mask.	
Shrink Mask	Successively shrinks the object mask.	-
Grow Mask	Succesively extends the object mask.	+
Import Mask...	Imports an existing object mask.	
Export Mask...	Exports the current object image's mask.	
Generate Image	Generates an artificial object image.	Apple-G

8.2.6 *Window* Menu

Use the commands of the *Windows* menu to activate the different *UZR 3D Professional* working modes.

Command	Function	Shortcut
Adjust Mode	Activates the *Adjust* Mode.	Apple-F1
Calibrate Mode	Activates the *Calibrate* mode.	Apple-F2
Mask Mode	Activates the *Mask* mode.	Apple-F3
3D Mode	Activates the *3D* Mode.	Apple-F4
Texture Mode	Activates the *Texture* Mode.	Apple-F5

8.2.7 *Help* Menu

The *Help* features all help functions.

Command	Function	Shortcut
Online Help	Displays the *UZR 3D Professional* online help.	F1
UZR 3D Forum	Opens the *UZR 3D* Forum in an Internet Explorer window.	
Personalize	Adjusts registration of *UZR 3D Professional.*	

8.2.8 The Image List

The Image List

The image list features a thumbnail overview of all loaded object images. Depending on the working mode activated, the image list offers a number of different functions. In the *View* mode, use the image list to check if all and, in case, wrong object images were loaded. In the *Calibrate* mode, the thumbnails offer a miniature view of the calibrating routine's results as well as the calibration's accuracy. In the *Separate* mode, the image list features black-and-white miniatures of the painted object masks. By activating the icons under each object image in the image list, these images are queued for the texture and voxel reconstruction process. If this is done in the *3D* mode, the voxel reconstruction/texturing process is restarted automatically after changing the status of each object image.

If you click an object image in the image list with the right mouse button, the image list context menu appears. This menu features all commands that you need to edit the object image selection.

8.2.9 The Index

The Index

Shortcut	Function
Apple-F1, -F2,..., -F5	Changes the UZR 3D Professional working mode.

Use the index to activate the different *UZR 3D Professional* working modes. It is always possible to switch to any desired mode. A mode is activated by clicking the corresponding index card or using the F1 to F5 shortcut.

8.2.10 The Work View

The Work View

As soon as an object image is loaded into the image list, the images can be displayed and edited in the work view. In the *3D* mode, the 3D

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model is displayed in the work view. Also, the reconstructed camera positions are indicated by small green cones. In the *Texture* mode, the work view features the whole object texture.

8.2.11 Icon Bars

The Standard Bar

The standard bar features zoom shortcuts that allow you to zoom in and out the object images.

The Tool Bar

The tool bar features all tools needed for the manual object separation. Use the paintbrush and the eraser icon to switch from paint to erase mode. The other icons activate the different object separation tools.

The Render Bar

The icons of the render bar allow immediate access to the 3D display. Use the icons of the render bar to analyse yout 3D model and to enhance its quality.

8.3 System Requirements

- PC: Windows 98/ME/NT/2000/XP

  P233 MHZ, 32 MB RAM (64 MB recommended)

- Mac: Mac OS X 10.1.5. or higher

  G4, 733 Mhz

- 800x600 graphics adapter, 16Bit (Highcolor), 50 MB free hard disk space, digital camera/webcam, printer

Tutorial

Use this Tutorial to practically follow and understand the *UZR 3D Professional* wrkflow. You will find the required image and *U3D* files in the *UZR3D/Tutorial* directory on your hard drive.

9.1 Loading the Images

Start *UZR 3D Professional*. Then, open the object images with the *Open Images* command from the *File* menu. The images *image01.jpg* to *image17.jpg* are loaded into the image list.
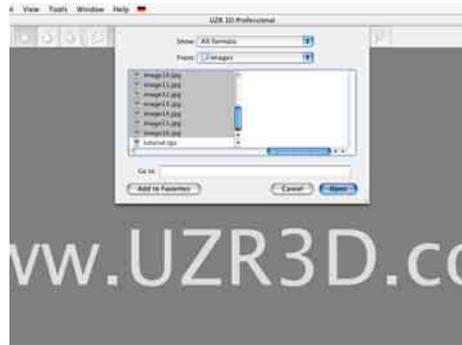
Loading the object images

This step is saved as *step1.u3d* in the *Tutorial/ Steps* directory on your hard drive.

9.2 Calibrating the Object Images

Open the *Preferences*. Set the *Focal Length Accuracy* value to *100%*. Close the dialogue with the *OK* button.

Next, activate the *Calibrate* mode by clicking on the *Calibrate* index. The images then are calibrated.

Calibrated images

The results of the automatic calibration are quite good. Yet, it can be improved in four of the images. You should check if the calibration accuracy can be increased with manual calibration.
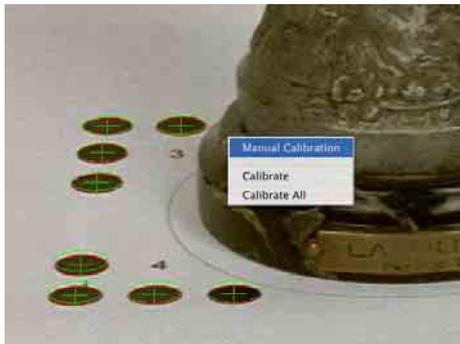
Faulty ellipse detection

Activate the image *image03.jpg*. You will see that *UZR 3D Professional* detects ellipses that are partly covered by the statue. You should remove these ellipses with the manual calibration tool.

Improved result

Open the work view context menu with a right mouseclick. Now, choose the *Manual Calibration* command and remove the faulty ellipses with a left mouseclick. Than activate the *Calibrate* command with a left mouseclick. The calibration accuracy increases from 0 to 66 percent.

Do the same work on image *image04.jpg*. Here you can increase the calibration result from 33 to 65 percent. The image calibration accuracy in *image12.jpg* can be improved from 6 to 85 percent. *image01.jpg*'s calibration result can be increased to 64 Prozent.

The calibrated images are saved as *step2.u3d* in the *Tutorial/Steps* directory on your hard drive.

9.3 Object Separation

Activate the *Mask* Mode.

On the upper half, the statue's separation is good enough. Yet, the object masks in the bottom part of the statue have to be increased to

achieve a higher level of reconstruction detail. Here, a slight shadow of the object has decreased the quality of the automatic separation.
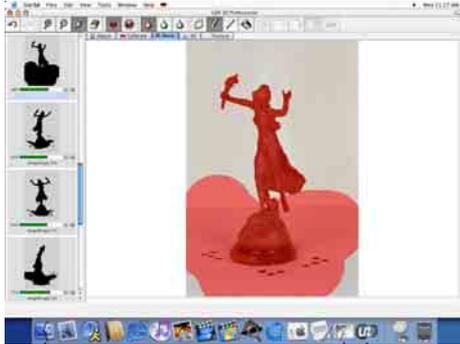
Activate the image *image07.jpg*. Then activate the pen tool and increase the pen size. Be sure that the paint mode is ative. Then roughly paint the deficient mask parts.
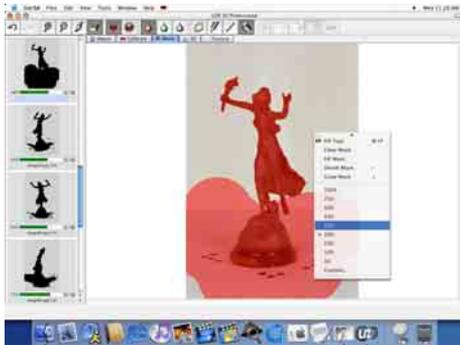
Next, activate the fill tool. Set the fill tool's tolerance to *25%* and activate the erase mode. Now erase the redundant parts of the mask fast and easy with a couple of right mouse clicks.

The mask is now improved. The last thing you have to do is delete the mask on the calibration points with the pen tool.

Do the same thing with all other object images. We recommend to work "tool by tool": first, rework all images with the pen tool, then with the fill tool and so forth. You can step through the object images using the PgUp/PgDn hotkeys. This way, you will increase your work flow.

You do not have to delete the mask on the points of the calibration pattern in every image; it is sufficient to remove it in *image07.jpg* and *image10.jpg*.

These steps are saved as *step3.u3d* in the *Tutorial/Steps* directory on your hard drive.

9.4 3D Reconstruction

Activate the *3D* mode with a clock on the *3D* index. The 3D model of the statue is being reconstructed.

Using standard settings

After reconstruction, you will realize that parts of the torch of the statue are missing. At the same time, the right arm's reconstruction is deficient. Improve the reconstruction result by adjusting the *UZR 3D Professional* settings.

Improved model

Open the *Preferences* dialogue and set the *Voxel Resolution* value to *135* and the *Voxel Smoothing* value to *4*. Close the dialogue with *OK*.

The object reconstruction is restarted automatically. After the calculation of the model, increase the number of polygons from *1000* to *7500*. The deficient parts of the model are now improved.

Rotate the statue in the work view so that you see it from above. You will see that parts of the shoulders and upper arms have not been cut out the voxel. These parts were not cut off because no image was made from this position.

Open the *Preferences* dialogue and set the *Voxel Resolution* value to *250* and *Voxel Smoothing* to *0*. Deactivate the texture reconstruction. Close the dialogue with *OK* and activate the *3D* mode.

As soon as the 3D model is reconstructed, set the polygon count to maximum by dragging the slider to the far right. Now, rotate the statue to view the deficient parts from above.

Deficient Parts of the model

Improved model

Now, generate an artificial onject image. Activate the *Separate* Mode and delete the mask over the deficient parts of the mask using the pen tool.

Rotate the model in the work view so you can see the statue's face. You will find that the texture in this area needs some improvement.

The texture of the statue's face was created from a number of images. In order to improve the results, you have to mask the statue's face in one of the object images using the *Texture on* mask.

Working on the generated object image

If you are satisfied with the *3D* model, set the poygon count back to *7500*. Open the *Preferences* dialogue and set the *Voxel Resolution* and *Voxel Smoothing* values back to *135* and *4*. Activate the texture reconstruction and close the dialogue with *OK*. The improved model is reconstructed and textured.

Faulty Texture

Activate the *Mask* mode. Now, activate the image *image06.jpg*. Use the *Pen* tool to paint the face of the statue. Mask parts that overlap the edges can easily be erased with the fill tool.

Textur on Mode

Undersurface of the model
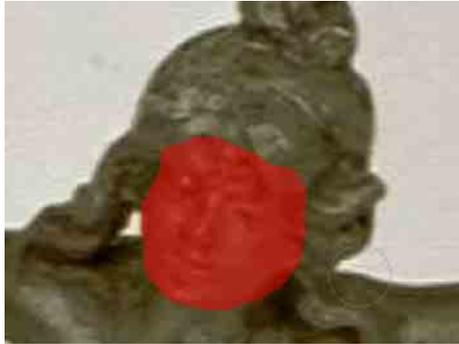
Now, reactivate the *3D* mode. The improved texture is reconstructed and mapped onto the model.


Improved Texture

Parts of the texture that are not visible on any of the images are artificially generated using mathematical interpolation. These parts, depending on the object images, might be deficient.
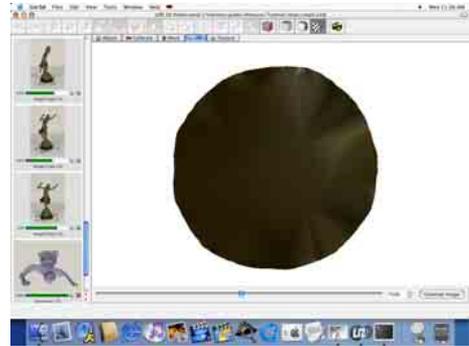
Parts of the texture that are not visible on any of the images are artificially generated using mathematical interpolation. These parts, depending on the object images, might be deficient.
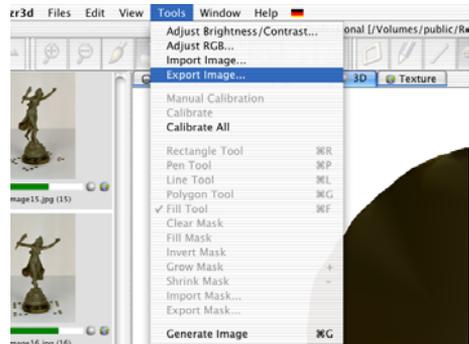

Exporting the generated object image

This artificially generated image will be displayed in the image list. Export this image with the *Export Image* command from the image list context menu and save the image to disk.

Next, open the image with an image editing software (e.g. Adobe Photoshop). Edit the generated image and save it to disk. The example

image *tutorial.tga* was painted black and provided with a writing.
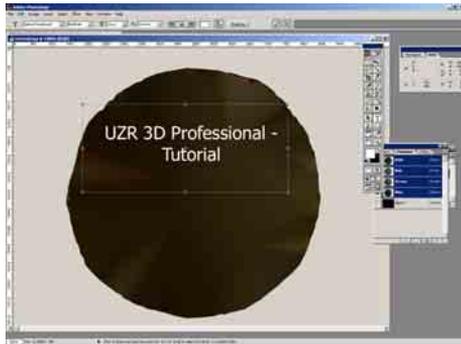
Reworking the generated image

Reimporting the image

Next, open the image with an image editing software (e.g. Adobe Photoshop). Edit the generated image and save it to disk. The example image *tutorial.tga* was painted black and provided with a writing.


Improved texture

You are now finished with the model. It can be exported (*Export* in the *File* menu).

These steps are saved as *step5.u3d* in the *Tutorial/Steps* directory on your hard drive. You will find the exported 3D files in the *Tutorial/Export* directory.

FAQ

When plane parts of the object are reconstructed, the turn out tapered or even round shaped. What can I do to avoid this?

UZR 3D Professional uses the detected calibration point and object separation information to reconstruct the camera positions and the object shape. Thus, the software can only relate to what can be seen in the images. When you check your object images, you will find that there are no images that show the object directly from the side. The object surface can only be reconstructed as seen in the object images. You can improve your result by shooting additional object images that show the object directly from the side. If you want to reconstruct extremely plane objects, *UZR 3D Professional* then might not be able to detect the calibration points of the object pattern.

If that is the case, there are two ways to improve your results: Either you set up the object on the edge to take the object images or you generate artificial object images. In these generated images you have to "cut off" the unnecessary parts of the voxel by reworking the object masks. These parts will be vanishing as soon as the 3D reconstruction is restarted.

How can I reconstruct the object's undersurface?

UZR 3D Professional can only reconstruct what is visible in the object images. If the object is standing on its undersurface, the undersurface's texture naturally cannot be reconstructed. Instead, you should hang the object up free-floating over the object pattern in order to make its undersurface visible.

The reconstructed 3D model is "spotted". What can I do about it?

As the object's shape, its texture is extracted directly from the object images. Thus, the texture quality can only be as high as the object images' quality. A "spotted" texture can have several reasons:

- *The object is faulty illuminated.*

- *The object is faulty separated. Parts of the image background are used for the texture reconstruction.*

- The calibration was not exact enough.

Try this to improve the texture quality:

- *Improve the image calibration.* Raise the *focal length accuracy* value in the *Preferences* dialogue. Raise the *voxel resolution* value as well and recalibrate the object images.

- *Check the object masks* . If required, rework the object masks, especially on the object edges.

- *Only use assorted object images for the texture reconstruction.* If you only acti-

vate images for the texture reconstruction that do not differ in color, the texture will turn out more even colored. Use the checkbox underneath the images in the image list to exclude the nonrequired images from the texture reconstruction process.

- *Adjust brightness and contrast of the object images* Use the featured *Adjust Brightness/Contrast* dialogue to enhance the quality of the object images.

- *Enhance the object image quality with an image editing software.* You can readjust the single object image's color with an image editing software (e.g. Adobe Photoshop). You don't even have to close *UZR 3D Professional* to do so; simply copy the images from the image list and paste them into the image editing software. Here, you can undertake the required adjustments and then copy the images again to paste them into the *UZR 3D Professional* image list.

The 3D is cut off on one side. How come?

This might have happened for three reasons:

- *The object separation is faulty in one or more object images.* Check the object masks and rework them if required.

- *The part of the object is cut off in one or more object images.* Check the object images. If you find one or more images not showing the whole object, simply delete these images from the image list and restart the object reconstruction process.

- *One or more object images were not correctly calibrated.* Check the image calibration. If the calibration failed in one or more images, delete and replace them with equivalent images that can be calibrated. You might also try to adjust contrast and brightness of the object image so the object pattern is easier to identify.

The 3D model's edges are greyishly blurred. Why?

UZR 3D Professional extracts the texture information directly from the object images. Parts of the object texture invisible on the object images (e.g. the objects undersurface) are artificially generated by interpolating between the visible texture edges. Here, blurry edges can be created if the object was not exactly separated on some of the images. Then small visible parts of the object pattern are included in the object mask. These white parts are included in the interpolation process and lead to the model's 'blurriness'.

Adjust the object masks to avoid the blurry edges. Use the zoom function to work precisely. This way, you will not cut of parts of the object.

What do I have to consider, if I want to publish 3D models in the web?

The higher the polygon number of the number, the bigger its UZR file will be. And the bigger a files, the longer it will take to download, and, thus, the longer a user has to sit in front of his browser window twiddling his thumbs. To avoid this, reduce the polygon number as far as possible, if you are optimising a 3D model for the internet.

Thin parts of the object are cut off in the 3D model. Why?

Through the image calibration, *UZR 3D Professional* reconstructs the camera position from the object images. This information then is used together with the object mask information to reconstruct the 3D model. The accuracy of the calibration can be adjusted. The more accurate the calibration, the longer it takes. But if the calibration's accuracy is not sufficient, too much of the voxel might be cut off.

In order to avoid this, open the *Preferences* dialogue in the *Edit* menu and change the *Focal Length Accuracy* value.

If you maximize this value, the 3D model is reconstructed as accurate as possible. Additionally, you should increase the *Voxel resolution* value and decrease the *Voxel Smoothing* value. Then, open the image list context menu and choose *Recalibrate All*. Now all object images are recalibrated, and an improved 3D model will be reconstructed.

The 3D model has holes I can actually look through. What can I do?

The object separation mask is faulty on one or more images.
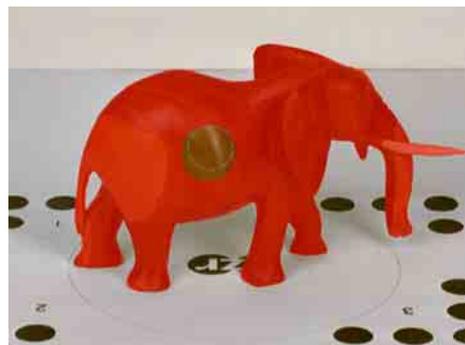
If a part of the object is not masked even in only one image, this part will already be missing in the 3D model.

Check the object masks and correct them. If you change the object mask color, unmasked parts of the object might become easier to be seen.

How can I shorten the image separation process?

If you take care during the object image acquisition process, the image separation process pretty much working automatically. As you can see with the object images provided in the tutorial files on your *UZR 3D Professional* CD ROM, it is in most cases sufficient to simply place a white sheet of paper underneath the object pattern. If you have to separate the object manually from the image background, there are some tricks that will ease this process:

- *Use the fill tool to erase parts of the masks.*

Roughly paint the object mask using the pen tool.

The parts of the mask that overlap on the object edges can easily be erased with the fill tool. Simply adjust the fill tool's tolerance. This way you can easily paint perfect masks.

- *Repaint the objects edges and fill the object.*
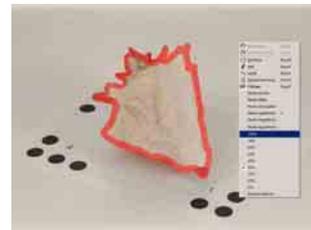
If you repaint the object edges you can easily fill the object and set the fill tool's tolerance to *100%*, it is easy to fill the whole object.
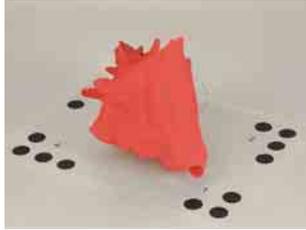
This method is especially recommended for objects with straight edges. Use the line tool or the polygon tool to repaint straight object lines and fill the object.

The 3D reconstruction result is missing a lot of the objects details. What can I do about it?

You will get a more detailed 3D model if you adjust the size of the object pattern to the size of the object you want to reconstruct. The smaller the object pattern compared to the object, the more details will be reconstructed. Make sure though, that the object does not cover any of the object patterns calibration points.

Some of the object images can not be calibrated. Why?

UZR 3D Professional only calibrates object images if two of the four sides (three corner points) of the object pattern are visible. Check the problematic images. If too few calibration points are visible or parts of the pattern are cut off, the image is not useable.

If the object pattern is captured in the object image and the image can not be calibrated because it is too light or too dark, it might help if the image's brightness and contrast is adjusted to emphasize the object pattern. Then recalibrate the object image. After the object image was calibrated correctly, simply undo the image quality changes. This way, the image can still be used for texture reconstruction. The calibration data remains unaffected.

 Caution *This approach is only recommended if the image can not be calibrated only due to the image's quality. If it can not be calibrated because the object pattern does not lay plane, the image quality enhancement might also be suc-*

cessful. But in this case, the camera position is reconstructed imprecisely. This might lead to a deficient 3D model.

Cavities of objects are not reconstructed. Why?

UZR 3D Professional reconstructs the object's shape by combining the object silhouette information with the camera position to "carve" the cubic voxel. Thus, *UZR 3D Professional* cannot recreate cavities unless these cavities go all through the object and form proper holes.

Error Messages

A TrueColor display is recommended to run *UZR 3D Professional* . Do you want to continue?

The ideal color depth (TrueColor) is 24 or 32 Bit (millions of colors). If the color resolution is lower than that (thousands of colors), the color display might be falsified. This only affects the texture display, not the texture data itself.

Your OpenGL implementation supports textures sizes up to x by y pixels. The current texture is a by b pixels so the display quality will be degraded.

The reconstructed texture information is too large for the graphics card memory supported by OpenGl. The texture display is automatically adjusted. The display quality might differ from what would theoretically be possible. The texture is not lost, though. When the 3D model is exported, all texture data is included.

Empty voxel at image x.

The separation information given by the indicated object image does not result in an object with significant volume. A reason for this might be an improper separation mask. Rework the object image's mask and restart the reconstruction process. Another reason might be a wrongly calibrated object. You can check the assignments of the identified object pattern corners in the "Calibration View". Try to recalibrate or to improve the contrast of the object image.

Printing aborted...

The printing of the object pattern has been aborted.

Opening aborted...

The opening of the object images has been aborted.

This system has no OpenGL support. OpenGL is required to run *UZR 3D Professional*. Exiting.

OpenGL is required to display the reconstructed 3D model. If your system does not feature OpenGL support, *UZR 3D Professional* can not run. Try to find out if your system can be upgraded with a new graphics driver that supports OpenGL.

Calibration pattern does not fit onto page. Printing aborted.

The calibration pattern size is too large for the printable area of the selected paper size. Either adjust the pattern size or select a different paper format in the printer setup.

The maximum number of patterns is limited to 64.

If you excel a number of 64 pattern definitions, no new pattern sizes can be defined. Instead, you have to delete or adjust an old one.

The current image (%1, %2) has a different size than the imported image (%3, %4). Importing image aborted.

If you import an image into the image list to replace an image, both images have to have the same resolution. Otherwise the import will fail.

The current image (%1, %2) has a different size than the imported mask (%3, %4). Importing mask aborted.

If you import a mask created with an external image editing software, the mask has to have the same resolution as the image in the image list. Otherwise, the import is aborted.

No valid help file found. Would you like to setup your language settings?

Adjust the language settings in the *Personalize* dialogue to a language in which the online help is available.