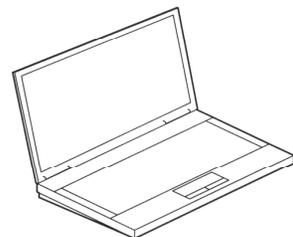
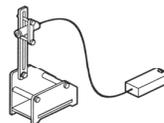
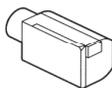


# TriAngles

## 3D SCANNER

3D Builder Version 2.0



**Disclaimer**

**TriAngles 3D Builder Version 2 Release 1 SOFTWARE**  
**TriAngles 3D Circumference Scanner Version 2 Release 1 SOFTWARE**  
**TriAngles Turn Table, Laser Support Stand DESIGN**  
**TriAngles 3D Circumference Scanner; Operations Manual Version 2 PUBLICATION**  
**TriAngles 3D Builder; Operations Manual Version 2 PUBLICATION**  
**Copyright © 2006-2009 intricad**

This software and publication pertains to the workings, manufacturing, assembly and operation of a machine apparatus and the use of a laser. This can be a dangerous undertaking. The use of this software and any information provided is therefore at the users own risk.

In no event shall the author and owner intricad, suppliers nor any related parties that contributed to the creation, marketing and sale of this publication be liable to any party for any direct, indirect, special, punitive or consequential damages (including but not limited to, damages to property, business, person(s), or other pecuniary or loss or claims suits or causes of action involving alleged infringement of copyrights, patents, trademarks, trade secrets, or unfair competition), arising out of the availability, use, reliance on, or inability to use the information contained in this publication.

In addition this applies to any accompanying or further information provided by any means, or any other damage that may result in any way whatsoever, even if this organization or owner shall have been advised of the possibility of such damages, and regardless of the form of action, whether in contract, tort, or otherwise, or for any claim attributed to errors, omissions, or any other inaccuracies in, or destructive properties of any information and/or software/hardware material. The author and owner of this software is under no obligation to provide support, service, corrections, or upgrades to the software programs. This software is supplied "as is" and no warranty of any kind is attributed to it.

It is the responsibility of the reader of this publication and/or user of the included software to determine the integrity and required safety precautions regarding the fabrication techniques, electrical circuits, mechanical construction and software which are described, explained and provided in this Publication and/or software. This project is only for adults with basic understanding of electronics and home machining skills. It is certainly not for children and should be kept out of their reach. If the reader lacks the required skill and/or knowledge to produce and/or operate the apparatus described then he/she should not proceed with this project or should seek professional engineering assistance.

The information and software supplied is for educational purposes and not intended for commercial use. Extensive effort has been undertaken to insure that the information contained in this manual and the supplied software does not breach any currently protected art nor intellectual property. To the best of our knowledge it does not as it is based on technology/art that is now become public domain. However given current practices in industry this cannot be fully ascertained. Use of this software for commercial purposes is at the users own risk.

By proceeding to read or use the information contained in this publication and/or software the user agrees to the above stated.

**TriAngles 3D Circumference Scanner**, Version 2 intricad  
**TriAngles; 3D Scanner and 3D Builder** intricad

**DO NOT LOOK INTO LASER BEAM**

All rights reserved. Information subject to change without notice

### **3 Worlds**

*now exist; the real world as we know it, the world of our imagination and the world that we have created within our computers.*

*While each world offers almost endless possibilities their limitation resides in the ability to efficiently and effectively*  
***interact.***

## Introduction

Drawing a 3D cube in your favorite graphics program is an easy task by today's standard. But try drawing something more intrinsic like a face or a car or some other complicated shape. Chances are that this will be a difficult task to complete. Fortunately there are other ways to accomplish this. Probably one of the most impressive solutions is to use a 3D scanner.

3D scanning offers the means to take a tangible object and convert it into a 3D computer model through some or other technique. The basic idea would be to have an apparatus detect enough points of an object in 3 dimensions and convert this into information that would allow a computer to display the object as a 3D model. Once it's in the computer you can modify it in almost anyway.

However, unlike 2D scanning, entering the third dimension is somewhat of an art. 3D scanning is not a trivial task to perform as many factors contribute to the integrity of the scanning process. It is important to clearly understand how these factors can influence the scan process and how they should be adjusted accordingly in order to permit the best scanning conditions possible. This product provides the platform to get started. Naturally, your most important tools will be your attention and patience.

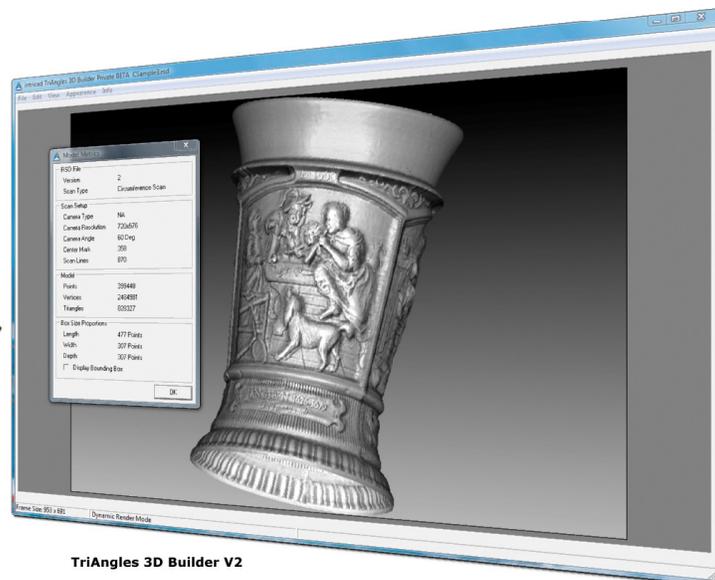
3D scanners are a special collection of range mapping technologies that typically rely on an optical process in order to capture the geometry of an object. The technology developed here includes a non-contact, circumference type 3D scanner. Non-contact meaning that the object is not touched during scanning as the scan technique is based on a visual acquisition process. Circumference means that it scans around an object. Apart from the supplied hardware, the basic setup requires things that most of us already have, such as a video camera, tripod and a computer.

The chosen design concept is based on various criteria. One of which is to bypass the economical constraints and electrical/mechanical complexities usually coupled with an apparatus of this type while providing high quality scanning capability. An added feature is that this scanner not only scans objects but also an object's surface color. The result is a 3D-scanner package that can approach the accuracy of high-end range scanners as well as permit scans to be made with texture in less than 2 minutes! Better yet, it does not cost thousands of Dollars. In fact this is probably one of the best cost to performance scanners on the market today.

intricad

Amsterdam 2009

## Capture the 3rd Dimension



TriAngles 3D Builder V2

## Table of Contents

### Getting started

<b>1. Product Overview</b>	<b>6</b>
<b>2. Process Overview</b>	<b>6</b>
<b>3. Data Processing</b>	<b>7</b>
3.1 Optimizing and Building the Data	<b>8</b>
<b>4. Rendering Preferences</b>	<b>9</b>
<b>5. Product Activation</b>	<b>10</b>
<b>6. Catching Errors</b>	<b>11</b>

### Maximizing the Build Process

<b>7. Build Options</b>	<b>11</b>
7.1 Patching	<b>11</b>
7.2 Smoothing	<b>12</b>
7.3 Mesh Editing	<b>13</b>
<b>8. Appearance Enhancement</b>	<b>14</b>
8.1 Softening	<b>15</b>
8.2 Color Setting	<b>15</b>
8.3 Texture Mapping	<b>16</b>
<b>9. Data Saving and Export</b>	<b>17</b>
9.1 The TriAngles Native File Format	<b>17</b>
9.2 Supported Export Formats	<b>17</b>

### EXTRA

<b>10. Distance Measurement</b>	<b>18</b>
<b>11. Capture</b>	<b>19</b>
<b>12. Post Processing and VRMesh</b>	<b>20</b>
12.1 VRMesh Overview	<b>20</b>
<b>13. Absolute Base Requirements</b>	<b>21</b>
<b>14. TriAngles 3D Scanner Specifications</b>	<b>22</b>

## Getting started

This section provides a quick overview on how to use TriAngles 3D Builder V2 to process the Raw Scan Data file from the 3D Scanner and build the 3D model. This manual will use sample files to support explanations. Once familiarized with the application you will have an enhanced idea on how to best process your scans. **The sample models can be downloaded from the intricad download section of the web site.**

The next section titled “Maximizing the Build Process” provides a more in depth and detail overview of TriAngles 3D Builder.

### 1. Product Overview

TriAngles 3D Builder is an application that was designed to build 3D models of scans using the Raw Scan Data file that was produced with the 3D scanner. The application includes some sophisticated elements to achieve this:

- **Data Repair and Enhancement Functions.** Smoothing, Patching, Softening, Texture Mapping and Editing
- **Graphics.** Hardware Rendered Graphics with adjustable rendering settings for use on a wide range of machines
- **Metrics.** Distance Measurement, Cut Through Viewing and Model Metrics
- **Export.** Export to Popular File Formats such as DXF, STL, VRML\*, OBJ\* and COLLADA\*

\* with texture

The design incentive behind TriAngles 3D Builder is to build, display and export 3D scanned models. 3D Builder is not intended to be a CAD or graphics editing program. There are plenty of very powerful applications on the market which will do an excellent job in the post processing of the exported 3D models. In fact, especially for graphic designers, there is a good chance that most users will want to perform editing in applications they are most familiar with and which include more specific levels of functionality. The various export formats that 3D Builder provides will easily permit 3D models to be imported into almost any 3D CAD or graphics application. Still, 3D Builder includes a very useful set of functions that may already be sufficient to finalize your scans the way you want.

As with TriAngles 3D Scanner, 3D Builder requires a high performance PC to build 3D models. Please consult the [Absolute Base Requirements](#) section for details.

### 2. Process Overview

The rsd file that was produced with the scanner is a basic text file which includes a set of structured, but unassembled, 2D coordinate points of a scanned object. Before building the 3D model based on the raw data we will first need to determine its integrity, make corrections if needed and enhance it before it can be exported. The basic process includes:

#### Data Processing

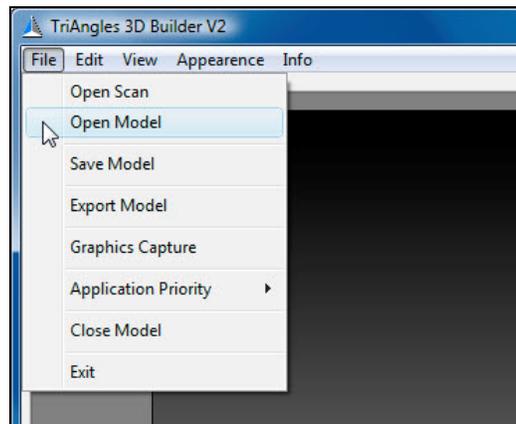
- **Building** Assembling the 2D data points based on camera angle and alignment settings into the 3D model point cloud (automatic).
- **Triangulating** Connects the points to form surfaces (triangles) and permits a smoothing procedure to be implemented on the data (automatic).
- **Editing** Smoothing the data, removing unwanted mesh segments from the model.

#### Appearance Enhancement

- **Softening.** Softens the way light reflects off of the model by manipulation of triangle normals.
- **Colors.** RGBA changes can be made to the model.
- **Texture.** The application, blending and positioning of a circumferential 2D texture onto the model.

### 3. Data Processing

The basic building blocks for all computer generated surfaced 3D models are triangles. The raw scanned data must first go through several processing stages before these can be used to display the 3D scanned model. This is carried out automatically when you open a .rsd file.



To give you a quick preview about what the end result can look like of a finalized model, run TriAngles 3D Builder, click on File in the applications main menu and then click Open Model. Select the sample TXS file called bottle.txs. Depending on your computers performance this may take a moment or two to open. Once the model is opened take a look **around** it using your left mouse button to drag it around. The explanations in this manual will demonstrate how this model was built.

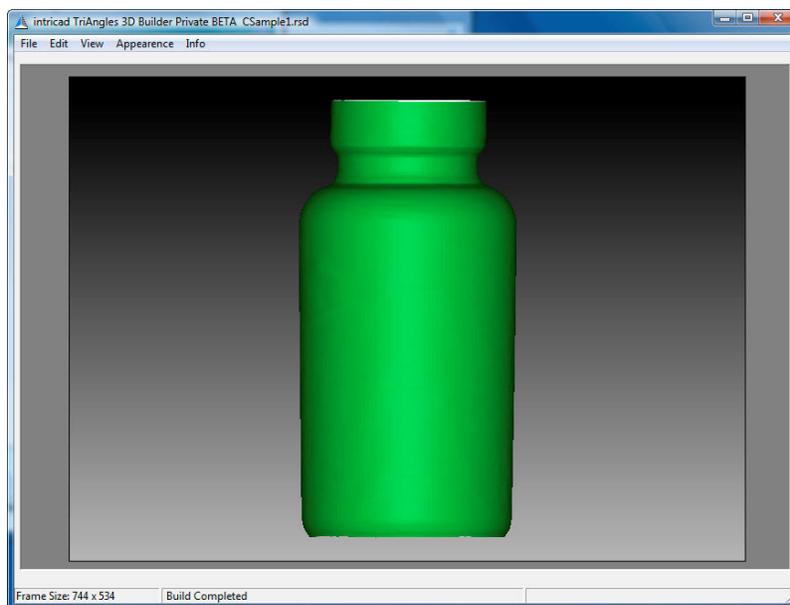


### 3.1 Optimizing and Building the Data

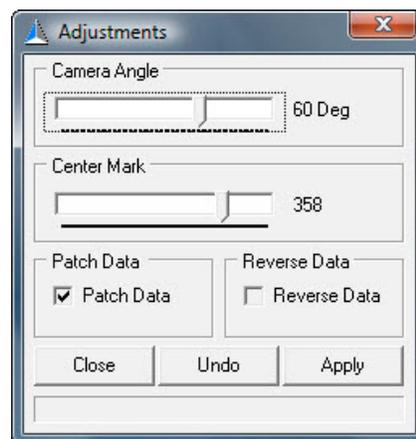
In the past, many optical 3D scanners suffered from spikes in the resulting scan. These were due to outliers or false positives in the scan data. Artifacts such as these corrupted the data and usually required a lot of manual editing to remove them. Unless scanning conditions were incorrect, TriAngles 3D Scanner does a good job in significantly reducing the probability of outliers. In addition to this, it includes sub pixel registration which basically means that it can interpolate points with greater resolution than that of the video camera resolution.

When you open a .rsd file TriAngles automatically optimizes and builds the data into a 3D Model. The optimization process also filters artifacts from the data that may have made their way through the scanning procedure. The building of the model includes calculating the 3D positions of each point and then connecting these to form triangles. Each triangles represents a surface segment of the model.

Run TriAngles 3D Builder and click on File in the applications main menu. Select Open Scan. At the Open Scan dialog choose the file named bottle.rsd. This is a quick, low resolution scan of a bottle. Its probably one of the easiest shapes to scan in with a circumference scanner due to its circular shape.



In the 3D Builder's main menu go to Edit and click on Addjustments. This will bring up the Adjustments dialog which includes the essential build criteria for the model. Here you can change the Camera Angle and Center Mark values that were used during scanning. Including these here may be useful in case these were incorrectly set during scanning or you wish to change the proportions of the 3D model's shape.



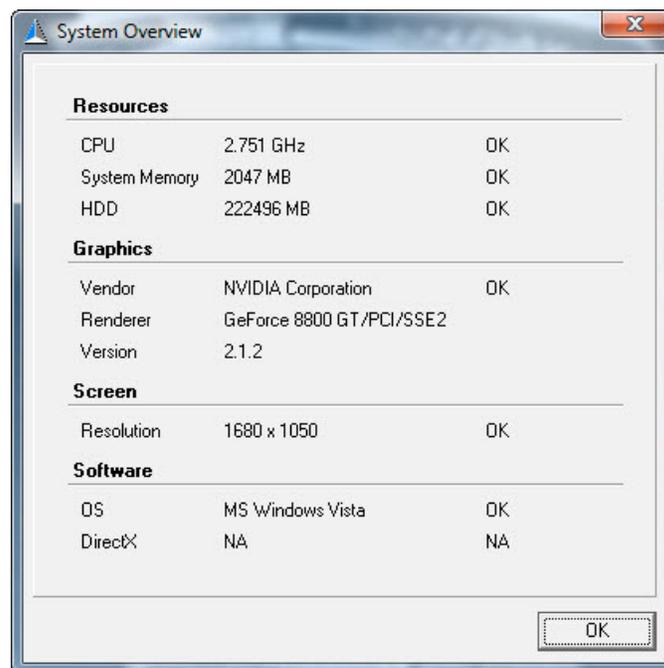
The dialog also contains 2 checkboxes. The first is checked by default and pertains to patching the data. 3D Builder includes the ability to automatically patch all open areas within the data. It does this by approximating what shape the opened area should look like based on the surrounding data. Usually it works out the way you want but in some cases, with very large and or complex areas in the data, it may not result in the desired shape. As an example of what patching does, uncheck the patch data checkbox and press the Apply button. After the model is rebuilt you will notice a few open areas in the model. Press the Undo button to return to the previous state. These opened areas are now auto patched.

The second checkbox in the Adjustments dialog is called Reverse Data. Checking this box will simply reverse the model drawing direction.

In most cases making changes in the Adjustments dialog will not be needed. Should the necessity arise to make changes here then it is best to do this early in the 3D model processing procedure.

## 4. Rendering Preferences

3D scanning and building 3D models involves a lot of processing and uses a substantial amount of memory. High density mesh models can include as many as 750,000 triangles and up, placing a very heavy load on system resources. It not uncommon for model file sizes to expand to more than 150mb when opened or exported. To make sure that your system meets at least the base standards go to Info in 3D Builders main menu and select System Overview.



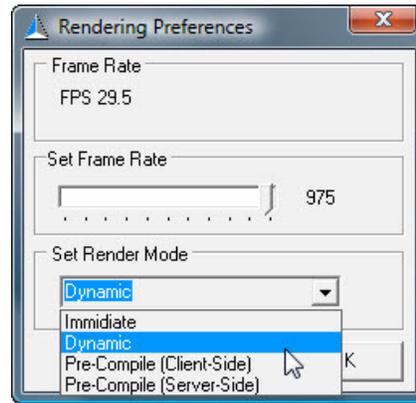
This dialog will display some of the main requirements that your machine must meet in order to process your scans correctly and efficiently.

Go to 3D Builders File in the main menu and select Open Scan. Open the cup.rsd file in the Open Scan dialog. Depending on your system's performance this may take a moment or two to load. Once the model is loaded move it around by holding your left mouse button down and dragging over the model surface with your mouse. You will notice that the model does not directly follow your mouse drag movements. In addition the movement of the model is not smooth.

Gaming type PCs are the obvious choice for 3D scanning, but not everyone has one. Fortunately, TriAngles offers some solution in order to allow it work on a wide range of machines.

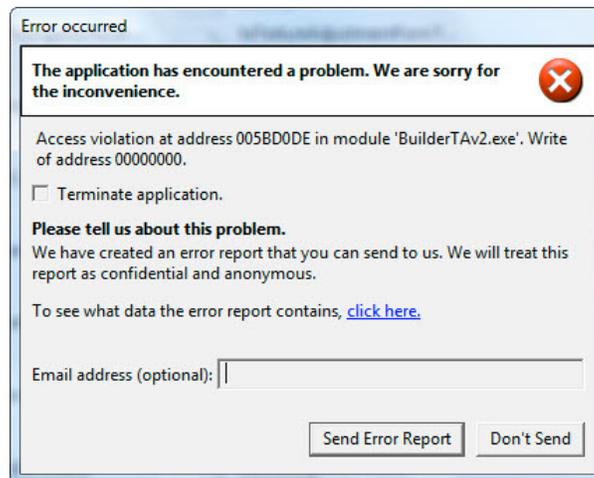
Go to View in 3D Builders main menu and select Rendering Preferences. This dialog allows you to set the desired rendering state for your machine. The drop down box includes 4 different rendering preference states:

1. **Immediate (Safe Mode)** Works on most all systems and uses the least amount of memory but does not take advantage of your systems full potential. Use during model editing sessions.
2. **Dynamic** The best balance between system resources. Requires a good graphics card. Use during model editing sessions.
3. **Pre-compile (Client-Side)** High performance rendering for graphics cards with low memory. Use for viewing models post editing. Typically requires a lot of system memory.
4. **Pre-compile (Server-Side)** Highest rendering performance but requires a graphics card with ample onboard (not shared) memory. Use for viewing models post editing.



For the moment select the Dynamic setting. This may take a moment to initialize after being selected. After this initializes try moving the model again with your mouse in the same fashion as before. The model now moves much more smoothly and easily. Try the other settings as well.

## 5. Catching Errors



Displaying a screen shot of an error or exception dialog in your product manual usually does not make the best impression. Actually, even the best software runs into a problem or two once in a while. And, we have made every attempt to make the best software we can. Most of the time its those little things in the far reaches of its use that can lead to being confronted with an error. In that case we want to know about it. More specifically we want to understand it in order to find solution as soon as possible.

TriAngles includes a special error catching utility that works in the background. Should you be confronted with an error, the dialog will allow you to send us a report about it. In some cases the error may be repetitive. If you have already sent the report or not you can check the Terminate Application checkbox in the dialog in order to attempt to directly close TriAngles.

## 6. Product Activation

TriAngles 3D Scanner is supplied in a demo state when downloaded. You will still be able to make scans and build them. In fact you can even save them in the TriAngles native .txs format or directly export your scan from TriAngles 3D Scanner to the .obj file format. The only limitations are that you can not use the 3D scanner's PC control functions, this includes the USB interface, to allow for high resolution scanning and video processing methods. In addition 3D Builder will not allow you to export your finalized scans.

If you have purchased a license then you can activate your copy for full control by including your license information. To do this go to info in either 3D Scanner or Builder's main menu and select Activate Product. This will bring up the Activation dialog. Include your information exactly as listed in your license.

## Maximizing the Build Process

The previous section provided a quick overview about what's involved in building the raw scan data to produce the 3D model. This section will go more in depth on the use of several functions that were mentioned in the previous explanations as well as many others. These functions modify the data and can enhance the appearance of the 3D Model.

## 7. Build Options

TriAngles 3D Builder includes smoothing, softening and editing options. Getting a better idea on how they do their work will give you a handle on how best to choose settings.

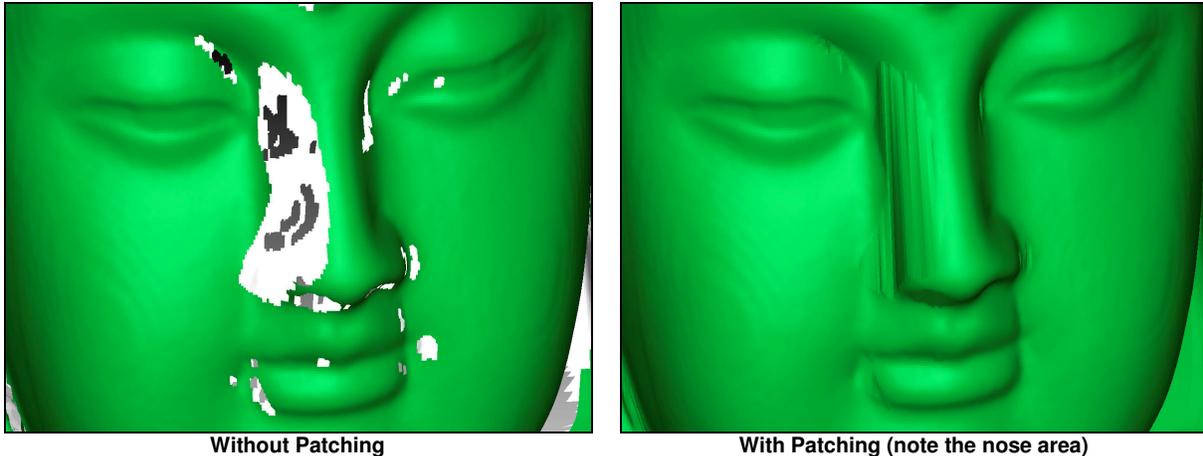
When viewing a raw built 3D model you may notice that the surface can seem pixilated, in particular when a low resolution camera is used for scanning. This pixilated surface is actually the discrete jumps from one pixel to the other on the camcorder CCD array. The pixilated result can be reduced by choosing a higher resolution camera and/or a larger camera angle to improve shape accuracy. Larger camera angles unfortunately also result in more occluded areas or undercut. Typically, occluded areas are unavoidable for certain object geometry. In these cases TriAngles 3D Builder can offer several solutions which will become evident later on in this manual.

### 7.1 Patching

TriAngles 3D Builder includes a quick patching function to fill holes in the data. The incentive is to get most of the data fixed without having to apply a great deal of time and effort to achieve this. The process is automatic. Patching can be selected in the Adjustments dialog under File > Edit.

Holes are usually due to occlusion. These are areas that are not illuminated by the projected scan line during scanning or could not be viewed by the camera during registration and lead to missed data.

The patching algorithm is designed to search only for closed holes in the data. When a hole is found it interpolates the best fit positions and inserts the necessary points. Usually this leads to the correct result but in some cases, with complex profiles, the positions may not entirely match with the real object.



The illustrations demonstrate the effectiveness of the auto patching function on the data. Most all holes have been correctly patched. The area around the nose however is complex and the patching has not been able to recover all the data in the correct shape (exaggerated example). Fortunately the subsequent smoothing functions will offer some solution to this.

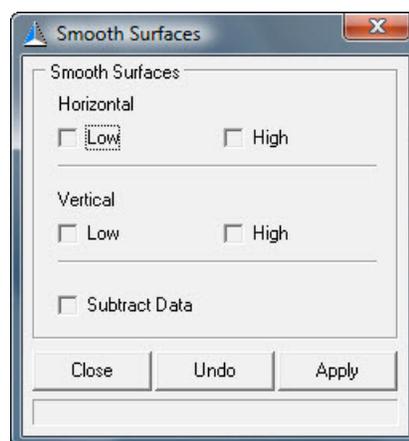
It should also be mentioned that this model was scanned using version 1 of TriAngles. TriAngles 3D Scanner V2 includes new functions (Video Folding and Dual Camera) and layout that actually prevent most of this type of occlusion from occurring.

The patching algorithm will only patch closed areas (holes). Also, areas not visible by the camera during scanning, which reside around the top and bottom sections or polar regions of the model are also not patched. The reason is that automatic patching of these areas would frequently lead to wrong geometry.

## 7.2 Smoothing

Smoothing operations are probably the most important functions for most all 3D scanners. They offer the ability to correct the curvature of the scan lines to best approximate the actual shape of the scanned model. It's analogous to sanding a rough surface into a smooth or even polished one.

Open the bottle.rsd file that was opened in the preceding sections. In 3D Builder's main menu go to Edit and select Smooth Surfaces. This will bring up the Smooth Surfaces Dialog.



TriAngles 3D Builder allows you to:

- Set the level of smoothing
- Choose the directions of smoothing
- Best preserve the actual shape of the object under high levels of smoothing (Subtract Data).

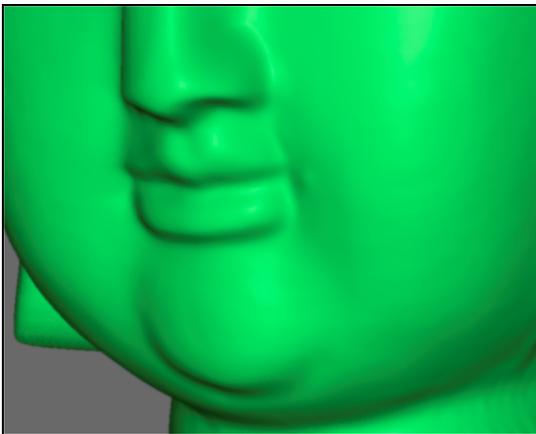
The levels of smoothing can be either Low, High or both. “Low” levels concentrate on smoothing the small imperfections in the models surface while “High” smoothing levels work on a wider range of points. Smoothing operations can be repeated more than once.

Selecting the smoothing direction pertains to smoothing either along the scan lines (vertical) or around the scan lines (horizontal). This can be useful as the axial and radial resolutions of a circumference scanner usually differ. In most cases, depending on the amount of scan lines, the amount of smoothing required around the model will be less than for the vertical.

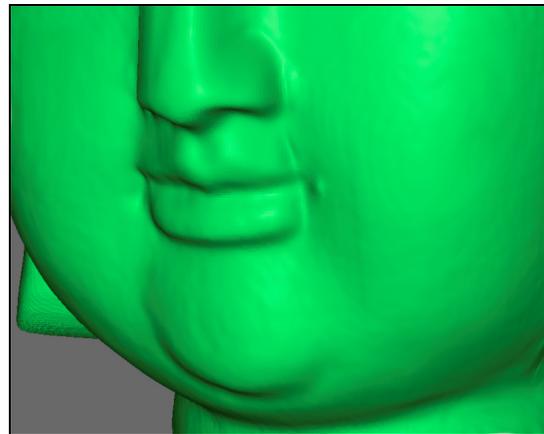
As an example; to implement the smoothing, check the all the check boxes except the Subtract Data check box and then press the Apply button. Noticed that the surface of the model becomes smoother. Press the Apply button again to repeat the smoothing.

Smoothing operations generally suffer from one deficiency; smoothing not only reduces the roughness of the scan line is but also the actual shape and detail. More specifically, sharp edges become blunt and rounded. TriAngles offers a way to retain these sharp edges even after high levels of smoothing.

The Smooth Surfaces dialog includes a check box called “Subtract Data”. Checking this and then pressing the Apply button will allow you to retain some of the sharpness and detail of the smoothed model. In other words, a model can contain a highly smoothed surface while still retaining much of its shape and detail accuracy.



No Data Subtraction Applied

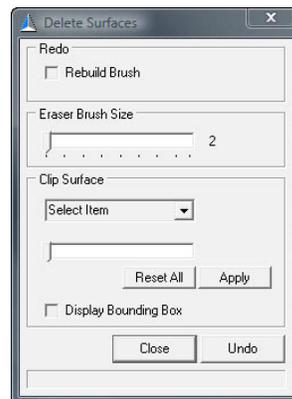


Data Subtraction Applied

### 7.3 Mesh Editing

Although 3D Builder is not a 3D graphics or CAD editor it does include some basic editing capability. While most high end 3D graphic applications will offer much more editing functionality and capability, 3D Builder allows some quick and fairly easy editing to be performed. More importantly, 3D Builder was specifically made for high density mesh editing. For instance, TriAngles includes a feature that very few graphics program have. This is the ability to isolate the surface of the model that is to be edited. This is can be very useful when editing very high density mesh models.

With the bottle.rsd file still open go to Edit and select Delete Surfaces. This will display the Delete Surfaces dialog.



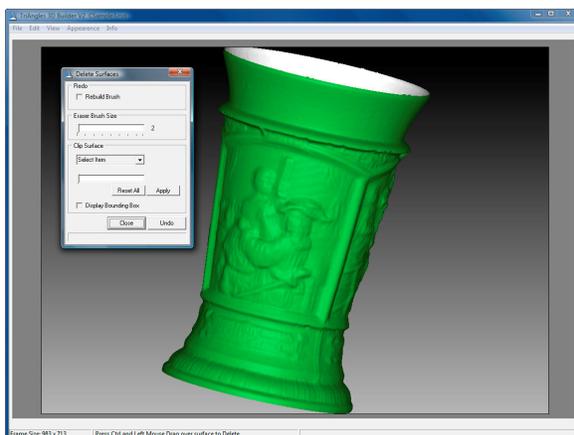
Click on the model's surface and zoom in a bit using the scroll wheel on your mouse. In case you do not have a mouse with a scroll wheel then you can also zoom by holding down the Shift key and then holding down the right mouse button. Drag over the model to zoom.

To delete sections of the model surface hold down the Ctrl key and drag the mouse with your left mouse button over the surface of the model. The deleted sections can be restored by pressing the Undo button. You can also rebuild any deleted section of the model by checking the Rebuild Brush check box. Just like deleting surfaces, press the Ctrl key while dragging with the left mouse button over surfaces that you want to rebuild. Uncheck the Rebuild check box.

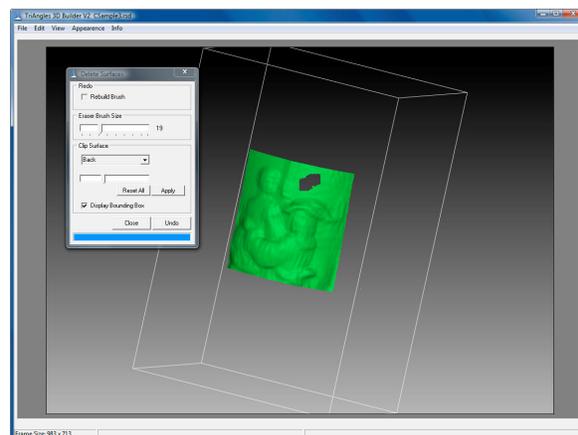
You can also select a larger brush size using the Eraser Brush slider. Make sure that the brush size is not too large in relation to the view of the model. Under these conditions the surfaces may not delete correctly.

If all went well then you will have noticed that the surface removal process was pretty easy to perform. But lets try deleting sections of a much larger and more complicated model. Open the cup.rsd file and delete some section on it. You will notice that this went much more slowly or not at all. Even on high end PC's the process is difficult and your CPU moves into overtime.

Fortunately, TriAngles allows you isolate or clip the model around an area of interest. Surface removal can then proceed much more easily. The reason is that your PC no longer has to draw the entire model, just the portion that you want. This significantly reduces system load. To clip the surface select which sections(s) you wish to clip and then press the Apply button.



Not Clipped (CPU intensive)



Clipped (lower CPU load)

Another area that may require editing is around the center of rotation area of the scanned object. You may have noticed that the scanned Buddha model presented in this manual shows a small twist at the top. This twisting of the 3D mesh is located around the center of rotation of the Turn Table. Exact alignment of the laser, reducing disc wobble as well as choosing the exact center of rotation of the Turn Table where the object is scanned on is almost not possible. The result is that here the coordinates twist around this area. One way to reduce this twisting is to choose a different Center Marker position and, to a limited degree, tweaking the Camera Angle.

## 8. Appearance Enhancement

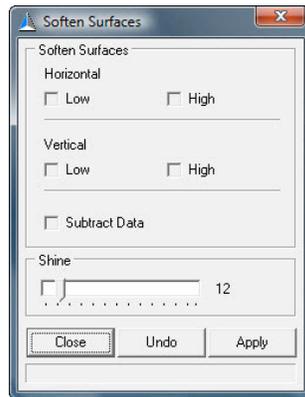
The previous chapters dealt with the building and the modification of the scanned data. The objective was to produce an accurate 3D model of the scanned object. However in many cases the way the model appears is equally if not more important than accuracy. Otherwise stated, how accurate the model *appears* is most significant.

TriAngles 3D Builder includes several ways to enhance the appearance of the 3D model. When applied correctly, these enhancements can produce an almost magically realistic view of the 3D model.

## 8.1 Softening

Softening is a function which modifies the way the 3D model surface reflects light by manipulating triangle normals. It distributes the light more evenly over the surface of the model creating, hence, a softened appearance. It can lead to producing a more realistic impression when combined with texture mapping (discussed later in this manual).

Go to File in the main menu and choose Open Scan. Open the bottle.rsd sample. Allow the model to load and then click on Appearance in the main menu and choose Soften. This will bring up the Soften Surfaces Dialog which resembles the Smooth Surfaces dialog in many ways that was mentioned earlier in this manual.

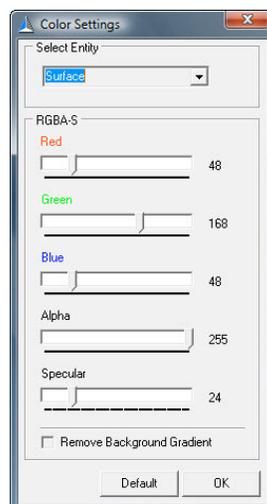


Apart from the checkbox the Soften Surfaces dialog contains a slider that can change the shine of the model. Used in conjunction with the Gloss function the model can be made to look mat, metallic or glossy. Check all the boxes except the Subtract Data checkbox and press the Apply button. You will notice how the model surface appearance becomes more mat and evenly lighted. Adjust the shine and select Gloss to get an idea of what the effect is on the model.

## 8.2 Color Setting

Probably the most basic way to effect the appearance of the model is through the use of coloring. TriAngles allows you to change the model color using RGBA and Shine settings which equals out to more than 16 million different possible color settings and 128 levels of shine. The model can be made to look like gold, silver, bronze and most any other color you can think of. In combination with a blended texture map, coloring and shine adjustment can significantly enhance the way the model looks.

To change the colors of the model click on Appearance in the main menu and choose Color. In the Color dialog select the entity you want to change the color of in the Select Entity drop down box and use the Red, Green, Blue and Specular sliders to change color settings.



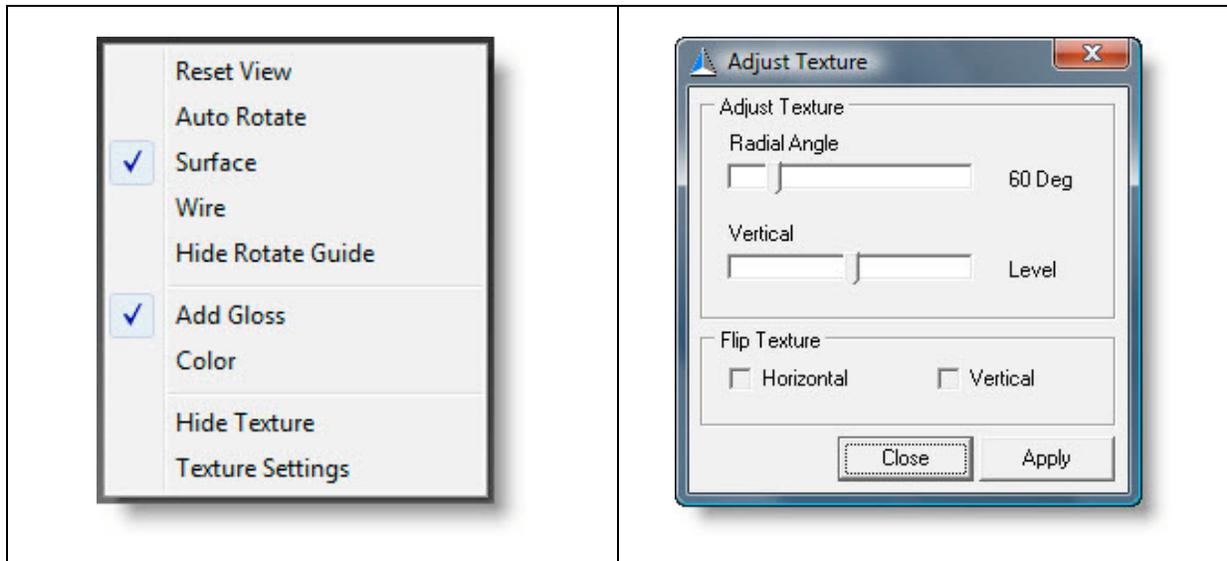
### 8.3 Texture Mapping

Texture mapping is probably the most powerful and effective way to add realism to a 3D model. In addition, the technique can offer important solutions such as significantly reducing model file sizes while retaining most of the appearance quality and surface detail.

Texture maps created with TriAngles are 2D circumferential bitmaps. Since it's a bitmap you can use most any photo editor to enhance or make changes the bitmap. This can then be loaded into TriAngles and applied to you models.

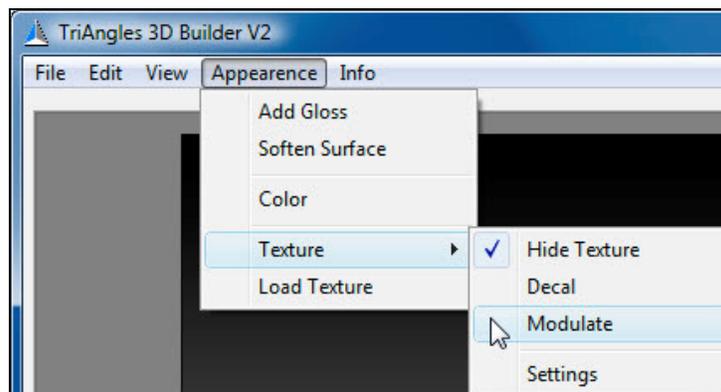
Open the bottle\_rsd scan. Apply some smoothing and softening operations to the model. In the main menu click Appearance and select Load Texture. Choose the bmp file called bottle.bmp.

The texture is now on the model. Its position will usually require adjustment. Right click on the model to bring up a popup menu and select Texture Settings. Alternatively, you can also go to Appearance and select Texture Settings.



In the Adjust Texture Dialog adjust the Vertical Level slider to a value of about 16 and Press the Apply button. The texture will move to a new position.

The texture is like a decal that is pasted over the models surface. However you can also choose to blend the texture with the material colors of the model. This can produce the highest level of realism since the texture and material surface of the model are blended together as one. Go to Appearance in the main menu, select Texture and then select Modulate.



You will notice that the you can see the texture but also the material surface of the model and its color. The colors may be incorrect. Open the Colors dialog by going to Appearance and selecting Color. From the drop down box in the Color dialog select Surface and set the Red, Green and Blue sliders to about 200. This will change the color of the model to a very light gray. Move the model around to view how the light now reflects off of the model.



Colored Surface

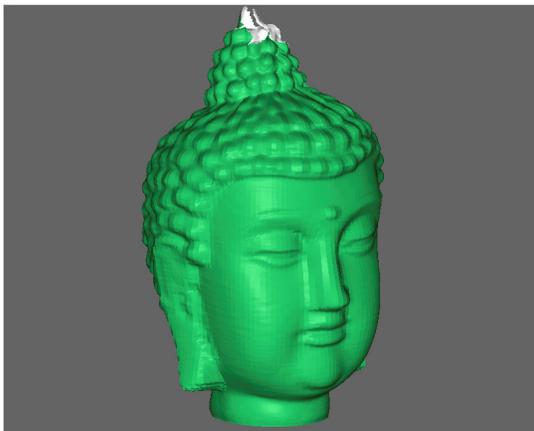


Modulated Texture and Shine



Modulated Texture and different Color

As mentioned, texture mapping can permit low resolution 3D models to retain their appearance quality. The result is reduced file sizes that still look almost perfect when a texture is mapped over.



Very Low Resolution



Very Low Resolution (with texture)

Despite the low resolution model in the above illustration the textured surface *appears* to preserve most all of its detail.

## 9. Data Saving and Export

Unlike 2D pictures, 3D models produce very large file sizes. 70-150 MB file sizes and even larger are not uncommon. In addition, opening and saving these large files typically requires a lot of processing time.

### 9.1 The TriAngles Native File Format

3D Builder includes a native file (.txs) format which includes the 3D model data as well as the texture map, color settings and other appearance data in a single file. The file format not only employs non-loss compression but also structures the data to allow for even lower file size and relatively quick opening and saving. For instance, a 70MB 3D model can be reduced to file size of about 3MB. Those familiar with 3D mesh modeling will really appreciate the many benefits of this file format.

### 9.2 Supported Export Formats

3D Builder includes several export formats to choose from. There are 9 in total. Click on [File](#) in the main menu and choose [Export](#).

Here is a short list of some of the more popular supported export file formats with a brief description:

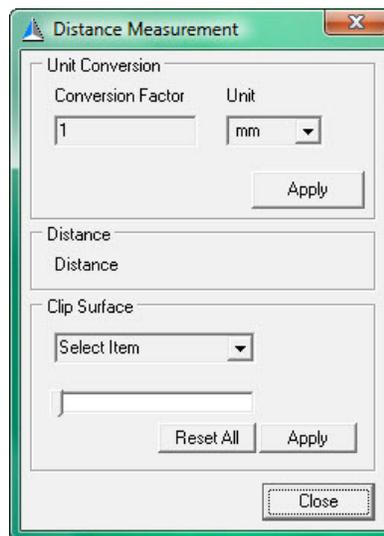
- **XYZ** This file format contains a point cloud of all of the scanned points. The file structure includes the xyz coordinates of a point per line. Many 3D applications can open this type of file although file structure may differ as well as the extension.
- **RAW** This file format is similar to the .xyz format but instead of points it contains the coordinates of the triangles that make up the 3D model mesh.
- **STL** This is the most popular format for rapid prototyping use. It is very widely accepted and supported. The file structure includes the triangles of the mesh as well as the normals for each triangle. The file also contains labels for each triangle vertex and triangle normal. This leads to larger file sizes than the raw type and prolonged opening and saving.
- **DXF** This is the industry standard when it comes to 2D and 3D technical drawings. Most every 2D and 3D application supports it.
- **VRML** The extension for this file format is .wrl. This file format showed great promise during the late 90's but it receded in popularity later. Today it is still supported by many graphics programs and it appears to be making a comeback with a revised format called X3D. The VRML format is highly versatile as it can contain multiple objects, texture coordinates, material properties (colors, lighting) as well as viewing and animation properties. The texture map is linked as separate file.
- **OBJ** For 3D graphics this file format is one of the most widely supported. It also saves texture coordinates and material properties (colors, lighting). The texture map is linked as separate file.

## EXTRA

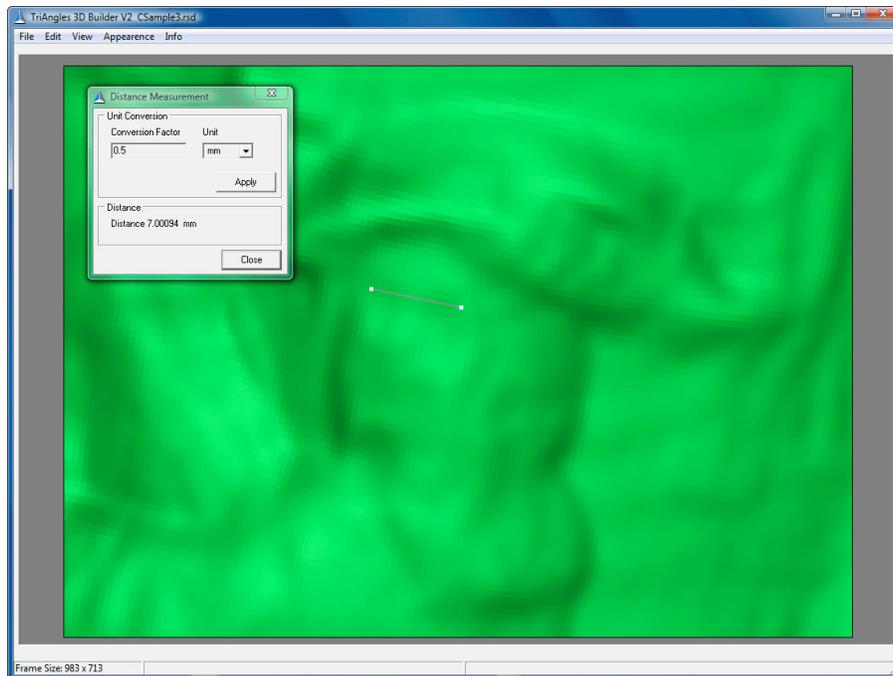
### 10. Distance Measurement

The distance measurement function in 3D Builder allows a quick and easy way to get an idea about the size of any part of the models geometry. More specifically, distance measurement allows you to determine the distance between any two points that you select on your model. As with the Delete Surfaces dialog it allows you to clip the surface in order to minimize CPU load for high density models.

Open the bottle.rsd sample file. To use the distance measurement go to View and select Distance. This will bring up the Distance Measurement dialog.

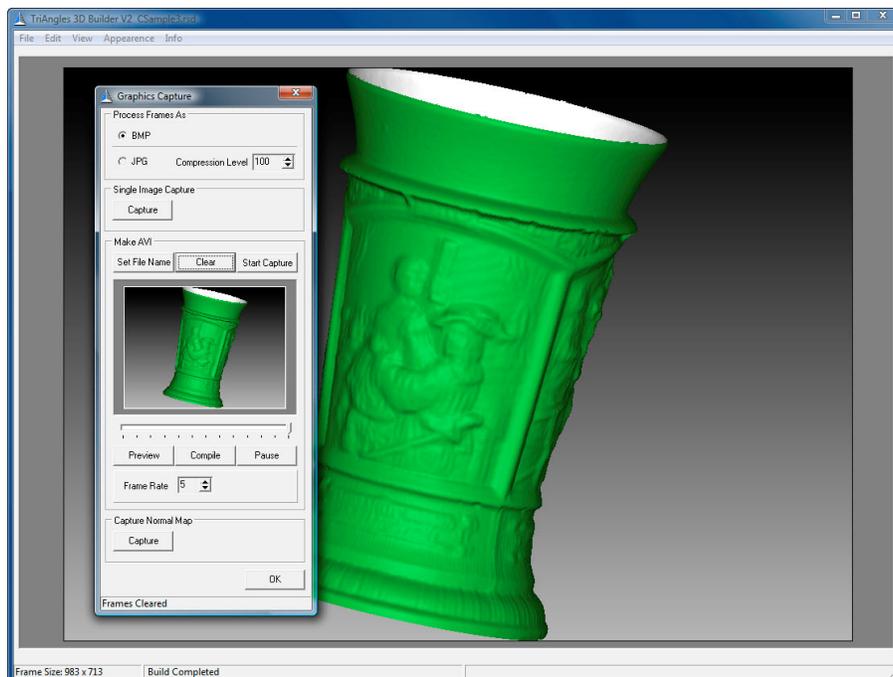


Left click on you model to select it and then press the Ctrl key. While holding the key left click on your model at a desired start point. Drag the mouse while holding down the Ctrl and left mouse button pressed to a desired end point. The distance will appear in the dialog's Distance group box. You can set a conversion factor and select a unit as well. This means that you will be able to directly measure the actual distance. For high density mesh models use the Clip surface function to isolate the model around the area to measure. This can significantly reduce your CPU load.



## 11. Capture

3D Builder includes a image capture dialog that will allow you to capture the screen image of a model. It also includes the ability to capture a normal map as well as produce simple animations of your model which can be saved as an AVI file. The AVI can be transcoded to WMV using TriAngles 3D Scanner and the video codecs on your machine.



After opening a model go to File and select Image Capture. To capture an image of the model in its present position simply press the Capture button in the Single Image Capture group box.

To make a simple animation press the Set File Name button to name the video file and its desired location. Press the Start button to start capturing. The Start button's name will change to Stop. Move the model to desired positions and then press the Stop button. Press preview to view the capture. This may take a moment to load. You can compile the capture to an AVI by pressing the Compile button.

TriAngles also allows you to save the normal map of the currently loaded model. Press the Capture button.



Normal Map

## 12. Post Processing and VRMesh

While the TriAngles 3D Circumference Scanner captures most of an object in one go, post processing is usually a necessity. This is true for most all 3D scanners available today. In many cases the included patching, smoothing and texturing features of 3D Builder will be sufficient to finalize the model the way you want. Yet for more demanding and specific applications it may be required to import the model into a preferred graphics program and take the 3D data to the next level.

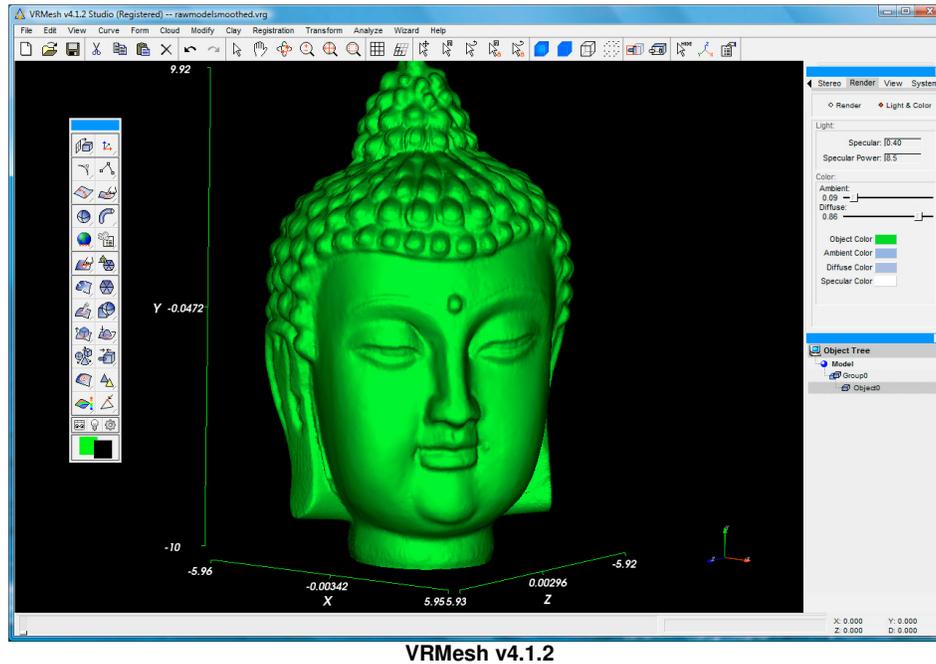
The wide range of export formats supported by 3D Builder provides you with an arsenal of graphic programs to choose from. VirtualGrid's VRMesh Studio is one such application and its functionality is in direct alignment with TriAngles. It creates a complete package, in particular, when it comes to efficiently and effectively handling very dense mesh data. If you have purchased the TriAngles/VRMesh bundle then you now have one the most cost effective 3D scan packages on the market today. No other package offers this level of performance and functionality at this price.

### 12.1 VRMesh Overview

The VRMesh manuals will best guide you through the process of finalizing your 3D scan data. Still, a very brief overview about common practices is provided here.

The most frequent aspects of 3D scan post processing deal with areas of a scan that have been occluded or left open due to shadows or reside around the polar region of the model. These need to be Patched and Sculpted into the correct shape.

Another common area of post processing is Decimation of the data. This is a very powerful feature. The data from 3D Scanner is based on scan lines; it's usually very dense and highly structured, in particular around areas that reside more close to the rotation center of the scan. For capturing fine detail this is a necessity but for more consistent low detailed areas it is unnecessary. 3D Builder allows you to export in the XYZ format, which is simply the point cloud data. This data can then be imported into VRMesh. VRMesh can then apply its decimation function to reduce the number of triangles of the 3D data and form a good approximation of the original geometry. The merit here is that you can significantly reduce file size while retaining much of the objects detail. It also means that you can more easily sculpt the data.



VRMesh v4.1.2

The above screen shot displays the modifications made to a scanned model. The data was decimated and the side of the nose (occluded area) and polar region were sculpted into shape. Local smoothing and sharpening was also applied. The modifications were made in about 5 minutes (including the CPU time for processing). Further processing could be performed but at this state the model is already water tight and could, for instance, be exported to the STL format for rapid prototyping a tangible version of the model.

### 13. Absolute Base Requirements

As mentioned throughout the manual, 3D scanning, as well as the post processing of the acquired data, sets a heavy load on a computers CPU, GPU and memory. Certain processes are also time dependant and can even fail unless the employed PC offers the required performance. The following chart includes the absolute base requirements needed to run and use TriAngles.

PC		
Unit	Absolute Minimum	Advised
CPU	1 GHz	3 GHz
System Memory	1024 MB	4 GB
Hard Drive	35 GB (high speed)	160 GB (7200 RPM), SATA 2
Free Drive Space	3 GB	25 GB
Graphics Card	64 MB (not Shared), OpenGL Compliant	256 MB (not Shared), OpenGL Compliant
Operating System	Windows 2000, XP, Vista	Same
Video Interface	USB, FireWire, Composite In	Same
Pointing Device	3-button, scroll-wheel mouse	Same
Other	DirectX 8 and Above	Same

Camcorder		
Unit	Absolute Minimum	Advised
Focus	Auto/Manual	Auto/Manual
Iris	Auto	Auto/Manual
Picture Stabilization	-	Yes
Digital	Analog/Digital	Digital
Tape/HDD/DVD	Tape/Hard drive	Tape
Remote	-	Yes
FireWire	USB, FireWire, Composite Out	FireWire

Note: HD 1080i type camcorder resolutions have not been tested. However provided that the required codec's are available on the PC that is processing the video then this should permit the use of Tri Angles. High end PC will be required as the processing load will be 4 times greater than using standard video.

## 14. TriAngles 3D Scanner Specifications

<b>Scan Type</b>	3D Non-Contact Circumference Scanner
<b>Scan Technique</b>	Point Triangulation
<b>Scan Method</b>	Deformation of projected pattern (stripe) over the 3D object/scene (laser, projection) to indicate depth points
<b>Scan Sensor</b>	CCD type visual array, video camera (recommended)
<b>Scan Range</b>	Depends on scan set up and optics
<b>Scanning Speed</b>	Typically less than 60 seconds at full video resolution per rotation pass
<b>Scanner Accuracy</b>	Factor 100-200 times less than height of object
<b>Scanable Materials</b>	Most opaque surfaces. (Mat white surfaces are best)
<b>Texture Scanning</b>	Yes
<b>Hardware Footprint</b>	Desk top
<b>PC-less scanning</b>	Yes
<b>Hardware control</b>	Manual (Motorized turn table)
<b>Software Features</b>	Auto interface to CCD video (Composite, USB, FireWire), DirectX video capture/preview/processing, Pre scan filters and process control, device interface control, post process transformations (patching, smoothing etc.), hardware rendered graphics, export to popular formats: STL,DXF,RAW,XYZ,VRML,OBJ and a compressed native format TXS

**Scan Your Imagination**