

FastSCAN II

**Hand held Laser Scanner v1.1
User Manual**

Copyright © 1995–2015 by ARANZ Medical Limited

110 Papanui Road
Christchurch 8014
New Zealand

PO Box 3894
Christchurch 8140
New Zealand

www.aranzmedical.com

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means—mechanical, photocopying, recording or otherwise—without the prior written permission of ARANZ Medical Limited. No patent liability is assumed with respect to the use of the information contained herein. While every precaution has been taken in the preparation of this manual, ARANZ Medical Limited assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from use of the information contained herein.

Document Number: 2015-00468-Rev2

Build Number: 80

Before You Begin...



Please read and fully understand the [Safety Guidelines](#) before using the FastSCAN II Scanning equipment. This section contains important safety information.

Table of Contents

Before You Begin...	iii
FastSCAN II	1
Introduction	1
Hardware and Software Setup	1
Components	1
Computer Requirements	4
Installing the Software	4
End User License Agreement	4
Licenses	5
Connecting It All Together	5
Important Connection Note	6
Installing the drivers	6
Running FastSCAN II	7
Scanning	8
The Scanning Environment	8
The Wand	8
Wand Indicators	9
Wand Controls	9
Changing Modes	10
Wand Sensitivity	10
Scanning with the Wand	10
Scanning Technique	10
Scanning Resolution - Limits Control	11
Profile Smoothing	12
Undoing Scans	13
Viewing Options	13
Data View/On Screen Format	13
Other Viewing Variables	15
Processing Scanned Data	15
Surfacing Options	15
Sweeps Surface	16
Basic Surface	16
Radial Basis Function (RBF) Surface	16
Export Format	17
Scan Files	17
Opening and Saving Scans	17
Editing Raw Data	17
The Sweeps	18
The Sweeps List	18
Selecting and Deleting Data	19
Undo/Redo Sweeps	20

Generating a Basic Surface	20
Basic Surface	20
Basic Surface Parameters	20
Smoothing	21
Decimation:	22
Limit Objects to:	23
Surface Simplification:	23
Apply Basic Surface:	23
Registering the Sweeps	23
Surface Information	24
Batch Processing	25
Generating an RBF Surface	26
Exporting a Surface	26
Export Options	26
File Types for Export	27
Export Formats	27
Delta	28
Save Snapshot	29
Hotkeys & Optional Features	30
Optional Features	31
Refraction Correction	31
Cast Inversion Mode	32
Export as AAOP/OP3 object	32
Sweep Auto Crop	32
FastRBF Extensions	33
Licensing	34
FastRBF Extensions	34
Overview	34
Data Flow	35
Generating A Basic Surface	36
Smoothing	36
Decimation	36
Limit Objects to	36
Surface Simplification	36
RBF Surface Processing	36
Fit Accuracy	36
Mesh Resolution	37
Memory to Use	37
Use Stylus Points for Fitting	37
RBF Surface Edge Behavior	38
Trimmed to Data	38
Trimmed to Edges	38
Open at Bounding Box	38
Closed at Bounding Box	39
Margin Size	39
RBF Surface Simplification	40
Simplification Target	40
Error	40
Number of Triangles	41
Number of Points	41
FastSCAN II Stylus	42
Optical Stylus	42
Optical Stylus Setup	42

Mark with Mouse	42
Activating Mark-With-Mouse Mode	42
Placing Points and Lines with the Stylus	43
Placing points	43
Point options	43
Placing lines	44
Line options	44
Removing Points & Lines	45
Viewing Options	45
Moving Points and Lines	46
Stylus Mark Bumps (and Dips)	48
The Stylus menu	49
Exporting	49
Export Stylus Points Dialog Box	49
Coordinate System	50
Data Type	50
Format	50
CSV Export Format	51
ASCII Export Format	51
Mark with Mouse	53
Activating Mark with Mouse Mode	53
Applying Marker Points and Lines	53
Placing points	53
Point options	54
Placing lines	54
Line options	55
Viewing Options	56
Moving Points and Lines	56
Stylus Mark Bumps (and Dips)	57
The Stylus menu	58
Export Options	59
Clipping	60
Clipping	60
Clipping (Automatic Baseline)	60
Clipping (Nominated Baseline Sweep)	63
Clip Tolerance	64
Clip Method: Point separation	65
Clip Method: Baseline Point separation	66
AAOP Export Wizard	67
The Structure of the AAOP file	68
Generating the AAOP File	69
Using the AAOP Export Wizard	69
Select Object Type	69
Distal & Proximal closure Object Types	70
Choose Axis	70
Choosing Vertical Limits and Spacing	71
Symmetrical build Object Types	73
Define Reflection Plane	74
Choose Axis on Reflection Plane	75
Divergent axes Object Types	77
Orientate The Object	77
Choose Slice Axes	78
Saving the AAOP/OP3 file	79

Cast Inversion	81
Overview	82
The Process	82
Preparation For Scanning	82
Scanning	84
Digitizing the Scanned Reference Marks	86
Applying Cast Inversion	86
The Final Surface	89
Getting Help	90
Refraction Correction	91
The Process	91
Scanning Setup	91
Scanning	92
Object Positioning	93
Processing	93
Appendices	97
Appendix A: Troubleshooting/ FAQs	97
Appendix B: Safety Guidelines	98
FCC Statement	98
CE Mark	98
WEEE Mark	98
Laser Warning	98
Electrostatic Discharge	99
Warning Labels and Locations	99
Appendix C: Distributors	100
Appendix D: Customer Service	102
Appendix E: Conditions of Transfer and End-User License Agreement for FastSCAN II	
Product Suite	102
Part 1: General Terms	103
Part 2: Terms of Use	104
Section 1 - Hardware Warranty	104
Section 2 - Software – Warranty Disclaimer	105
Section 3 - Driver Software	105
Section 4 - Software – Technical Support Policies	106

FastSCAN II

Introduction

Thank you for purchasing a FastSCAN II™ 3D laser scanner. Your scanner will quickly and conveniently digitize the surface of an object into a series of points that fit together in 3D space. The FastSCAN II software then transforms this data into a detailed 3D object, in a file format that suits your needs.

The FastSCAN II software combines overlapping sweeps and eliminates redundant data to create a complete surface. This can then be further processed using a mathematical algorithm called an RBF (Radial Basis Function) to create a smooth watertight surface in the form of your scanned object. The resulting 3D object can be exported in a range of industry standard formats for use in other applications.

Please ensure you have read the [Safety Guidelines](#) before using this product.

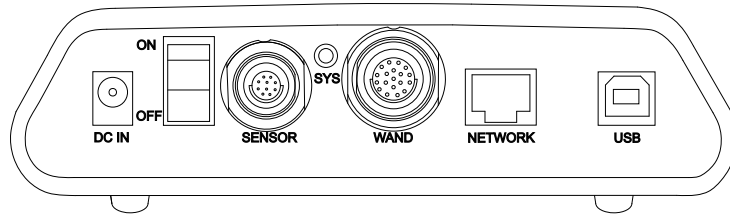


Hardware and Software Setup

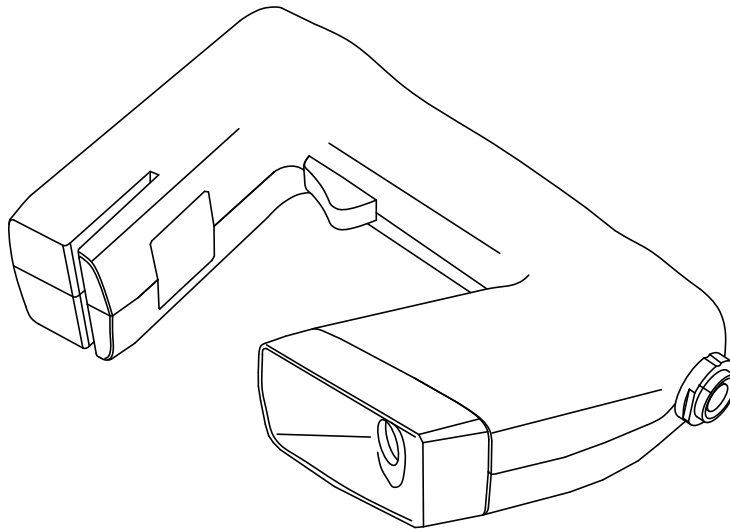
Components

You should have received the following components with your FastSCAN II package:

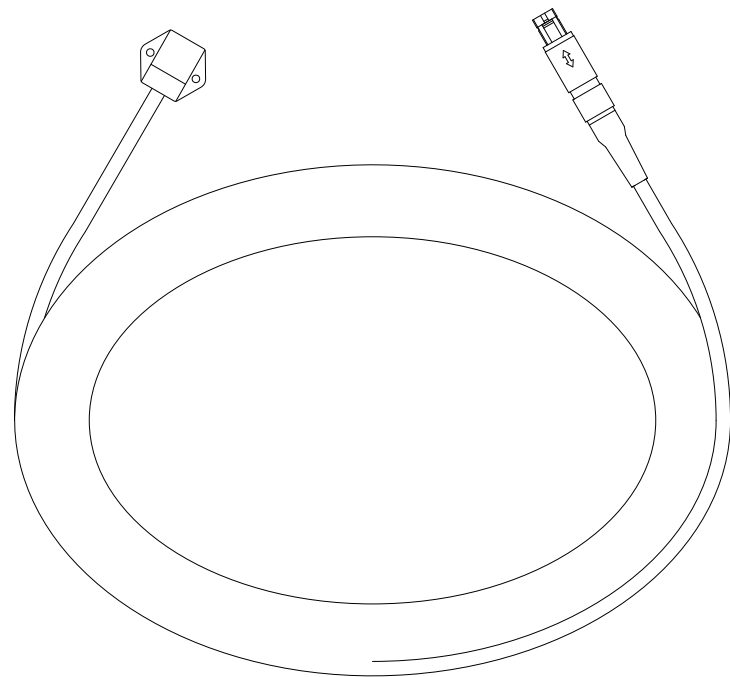
System Electronics Unit (SEU)



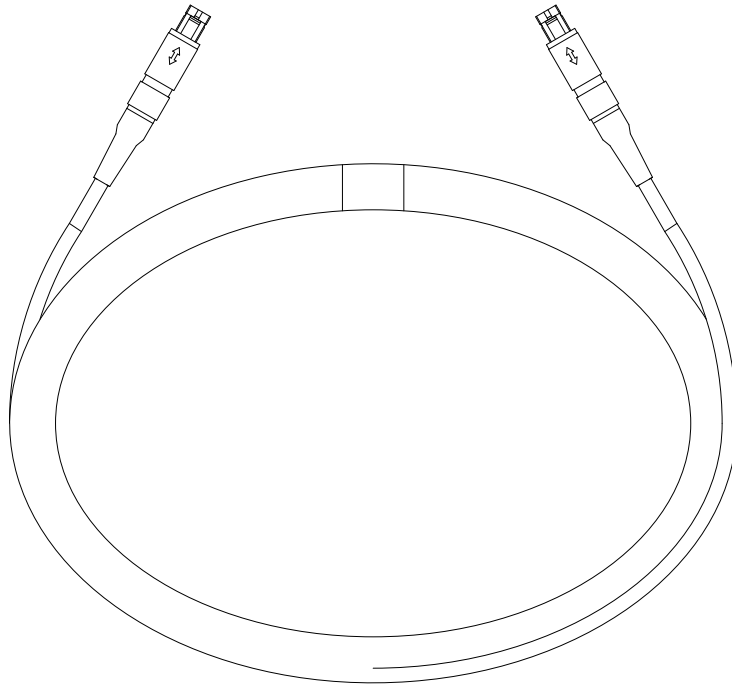
Wand



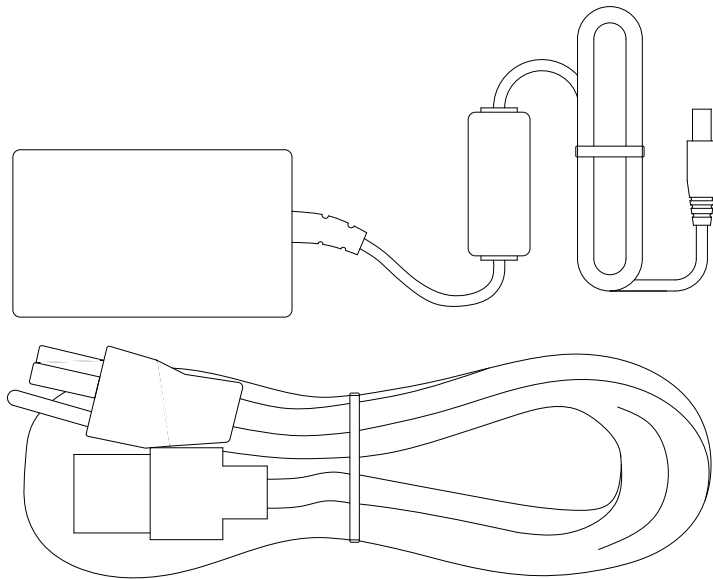
Reference Receiver



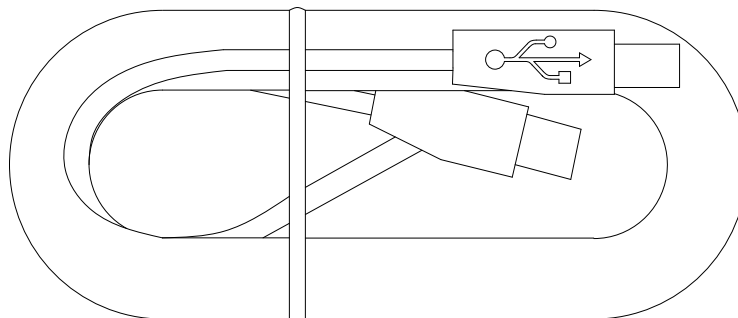
Wand Cable



SEU's Power Supply and Power Cable



USB Cable



Computer Requirements

- Windows Vista SP2 32 or 64 bit OS or later
 - 2 GHz Intel Pentium IV or greater
 - 1 GB RAM or greater
 - USB 2.0 or 3.0 port.

Installing the Software

Important: In order to install FastSCAN II ensure you have administrator privileges on the computer.

Note to Windows Vista users: Before installing the FastSCAN II software do the following:

- Go to **Start/Settings/Control Panel/User Accounts**.
- Uncheck the box **Turn user account On/Off**.
- Click **OK**.

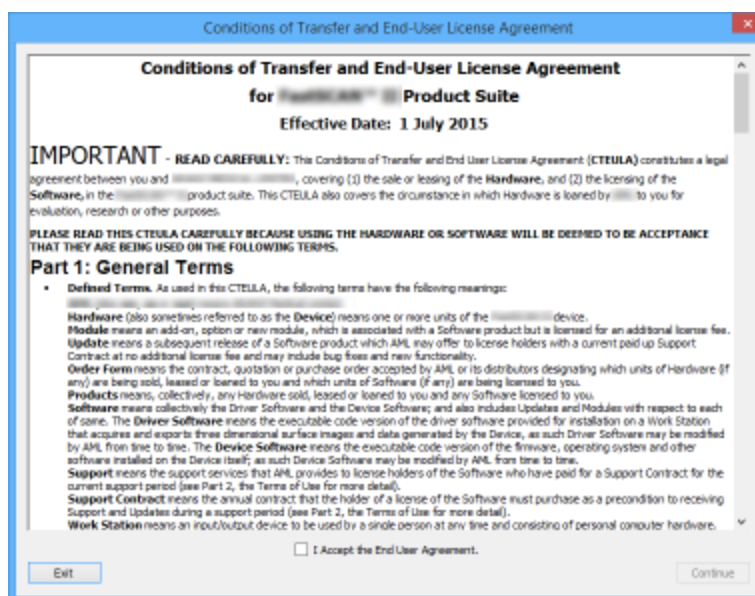
To install FastSCAN II, FastSCAN II (Polhemus) Setup.exe will need to be downloaded to your computer. This file download link should have been sent to you along with your client code as an email from Polhemus Support.

The installation procedure is as follows:

1. Download the setup file to your computer, right-click on the **FastSCAN II (Polhemus) Setup.exe** file and select **Run as Administrator** to start the wizard.
2. You will be guided through the installation of the FastSCAN II software. Install the FastSCAN II files in the default directory. The setup program will also install the USB drivers automatically. You will be prompted to restart your computer if necessary.

End User License Agreement

When FastSCAN II is run for the first time the Conditions of Transfer and End-User License Agreement dialog will appear.

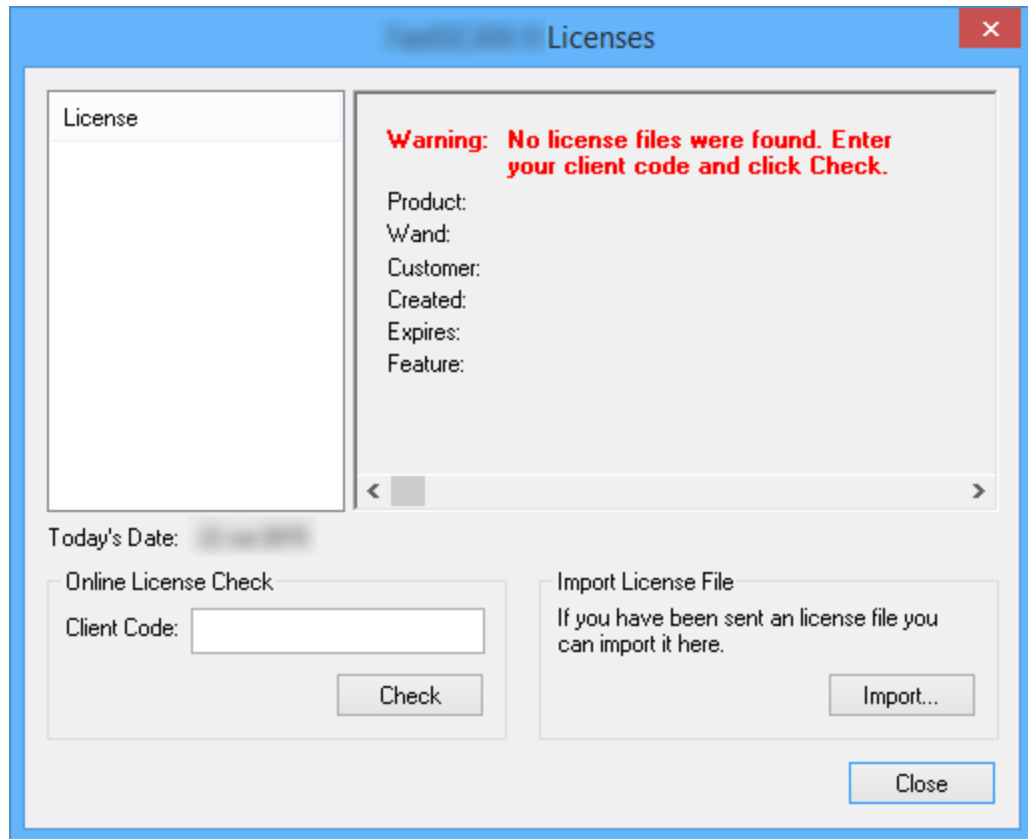


The End User Agreement Dialog

Click the tick-box **I Accept the End User Agreement**, then click **Continue** to enter the application.

Licenses

You will need a license file to run the FastSCAN II software, after installation and accepting the End User Agreement you will be prompted to import one.



The Licenses Dialog

There are two ways of licensing the product:

1. **Online License Check** - Enter the Client Code you were provided in the Welcome Email from the support team, and click Check to search on the licensing server. Note: the Computer must be able to connect to the internet in order for this to work correctly.
2. **Import License File** - Manually browse to a license file that has been provided to you.

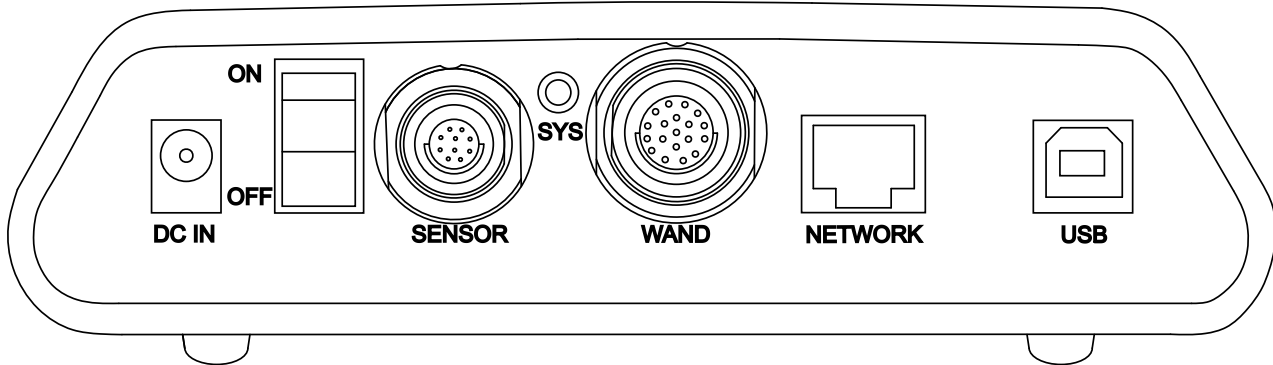
When a valid license has been detected the software will store it with the program data and populate the License fields with the appropriate information.

Connecting It All Together

Note: Ensure that the SEU is switched off before any of the front panel leads are connected or disconnected, or the Wand is detached from its cable.

1. Place the SEU near the computer and plug it into a power source using the power pack and cable. Connect the USB cable to the front of the SEU and to the computer.
2. Plug the Wand cable into the respective socket on the Wand. Plug the connector at the other end of the Wand cable into the socket at the front of the SEU, labeled 'Wand'. The plugs/sockets are formed to

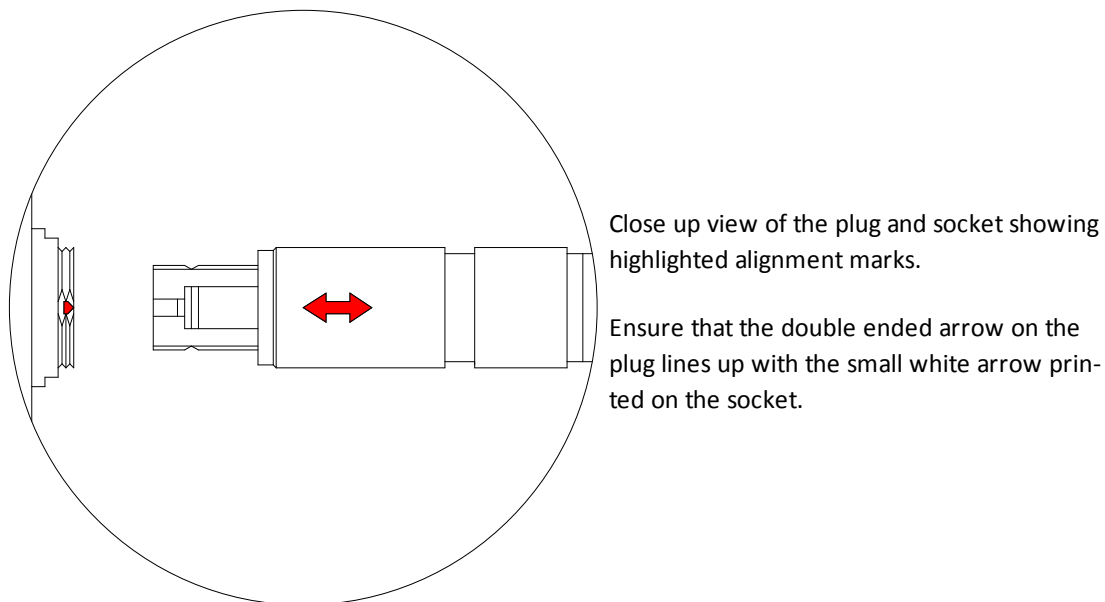
- ensure they cannot be connected incorrectly. Note that both ends of the Wand cable are identical.
3. Plug the Receiver connector into the socket labeled 'Sensor'.



Front view of the System Electronics Unit.

Important Connection Note

The plugs on both the Reference Receiver and the Wand Cable have alignment indents, this means they must be orientated correctly when inserting them into their respective sockets. Failure to insert the plugs correctly can severely damage your scanning system.



Close up view of the plug and socket showing highlighted alignment marks.

Ensure that the double ended arrow on the plug lines up with the small white arrow printed on the socket.

Installing the drivers

Ensure you have run **FastSCAN II (Polhemus) Setup.exe** as an Administrator. The FastSCAN II installation process provides your computer with the necessary drivers. They will become available for loading when the hardware is plugged in and powered on for the first time.

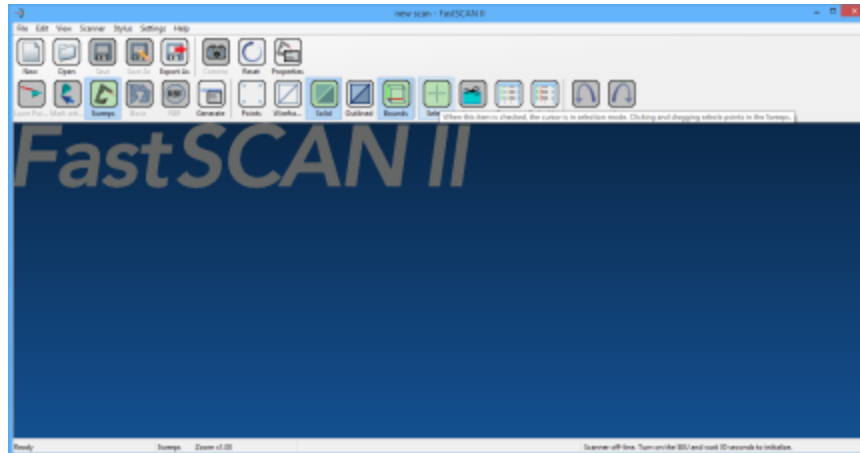
For Windows Vista:

1. Before powering up the SEU connected to your computer click: **Start/Settings/Control Panel** to open the **Control Panel** window.
2. Double-click on **System**.
3. In the **System** window click on **Advanced System Settings**.

4. In the **Advanced System Settings** window choose the **Windows Update Driver Settings** button.
5. Select the middle option: **Ask me each time I connect a new device before checking for drivers.**
6. The drivers should now automatically install when you power up the FastSCAN II system connected to your computer.

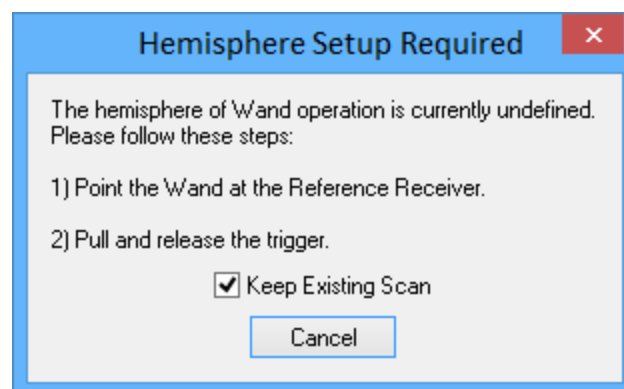
Running FastSCAN II

1. Ensure the system is fully connected and the scanning environment set up as desired.
2. Turn on the SEU. The light on the front of the SEU labelled **SYS** should be Orange. If it doesn't, check that the Wand cable and SEU's power supply are connected correctly to the SEU.
3. Start FastSCAN II by double clicking on its desktop icon. The following startup screen will appear.



The FastSCAN II startup screen.

4. The status indicator at the bottom right of the screen should initially display **Scanner disabled** changing to **Scanner booting**, then **Scanner initializing...** After up to 1 minute this should change to **Scanner on-line**, indicating that the system has initialized. **Note:** Do not depress the trigger while the Wand is initializing. If the Scanner is not switched on (or disconnected) then **Scanner off-line. Turn on the SEU and wait 30 seconds to initialize** will be displayed.
5. When the system has initialized, and the status bar indicates that the scanner is on-line, pull the trigger on the Wand. A dialog box (shown below) will prompt you to define the hemisphere of operation—follow the instructions in the dialog box.
6. Once the hemisphere has been defined FastSCAN II is ready for use.



The **Wand Hemisphere Setup** box.

Scanning

The Scanning Environment

An area of subdued lighting is ideal for scanning, with no direct external light entering from windows. Scanning errors can arise when the scanner's camera directly views sources of strong, bright light, such as the sun or a powerful incandescent light.

Keep the scanning area away from the System Electronics Unit, computer, and any other significant electrical or metallic objects. A wooden table is an ideal surface on which to place objects for scanning.

For best results always position the Receiver as close as possible to the object that you are scanning. It is usually most convenient to place it behind or under the object.



An example of scanning a model.

The Wand

The Wand is a light and compact single camera hand held laser surface scanner.



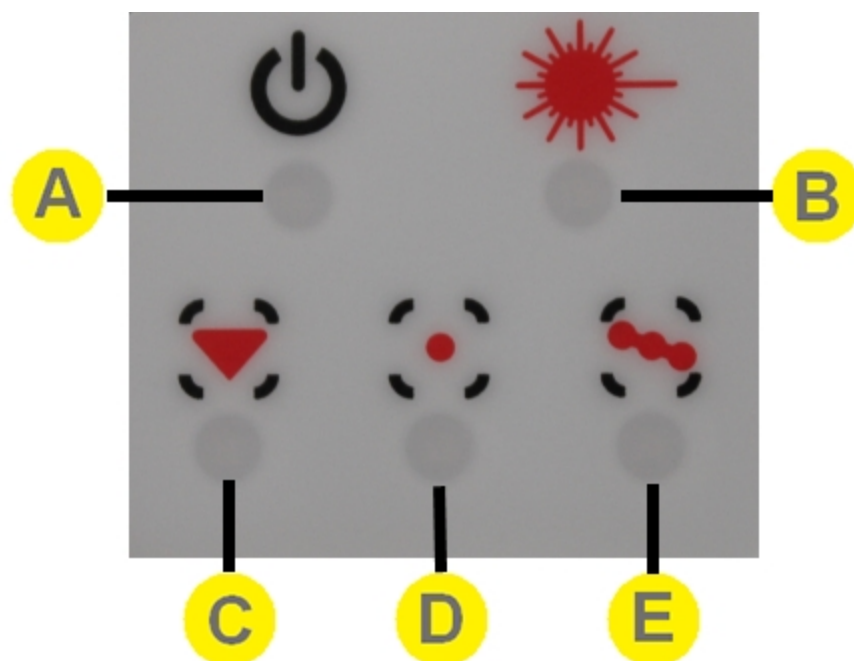
The Wand.

Handling the Wand

- The Wand is a sensitive optical instrument—**handle it with care** at all times.
- After finishing your scanning session switch off and return the Wand to its protective case.

Wand Indicators

- A** Power
- Orange - The Power is on, but the system has not yet initialised
 - Green - The Scanning System is now on-line and ready for scanning
- B** Laser
- Orange - the Trigger has been pulled in half way and the Wand is in Preview Mode
 - Green - The Trigger has been pulled fully in and the Wand is in Scanning Mode
- C** Scan - (Default Mode) The Wand is in Scanning Mode
- D** Point - The Wand is in Point Mode
- E** Line - The Wand is in Line Mode



The Wand display panel.

Wand Controls

The 2-position trigger switch of the Wand controls scanning:

Preview position (trigger pulled in to the first click)

- displays laser profiles on the screen in real-time, but does not store them
- provides feedback to help align successive sweeps in a scan and for filling in gaps
- reorients the display on the computer screen to a 'camera's eye' view
- illuminates the **Laser Indicator** (shown above) Orange.

The secondary function of the Preview position is to reorient the on-screen image without having to return to the keyboard. This is achieved by pointing the Wand at the object, pulling the trigger to the Preview Position so that a profile is displayed on screen, and releasing the trigger. The display will then automatically assume a 'Wand's eye' view.

Scanning position (trigger pulled in completely)

- displays laser profiles and surface data on the screen in real-time and stores them in memory
- illuminates the **Laser Indicator** Green.

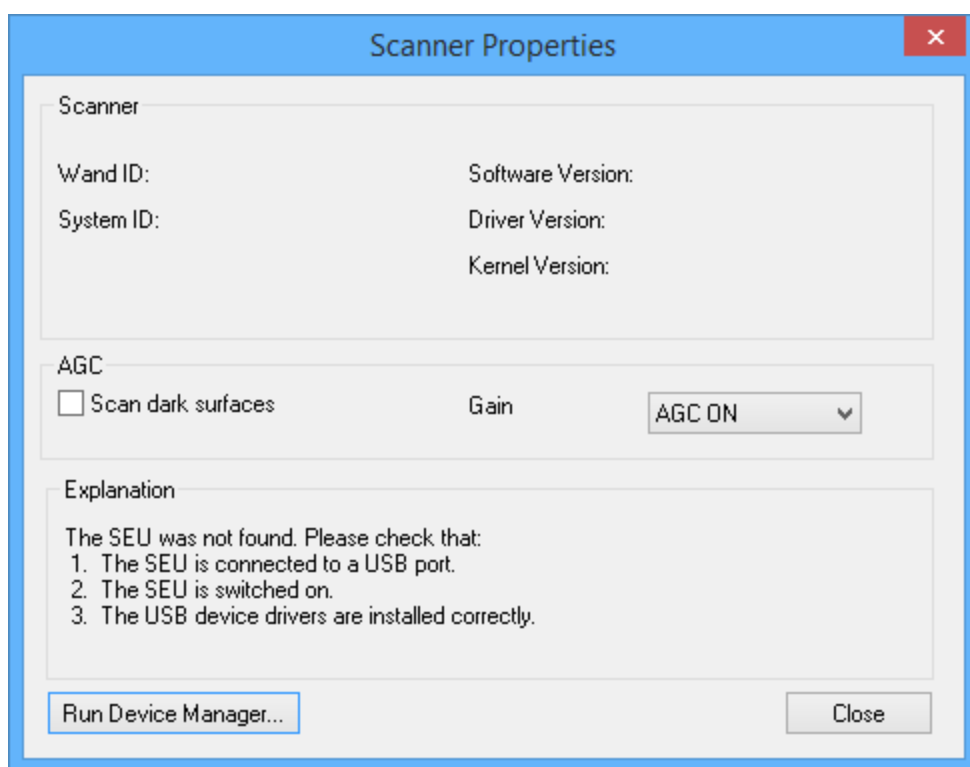
Changing Modes

The Mode that the Wand is in can be changed by pointing the Wand 180° away from the Receiver and pressing the Trigger, this will Scroll thru **Scan, Point** and **Line** Modes as indicated by the green indicators on the back of the Wand.

Note: this can also be controlled via the software.

Wand Sensitivity

The FastSCAN II system uses a method of Automatic Gain Control (AGC) to regulate the signal level from the scanning laser to ensure the correct amount of data is collected from the item being scanned, if the item being scanned is dark in color click the **Scan Dark Surfaces** check box in the **Scanner Properties Dialog** box via **Scanner/Properties...**



The **Scanner Properties Dialog** box.

Scanning with the Wand

Scanning Technique

To scan a complete object you will need to perform a number of sweeps with the Wand. Keep the Wand approximately 10-15 cm away from the subject. Due to the Wand's field of view objects too

close (less than 7 cm) or too far away (greater than 21 cm) will be outside the range of the camera.

Scans are built up from a number of overlapping sweeps, in a manner analogous to spray-painting. A smooth consistent action is required for best results.

To collect a single sweep of data from an object:

1. Prepare the equipment for scanning as outlined in the section [Running FastSCAN II](#).
2. Depress the Wand's trigger into the Preview position, and ensure you can view the laser profile/sweep start-point on-screen in the FastSCAN II viewing window.
3. Press the trigger to the Scan position. The Scan LED on the control panel will illuminate to indicate that data is being collected, and the scanned data will appear on-screen simultaneously.
4. Move the Wand across the surface of the object in a smooth consistent motion.
5. Release the trigger at the end of the sweep.

As you perform the scan, data appears in the viewing window on screen. This lets you see any areas that may have been missed or that might need going over again, to enable an accurate scan of the whole object.

Pointing the Wand at the area of the object you wish to scan, pressing the trigger to the Preview position and releasing it will reorient the on-screen object to enable viewing of that area.

For best scan results:

- allow the wand to warm up for 5 minutes before scanning an object
- minimize distance of the Wand from the object to increase the accuracy of the scan. Also keep the Wand as close to the receiver as conveniently possible
- each sweep of the Wand should be a smooth action as if spray-painting
- use both hands on the Wand to improve steadiness
- remove any metal objects or electrical devices from the scanning environment before beginning
- sweeps should overlap slightly, and missing patches can be rescanned
- a slow steady scan is typically best to get the most accurate data and achieve the smoothest final surface
- avoid repeated scanning of the same part of a surface to reduce file size
- for large objects requiring many sweeps, save your scan at regular intervals to prevent loss of scanned data.

You can erase the last sweep by clicking on [Scanner/Undo Sweep](#), or by double clicking the Wand trigger (on by default). The erased sweep can be put back into the scan by clicking on the **Redo Sweep** button.

The speed at which you move the Wand over the surface of the object is the major determinate of the resolution of the sweeps. Selecting **Points** from the **View** menu will allow you to experiment with different scanning speeds and see the difference in results. The slower the scanning speed, the closer the points are together, the higher the resolution and quality of the data.

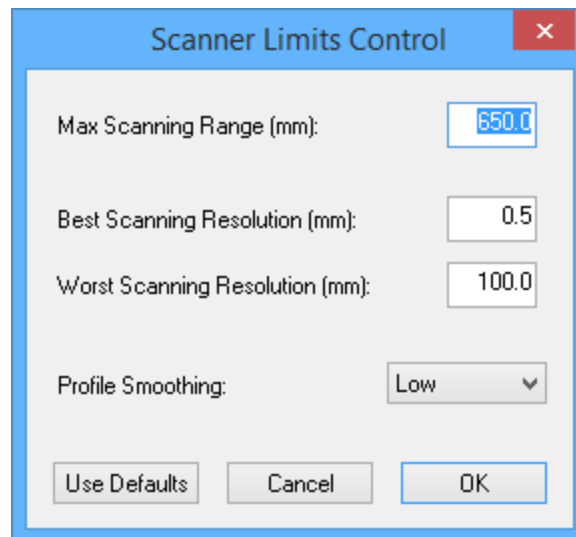
Scanning Resolution - Limits Control

In some situations you may wish to place a limit on the resolution at which data is collected, e.g. to reduce memory and processing requirements. This can be achieved by adjusting the **Best Scanning Resolution** in the **Scanner Limits Control** dialog box (accessed from **Scanner/Limits Control**).

You can control the coarsest scanning resolution at which data is collected via the **Worst Scanning Resolution** in the **Scanner Limits Control** dialog box.

Use this to avoid inadequate resolution when scanning very quickly, in order to maintain a desired accuracy and not miss important detail, or to avoid filling in holes.

Selecting **Wireframe** from the **View** menu will allow you to experiment with different scanning speeds and **Best/Worst Scanning Resolution** values to assess the effect on resolution.



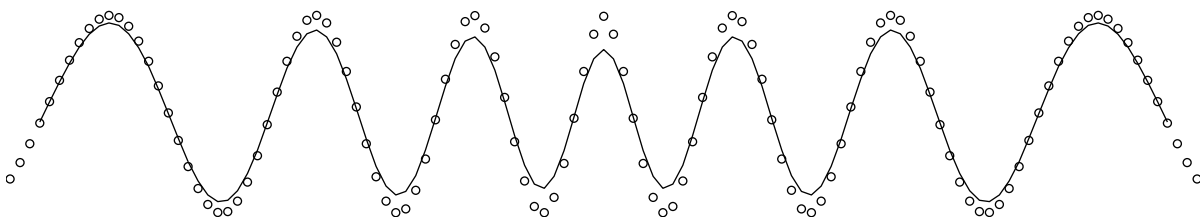
The Scanner Limits Control dialog box.

Profile Smoothing

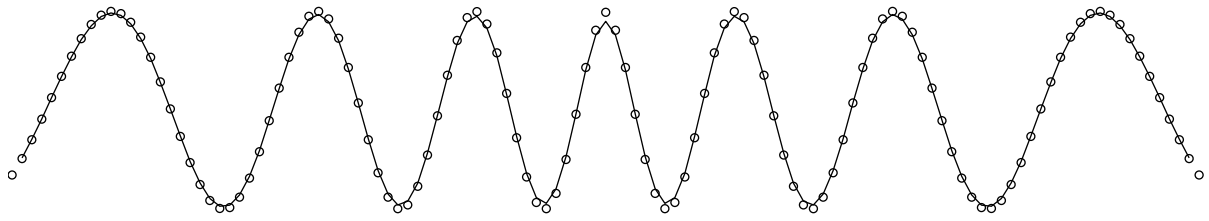
The FastSCAN II program filters and applies a degree of smoothing to each profile during collection. This filter removes noise and errors in the scanner data, but can also remove surface detail. A high value will remove a larger amount of detail while a low value will preserve detail where it is present but tend to give a rougher (more noisy) surface.

A side effect of the profile smoothing is that some points are lost from the ends of each profile. If the data has a gap in it (as might occur when scanning a hole in a surface) then points are also lost from both sides of the gap. Higher smoothing values increase the number of points lost.

You can control the amount of smoothing using the **Profile Smoothing** option in the **Scanner Limits Control** dialog box (High, Medium, Low (default), or Off—see above). Changing this value affects newly captured profiles—it cannot change data that you have already collected. You may need to experiment to find the optimal value before you begin scanning. The images below show how smoothing can affect a profile.



(a) A profile with high smoothing.



(b) A profile with low smoothing.

Examples of profile smoothing applied to a single profile when scanning a corrugated surface. The dots are the original scanned points and the black line is the resulting profile. Note that high smoothing drops three points at the end of the profile, while low smoothing only drops one.

The generation of [Basic and RBF Surfaces](#) applies a different type of smoothing to profile smoothing. Unlike the profile filter, you can adjust this without having to rescan your object.

Undoing Scans

This Wand function is switched **ON** by default. Click on **Settings/Wand** and you can choose to switch on **Double-click Undoes Sweep** or **Triple-click Undoes Scan**. Selecting this option allows you to double or triple click the trigger during scanning to delete the previous sweep or the entire scan respectively. **Use with caution!**



Data View/On Screen Format

The appearance of the data can be changed by clicking on **View** and choosing from the 3 options: **Points**, **Wireframe** and **Solid**, or their icons in the toolbar. These allow you to view the data in different formats and use this information to get the best possible scan. Many of these functions can be performed via the keyboard [Hotkeys](#).



Points:

Shows the individual data points that make up the scan (below (a)).



Wireframe:

Displays the surface triangular mesh, created by linking the points data (below (b)).



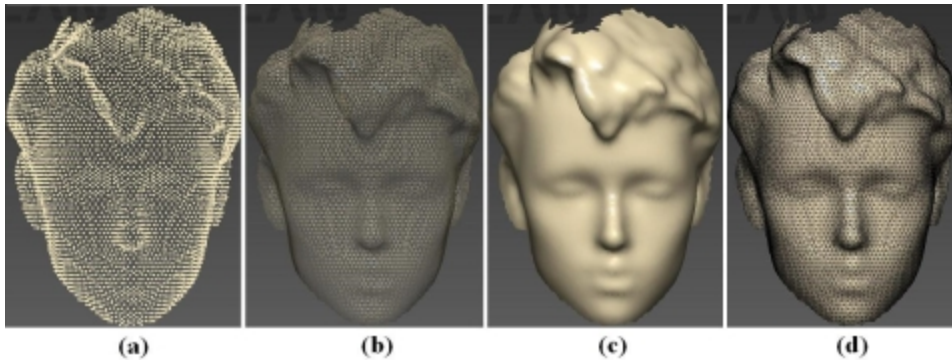
Solid:

Displays the scanned object as a solid surface (below (c)).



Outlined:

Displays the object as a solid surface with the wireframe overlaid upon it (below (d)).

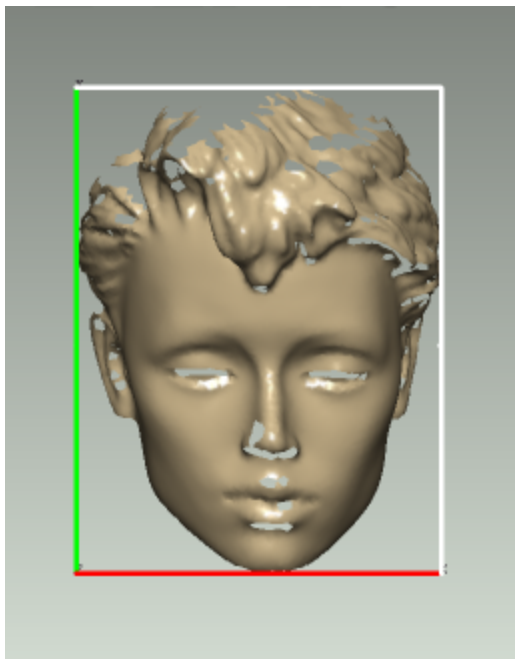


A scan as it appears with the different data viewing options applied.

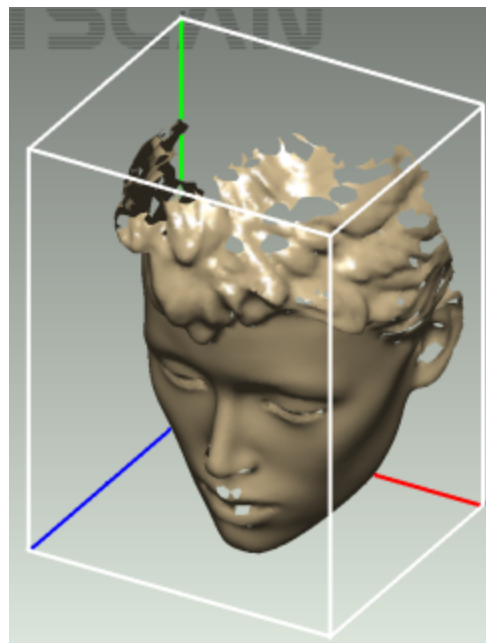
Bounding Box:



The **Bounding Box** enclosing the perimeter of the data is used in the RBF surfacing process and, in coordination with the **Extents Window**, gives the physical size of the object. It can also be useful for users needing a file for CAD systems or wanting a watertight model or closed object. Click on **View/Bounding Box** to see the Bounding Box. The **View/Set Bounding Box to View** allows you to reorient the Bounding Box around the data, and the exported data will be exported with the changed coordinate system. **View/View Bounding Box From** enables viewing of the Bounding Box from other angles (Front, Back, Top, etc).



(a) Press **F1** to get the view of the front of the Bounding Box.



(b) Use the **movement keys** or **mouse** to get this view.

The Bounding Box as seen from: (a) the front (b) above and to the side.

The Extents Window:

The **Extents Window** displays the exact dimensions of the scan, as enclosed by the Bounding Box. Click on **View/Extents Window** to see it. Click on **Settings/Display Units** to choose between millimeters and inches.

Other Viewing Variables

Viewpoint: The data/object can be moved on-screen by clicking and dragging with the mouse or by clicking on **View/Viewpoint** and selecting the desired direction. **Shortcut keys** to use these functions via the keyboard are also listed here.

Movement: Clicking on **View/Movement** allows you to set the speed at which the data/object changes position when manipulating it using the **View/Viewpoint** options or the keyboard.

	Rotate	Translate	Zoom
Normal	30°	25mm	√2 x 100%
Fine	5.0°	5mm	1/5 x Normal
Very Fine	1.0°	1mm	1/5 x Fine
Ultra Fine	0.2°	0.2mm	1/5 x Very Fine

Movement amounts. The zoom increases movement by 5X for each increment.

Normals: Clicking on View/Normals will display the normals (90° to the object surface) of all the data points that make up the object.

Scanning Feedback—Color Mapping:

The **View/Color Mapping** options (listed below) display the object's surface in color, highlighting optimum or poor parts of the scan.

- **Scanning Resolution:** dictated by the speed of the Wand during each sweep. Red is fine resolution/slow speed, blue is coarse resolution/high speed.
- **Tracker Range:** displays the distance between the Transmitter (Wand) and the Receiver during scanning. Green is optimal, red is poor.
- **Wand-Point Range:** displays the distance from the end of the Wand to the object's surface during scanning. Green is good.

Tracking: View/Tracker Positions enables you to see where the **Receiver** and **Wand** were during the scanning process, which can assist in improving the quality of your scanning.

Lighting and Colors: Settings/Lighting and Colors allows you to change the object, laser and background colors as well as altering the position and strength of the lighting on the object, enabling easier viewing of hard to see areas, or those previously in shade.

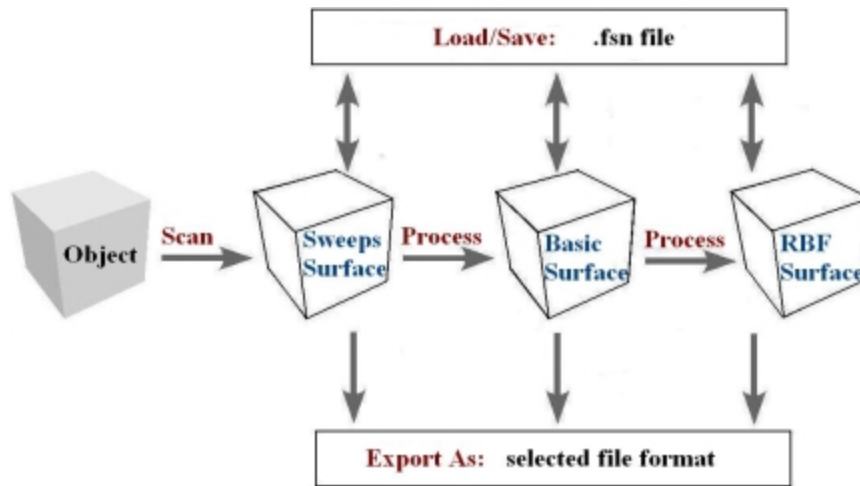
Magnification: Use the mouse wheel or right-click and move the mouse arrow up/down to zoom in/out. The magnification is displayed in the status bar at the bottom of the viewing window.

Processing Scanned Data



Surfacing Options

The FastSCAN II software deals with three surfaces: the Sweeps Surface, the Basic Surface and the RBF Surface. The image below shows the path taken to generate these three surfaces.



Objects and processes in the FastSCAN II program.

The display view may be changed between the Sweeps Surface, Basic Surface and RBF Surface. If processing is required to obtain a view it will begin automatically when that display option is selected.



Sweeps Surface

The Sweeps Surface is effectively the raw data gathered by the scanner and is made up of a number of individual sweeps of the object. The (individual) sweeps may overlap and intersect each other, contain holes and may have been scanned with differing resolutions.



Basic Surface

The Basic Surface is generated from the Sweeps by:

- merging overlapping sweeps
- changing and filtering the data
- standardizing the resolution
- simplifying the triangular mesh (optional)
- limiting the number of objects (pieces of data contained in the Sweeps (optional)).



Radial Basis Function (RBF) Surface

The RBF Surface is generated from the Basic Surface by:

- modeling the points of the Basic Surface with a Radial Basis Function (RBF)
- constructing an isosurface (a mesh with evenly spaced points)
- constraining the boundary of the RBF Surface in space
- simplifying the isosurface (optional).

See the FastRBF Extensions Manual for more details regarding the RBF Surface.



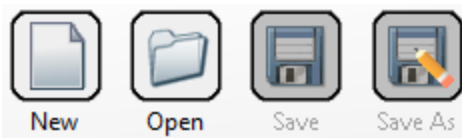
Export Format

Surfaces can be exported in a variety of industry-standard formats using the **File/Export As** sub-menu—this is also accessed by clicking on the **Export As** icon. Supported export file formats include:

.psl	.3ds	.txt	.dxf	.igs	.iv	.lwo	.aop
.op3	.mat	.ply	.stl	.wrl	.vtk	.obj	

Refer to Exporting a Surface section for a full description of the various [export formats](#).

Scan Files



Opening and Saving Scans



New Scan:

To commence a **New Scan** click on **File/New** or the **New** icon in the toolbar.



Open:

To **Open** a scan click on **File/Open** or the **Open** icon in the toolbar. Only **.fsn** and **.hls** file formats can be opened. Saved scans can be processed and exported, but you cannot add more sweeps to them after exporting.



Save / Save As:

Save changes to your current scan file by clicking on **File/Save** or the **Save** icon in the toolbar.



To save a scan under a new name or format click on **File/Save As** or the **Save As** icon in the toolbar. Scans can only be saved in the **.fsn** and **.hls** file formats. Saved scans can be processed and exported, but you cannot add more sweeps to them once exported.

Note:

If you want to export to a different format, or to change the processing parameters at some time in the future, make sure that you save the scan as an **.fsn** file so that you can reopen it.

Editing Raw Data





The Sweeps

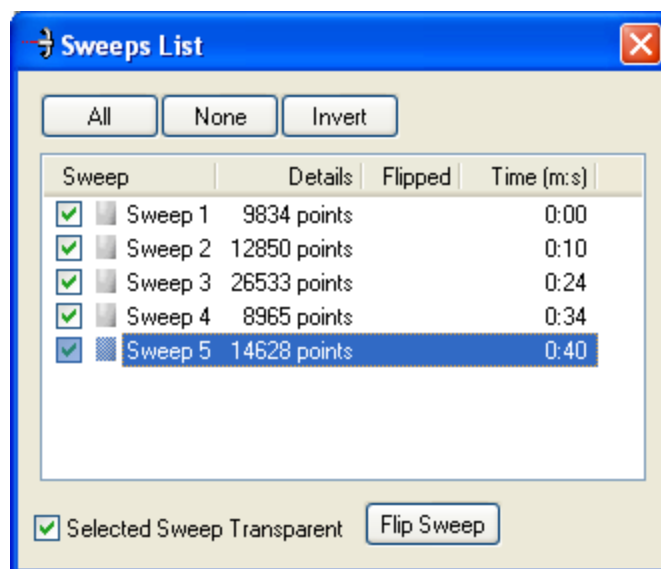
During scanning your data appears on-screen as the Sweeps. You can revert to this view at anytime during the surfacing process by clicking on **View/Sweeps** or on the **Sweeps** icon in the toolbar.



The Sweeps List

You can view a log of all the sweeps in a scan by clicking on **Edit/Sweeps List....** This log allows you to view each sweep individually and to remove single sweeps from your scan if desired.

The **Sweeps List** dialog box (shown below) contains a list item for each sweep. The second column gives the number of points in the sweep.



The Sweeps List dialog box.

To highlight a sweep (best viewed with the Solid option), click on it in the list. Hold down **Ctrl** or **Shift** while clicking to select multiple sweeps. The color of the highlighted sweep(s) in the main window will be changed to the preview color. The actual display of the highlighted sweep(s) depends on the status of the **Selected Sweep Transparent** check box in the **Sweeps List** dialog box. If unchecked, only those parts of the sweep not concealed by other sweeps will be colored, as shown in ((a) below).



a. With some sweeps highlighted, and Selected Sweep Transparent box **unchecked**.



b. With some sweeps highlighted, and Selected Sweep Transparent box **checked**.

Scan with highlighted sweeps, showing color differences. With (a) only visible parts of selected sweeps shown (b) all parts of selected sweeps shown, with different color shades.

If checked, the shading will vary depending on the surrounding sweeps, as shown in ((b)above):

Darker sweep color: this sweep is the only one covering this part of the surface.

Medium sweep color: this sweep is on top, but has other sweep(s) behind it.

Light sweep color: this sweep is underneath other sweep(s).

To hide a sweep uncheck the box to the left of the list item. Hidden sweeps will not be displayed in the main window. Hidden sweeps are ignored when processing and exporting, but they are still saved by default when you save in **.fsn** format. You can hide sweeps at any time, and you can continue scanning after hiding sweeps.

Clicking on **Invert** will reverse the status of all the check boxes in the list and the sweeps visible/ invisible on-screen.

Use the **Flip Sweep** button to turn the selected sweep(s) inside out. This reverses the orientation of the sweeps, and can be used to make a mold with further processing.

Selecting and Deleting Data



It is possible to delete unwanted or inaccurate areas of the scan. Change the cursor to a selection tool by either choosing **Edit/Select**, clicking on the **Select** icon in the toolbar or by holding down the **Ctrl** key. Then left-click-and-drag the mouse to enclose the area you wish to delete. To delete either



select **Edit/Delete**, click on the **Delete** icon or use the **Backspace** key. Be aware that you may be unwittingly selecting other sweeps behind the one you intended to edit (e.g., the back of a scanned object). To prevent this, you may want to hide all of the sweeps other than the one to be edited by unchecking them in the left hand column in the **Sweeps List** dialog box.

Undo/Redo Sweeps



The **Undo Sweeps** icon enables the removal of single sweeps from the scan (from the most recent to the first created). The **Redo Sweeps** icon places a single sweep back into the scan (from the last removed to first removed).



Generating a Basic Surface



Basic Surface



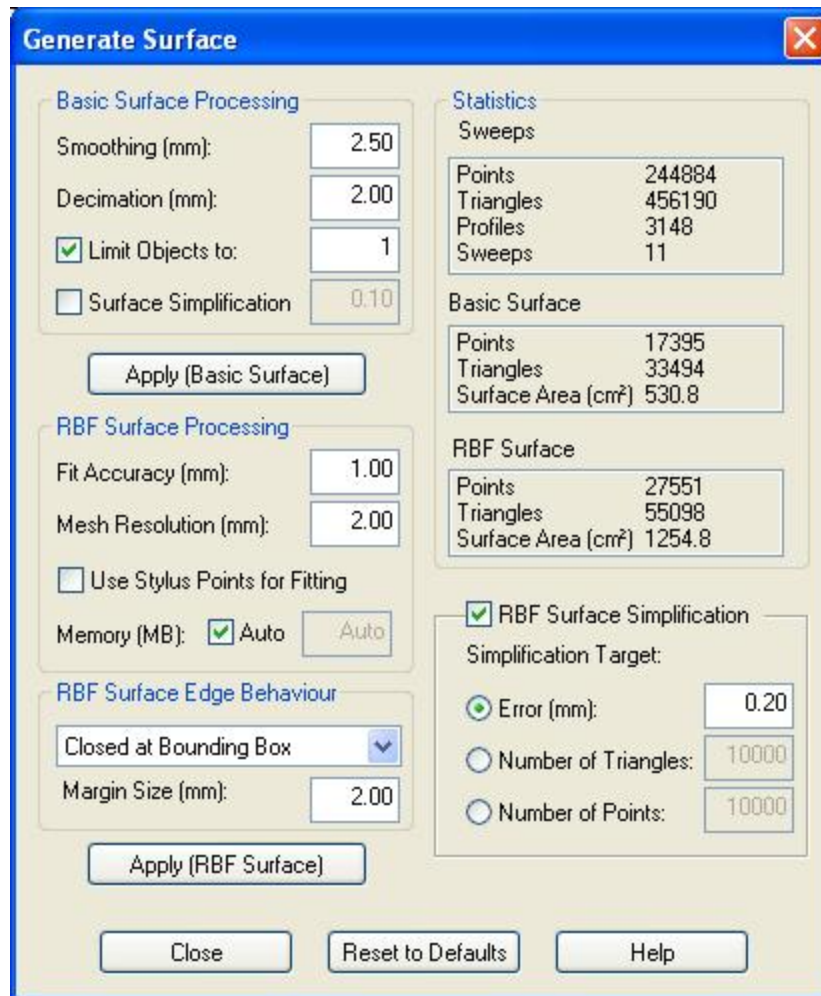
Creating a Basic Surface removes redundant points in overlapping sweeps. The scanned points can be repositioned and the minimum distance between them fixed to determine the amount of detail present in the final surface.

When you have sufficiently edited your Raw Data click on the **Basic Surface** icon to generate the **Basic Surface**. This uses default parameter settings—you can change these parameters via the **Generate Surface** dialog box—as outlined in the next section.

Basic Surface Parameters



Clicking on **Edit/Generate** or the **Generate** icon on the toolbar will bring up the **Generate Surface** dialog box (as below). This enables the user to alter the characteristics of the Basic Surface before processing it.



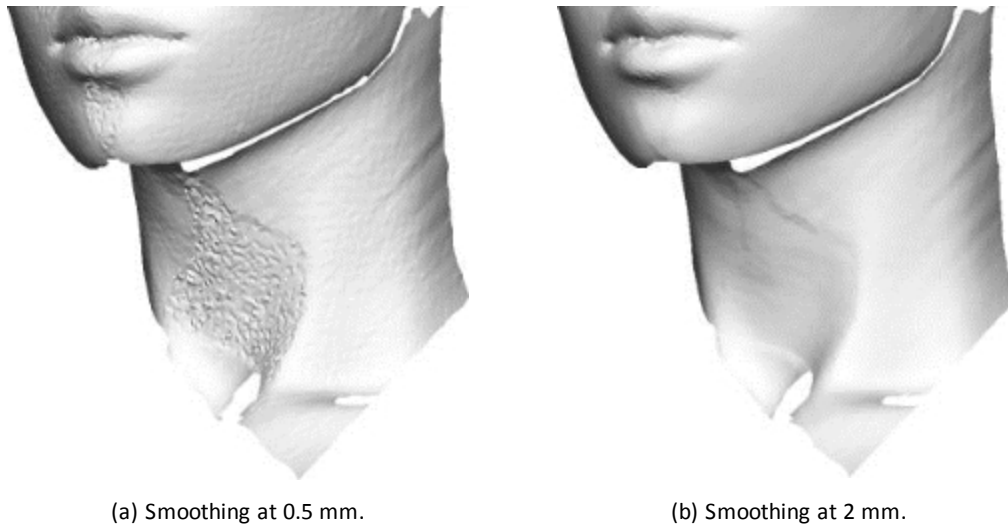
The Generate Surface dialog

Smoothing

When scanning, you will probably scan some parts of the surface with multiple sweeps. These sweeps may not always align perfectly. Possible causes can include:

- small errors in the scanner measurements
- metal objects interfering with the magnetic locator
- the object or reference moving unintentionally during scanning.

The **Smoothing** parameter controls the degree of smoothing FastSCAN II uses when aligning sweeps. A low value creates a more detailed surface, but will fail to merge the more widely separated sweeps. A higher value will merge sweeps better, but remove more surface detail. Typically the smallest possible value that merges sweeps correctly is ideal. The images below show the effect of different values.

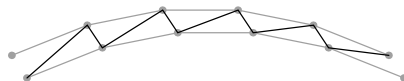


(a) Smoothing at 0.5 mm.

(b) Smoothing at 2 mm.

Two Basic Surfaces generated from the same Sweeps using different Smoothing parameters. In (a) the sweeps did not combine correctly, while in (b) they did.

If the FastSCAN II program does not merge the overlapping sweeps correctly when it creates the Basic Surface, the surface will appear 'blistered'. The image below shows how the blistering occurs as the Basic Surface jumps between the points in the two sweeps.



An illustrative example of how a blistered surface (black line) can form between two misaligned sweeps (gray lines).

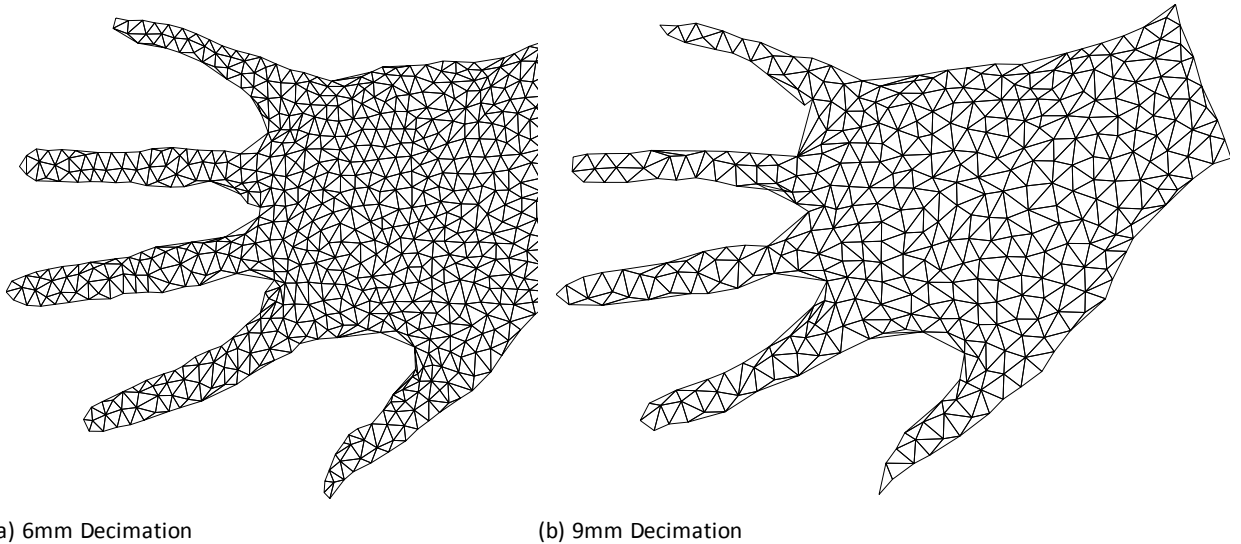
Decimation:

Increasing the **Decimation** value in the [Generate Surface](#) dialog reduces the number of points and triangles. This means a smaller export file and subsequently faster rendering of exported scans when loaded into other programs. Decreasing the value produces a more detailed mesh and a larger, slower file. The images that follow show the same object exported at two different decimation values.

The amount of blistering that occurs is also dependent on the Decimation parameter. Smaller Decimation values will have more blistering, while larger values may be completely free of it. If you lower the Decimation value you may also need to raise the **Smoothing** value to compensate.

If you cannot find a suitable value that merges sweeps while also preserving detail, try the following:

- [Register the sweeps.](#)
- Delete the portion of the sweep(s) which is causing the problem.
- Undo the sweep(s) over the problem area, and re-scan if necessary.
- Re-scan the object after removing metal objects from the scanning area.
- Fix the object and the reference securely so that they cannot move during scanning. Tethering the cables of the receiver is often important.
- Ensure that the Wand, Receiver and object are kept as close to each other as is conveniently possible.



The same object at different decimation values. The 6mm version (a) has 1378 triangles, while the 9mm version (b) has only 704 triangles.

Limit Objects to:

You may find that your surface contains parts of background objects (such as the scanning table) that you did not mean to scan—the camera can pick-up partial profiles on objects behind the target object. You can use the **Limit Objects to** control to remove these extra bits of surface, but only if they are disconnected from and smaller than all the pieces of the main object.

Check the **Limit Objects to** box in the [Generate Surface](#) dialog and enter the number of objects N that you wish to be preserved. The export process will remove all the smaller objects, leaving only the N largest.

If this method fails, you can:

- [delete parts from the Sweeps](#)
- edit the Basic Surface afterward using a separate application
- rescan after covering background objects in a black cloth (or similar arrangement) in order to suppress the laser return from them.

Surface Simplification:

Check the **Surface Simplification** box to reduce the complexity of the Basic Surface— this generates fewer triangles for roughly the same accuracy.

Apply Basic Surface:

When you have set the **Basic Surface Processing** values click on the **Apply Basic Surface** button to generate the Basic Surface.

Registering the Sweeps

The various sweeps of the scan may not always overlap perfectly. This may be due to:

- small errors in the scanner measurements
- metal objects interfering with the magnetic locator

- the object or reference moving unintentionally during scanning.

Such errors in sweep alignment are manifested as bumpy patches or blistering on the Basic Surface. You can attempt to correct these by selecting **Register Sweeps** from the **Edit** menu. The process is automatic and takes just a few seconds for a typical scan. Once you have performed sweep registration, regenerate the Basic Surface in the normal way and see if the **RMS error** has improved. Image ((a)below) shows an object with artifacts before **Register Sweeps** has been used and image ((b)below) the improved result after it has been applied.

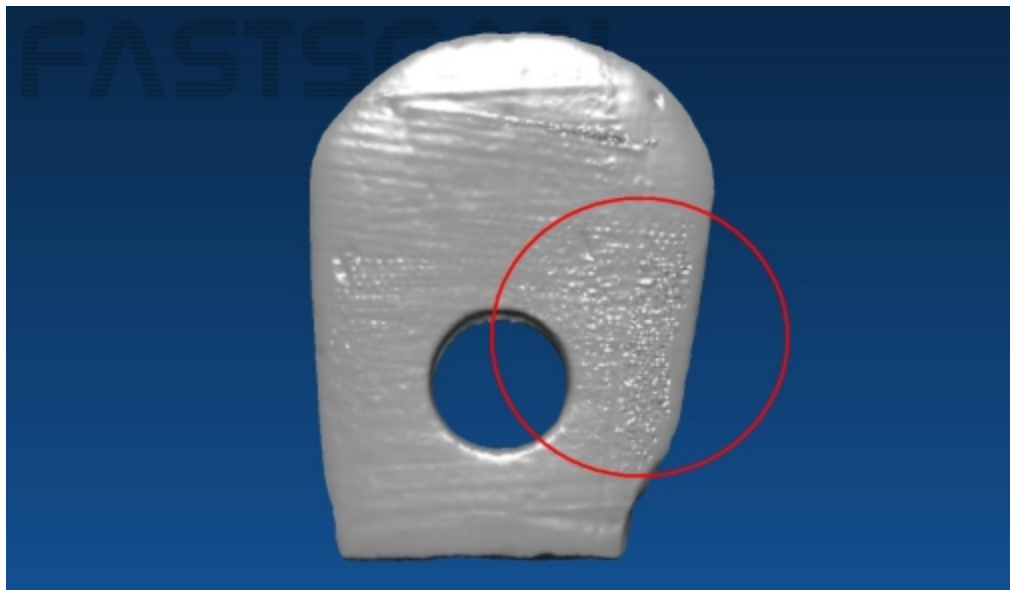
Occasionally **Register Sweeps** can cause deterioration in the quality of the Basic Surface. If the RMS error is larger after **Register Sweeps** has been applied, choose **Unregister Sweeps** from the **Edit** menu. The registration algorithm only applies a rigid body transformation to each sweep, i.e. a translation and a rotation. Such transformations cannot correct misalignments due to problems that cause distortion of the data within the sweep.

The optional **Sweep Auto Crop** functionality can also be helpful for improving scan quality (see description in the Optional Features section).

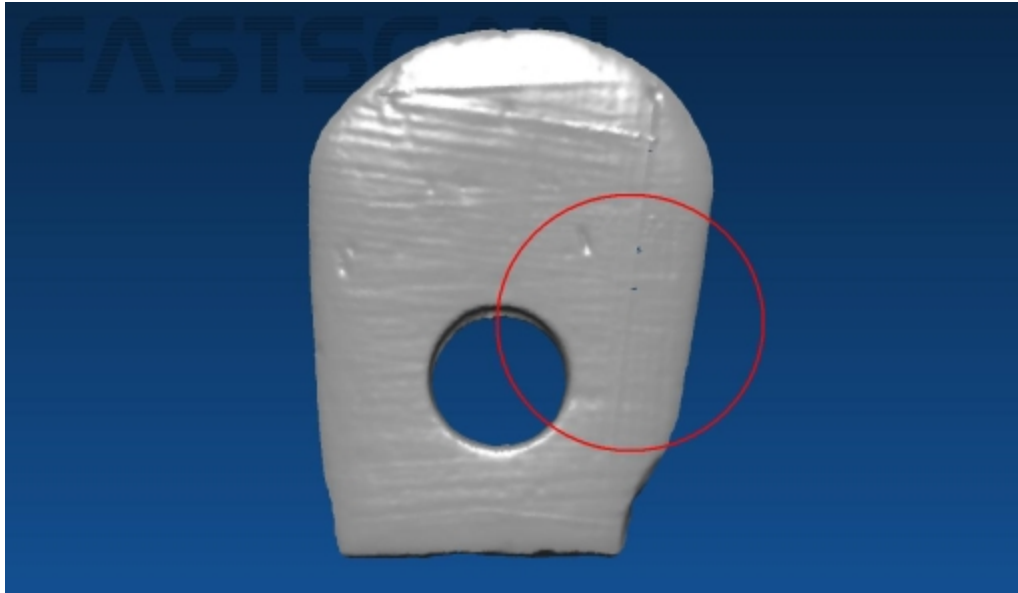


Surface Information

To view the statistics of your surface, open the [Generate Surface](#) dialog box. For the raw data this shows the number of points, triangles, sweeps and profiles. For the Basic and RBF Surfaces it shows the number of points and triangles and the surface area.



(a) The object with artifacts visible on the Basic Surface.



(b) The object after **Register Sweeps** has been used.

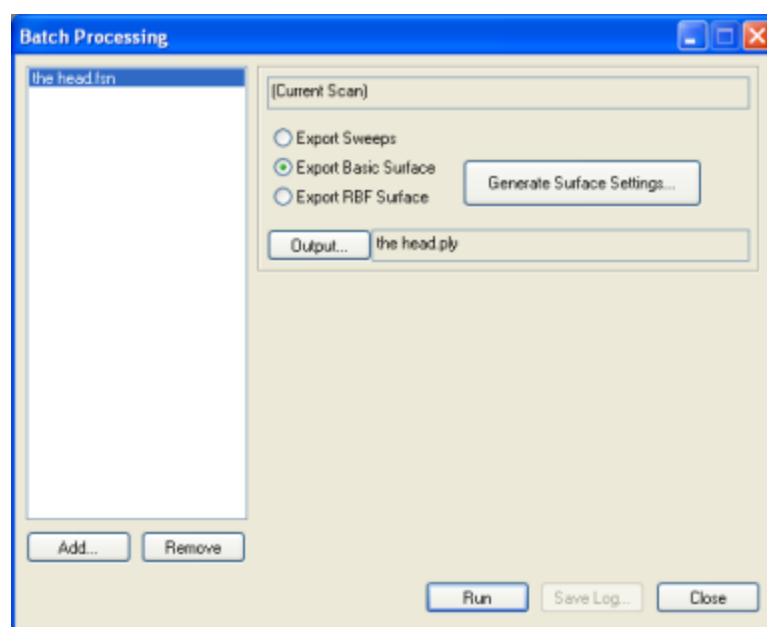
Register Sweeps is used to better align the Sweeps and remove any artifacts.

Batch Processing

The **Batch Processing** interface allows you to process and export several scan files at once, each with different parameters if required. The image below shows the batch processing dialog.

Select **File/Export As/Batch Process** to open the **Batch Processing** dialog. On the left of the dialog is the list of scans to be processed. If you currently have a scan open it will be placed in this list, otherwise the list will be empty.

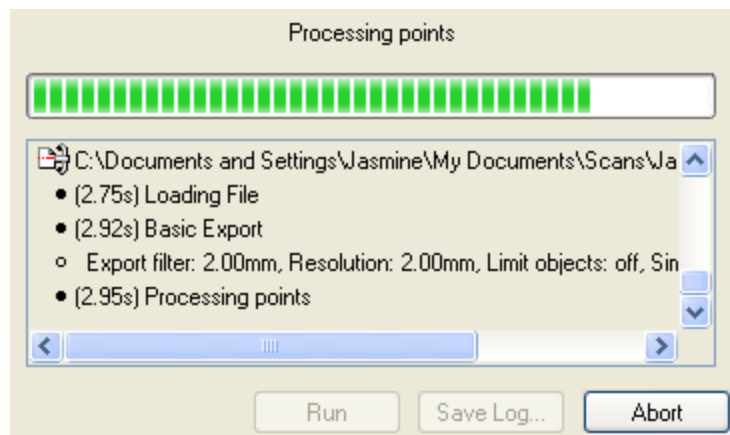
On the right of the dialog box are the controls for changing the settings of the selected scan. The upper-most box displays the input scan file name, which cannot be changed.



The Batch Processing dialog.

Choose from **Export Sweeps**, **Export Basic Surface**, or **Export RBF Surface**. The **Generate Surface Settings...** button opens the **Generate Surface** dialog, where you can specify the surface parameters for the Basic Surface or RBF Surface. The **Output** control displays and allows you to change the output file's format and filename. The default output filename is the scan filename.

Click the **Add** button to add a new scan to the list. The newly added scan's settings (in its **Generate Surface Settings** box) will duplicate those of the preceding scan in the list (if you want to process several scans with the same settings, configure the first scan before adding the rest—if you want different surface settings for each file then be sure to edit them individually via the **Generate Surface Settings** box). To remove a selected scan from the list click the **Remove** button.



The progress bar and message log displayed during batch processing.

Click the **Run** button to process and export each scan in the list, according to the specified parameters. While running the empty part of the dialog displays a progress bar and message log (as above) displaying which scans and processing steps have been run, the processing parameters and any errors. When processing is complete the **Save Log** button allows you to save this message log to a text file.



Generating an RBF Surface

See the [FastRBF Extensions](#) Section for instructions on how to generate an RBF surface. While an RBF surface may be generated and saved with the unlicensed FastSCAN II software, a license is required to enable exporting of the surface.

Exporting a Surface

Export Options

You can export a surface at any stage of processing; the types of files available are determined by the stage you are at.

FastSCAN II can export files in a number of industry standard formats. We have attempted to support the most popular variant(s) for each—if you have difficulties importing one of these files into your 3D application, try exporting another variant or format. If you continue to have difficulties, please contact sales@polhemus.com with the following information:

- the file format used to export from FastSCAN II
- the importing program's application name and version
- the problem file
- a file that is known to work with your application program.

Scans can be exported with respect to the Screen, Reference or Bounding Box coordinate systems, by selecting the appropriate option in the **Coordinate System** section of the **File/Export As/** dialog box.

Note: you cannot reload any of these formats back into the FastSCAN II program.

When saving the Sweeps, some file formats support saving each sweep as a separate object in the file—check the **Separate Sweeps** control. This allows you to manipulate the sweeps easily in another application. Currently only the **Wavefront (.obj)** format supports Separate Sweeps, and only for triangle meshes.

File Types for Export

There are two **Surface Types**, both of which may be available for export with some file types:

Triangle Mesh: Contains points and facet information (created by joining points together).

Cloud of Points: Saves only points and no facet information. This is a smaller file as it contains less data.

Export Formats

FastSCAN II lets you export your data in the following formats:

Polyworks Scan Line (.psl) A binary file format for saving the sweeps only. It consists of raw scan data requiring further processing.

3D Studio (.3ds) The file format used by 3D Studio and supported by 3D Studio Max; also supported by other programs. This format supports **cloud of points** or **triangle mesh** data.

Ascii (.txt) ASCII stores a plain-text list of vertex locations. Each line contains the x, y, and z location of a single vertex, separated by spaces.

AutoCAD Drawing Interchange Format (.dxf) A file format used by Autodesk, AutoCAD, and other CAD programs. Supports **cloud of points** or **triangle mesh** data, the latter as **3DFACES** or **POLYLINES**, which may be supported differently by various programs.

IGES—Initial Graphics Exchange Format (.igs) IGES is a complex format that can be used to exchange many different types of data. These files tend to be much larger than other export formats. The FastSCAN II program can save three different types of IGES:

- **NURBS patch—Entity 128:** A **triangle mesh** with each triangle represented as a separate B-spline surface. This format is very inefficient and many programs may run out of memory when trying to load it.
- **Copious data—Entity 106:** A **triangle mesh** with optional normal vectors. This is the preferred mesh format as it is more efficient than Entity 128.
- **Point Cloud—Entity 116:** Automatically used when exporting as **Cloud of Points**.

Inventor (.iv) The native file format of SGI Inventor. Supports **triangle mesh** data only.

Lightwave Object (.lwo) The file format of the Lightwave animation software; also supported by other programs. This format supports **cloud of points** or **triangle mesh** data.

AAOP/OP3(.aop, .op3) These file formats are used by prosthetic and orthotic CAD/CAM vendors (named after the American Academy of Orthotists and Prosthetists (AAOP)). Exportable via the AAOP Export Wizard.

(A license is required to gain access to the AAOP/OP3 Wizard.)

Matlab (.mat) A binary data file format used by The MathWorks MATLAB. Supports **cloud of points** or **triangle mesh** data, both with optional **vertex normal** vectors or **pseudo gray-scale values**. The file will contain five MATLAB variables at most:

- **Points:** A 3-by-N matrix where each column is a vertex location.
- **Normals:** A 3-by-N matrix giving the vertex normal vector for each vertex.
- **Facets:** A 3-by-M matrix where each column defines a triangle as three indexes into the list of Points.
- **Info:** A string containing information about the file.
- **Albedo:** A 1-by-N vector giving the surface **pseudo-grayscale** brightness for each point in **Points**.

Note: **N** = points, **M** = facets.

Stanford Polygon File Format (.ply) Also known as the Stanford Triangle Format, this format was principally designed to store 3D data from laser scanners. It describes a single object as a series of flat polygons and can be saved as **cloud of points** or **triangle mesh**, in both **binary** or **text** formats. The **.ply** file can also be saved with optional **vertex normal** vectors or **pseudo gray-scale values**.

Stereo Lithography (.stl) A common format that supports **triangle meshes**. The FastSCAN II program supports both **text** and **binary .stl** files (binary is faster and creates a much smaller file).

Virtual Reality Modeling Language (.wrl) Virtual Reality Modeling Language is a scene description language common on the Internet. There are different versions of VRML; the FastSCAN II program produces the older 1.0 version, which is still widely supported. Generated files contain a single **triangle mesh** object and a camera object based on the current view.

Visualization Toolkit (.vtk) Supports both **cloud of points** and **triangle mesh**. Only the **ASCII** file format is supported (text files).

Wavefront Object (.obj) The file format used by the Alias|Wavefront software and widely supported by other programs. This is a text file that supports **cloud of points** and **triangle mesh**, the latter with optional **vertex normal** and **pseudo gray-scale values**.

Note: Not all third party software supports color information with .obj files.



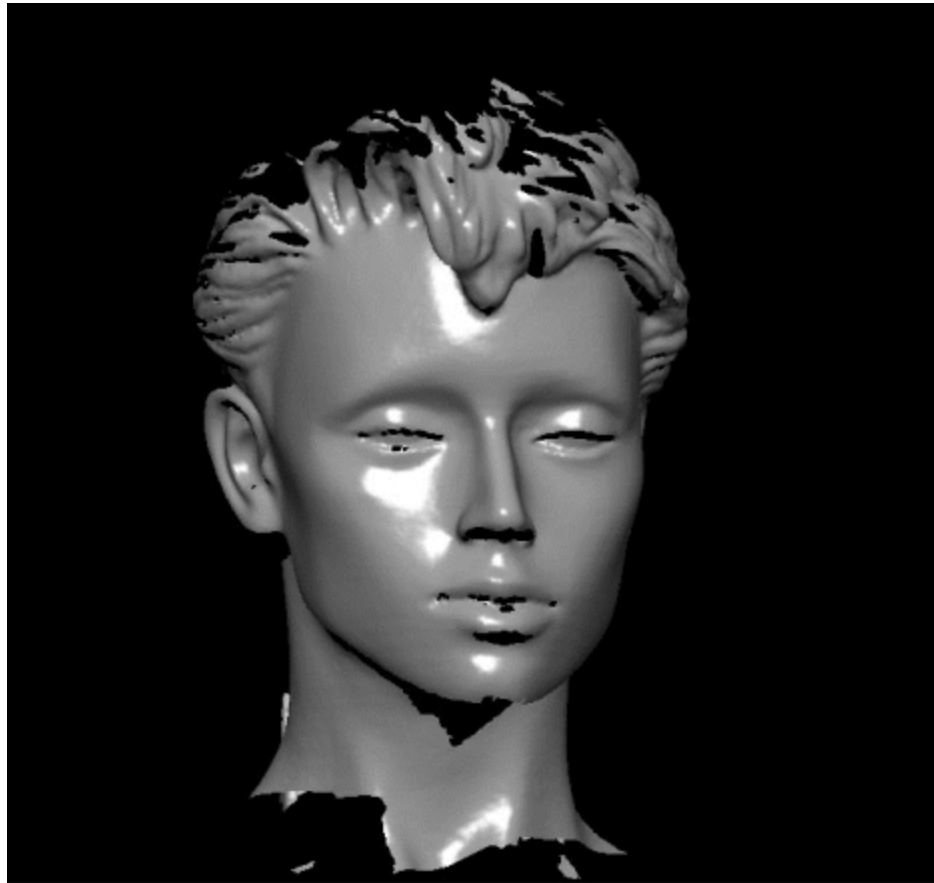
Click on the **Delta™** icon to load the scan data directly into **Delta** software—you must have **Delta** installed.

Delta is a stand alone tool that enables comparison of surface distance and volume variations between two objects. You will need a license to use the **Delta** software. A demonstration copy of **Delta** can be downloaded from:

<http://www.fastscan.com/download/delta>.

Save Snapshot

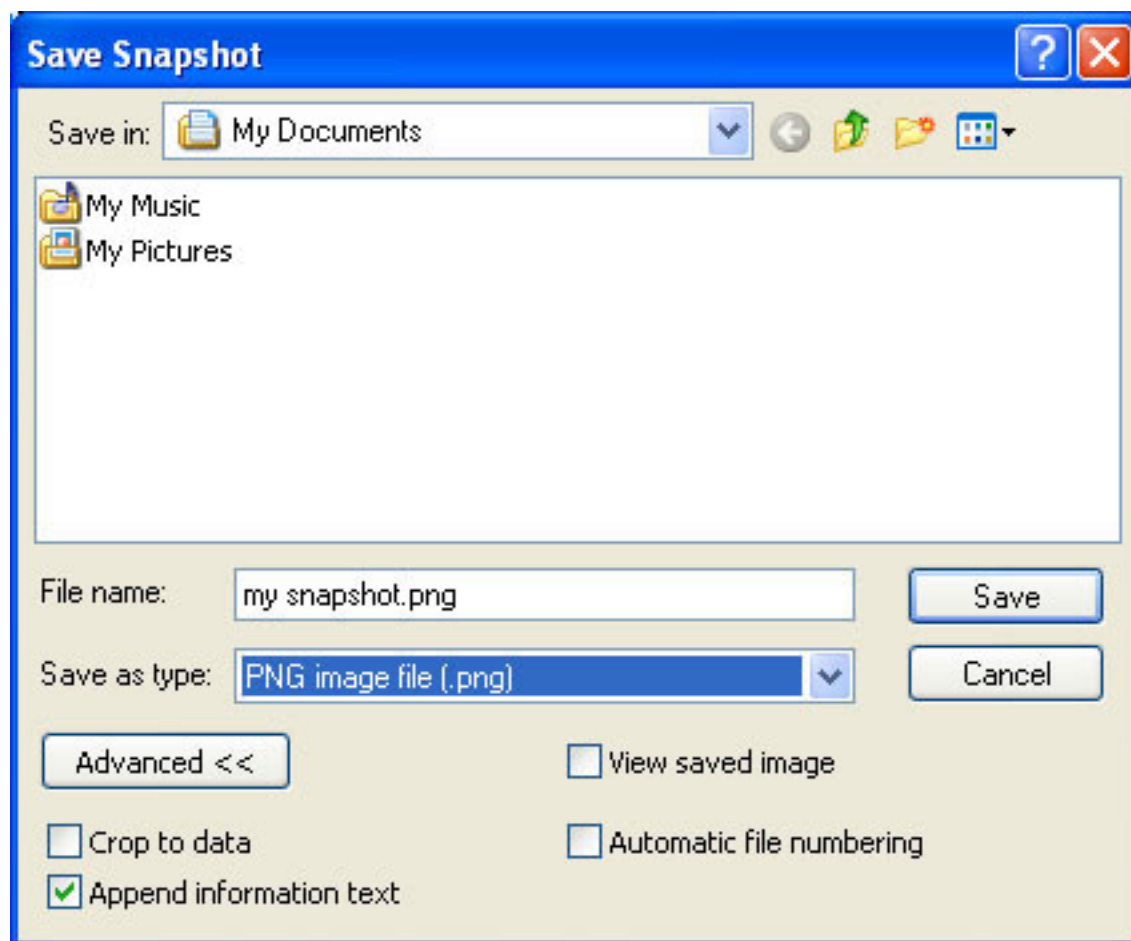
Selecting **File/Save Snapshot** or pressing hotkey **F11** creates a .png screen image of the current data window (as below).



Basic Surface: 62690 points, 121717 facets, surface area = 621.889 cm sq
Basic Parameters: smoothing = 1 mm, decimation = 1 mm, object link = off, simplification = off

Example of a Saved Snapshot file

Options with this function are available by selecting **Save Snapshot/Advanced** including **Crop to data**, **Automatic file numbering** and **Append information text**.



The Save Snapshot dialog box (with advanced options).

This Dialog may be bypassed, if it has previously been displayed and **Automatic File Numbering** has been selected. Holding down the **Ctrl** key while taking the snapshot (**F11**) will enable the user to take multiple snapshots in a numbered sequence, as they rotate around an object for example.

Hotkeys & Optional Features

File/New Scan	Ctrl+N
File/Open	Ctrl+O
File/Save As	Ctrl+S or F4
File/Export Surface	F8
Edit/Undo	Ctrl+Z
Edit/Redo	Ctrl+Y
Edit/Select	Ctrl+left mouse button
Edit/Delete	Backspace
Edit/Sweeps List	Ctrl+W
Edit/Stylus Marks List	Ctrl+T
Edit/Generate Surface	Ctrl+G
View/Sweeps	F5
View/Basic Surface	F6

View/RBF Surface	F7
View/Set Bounding Box to View	Ctrl+B
View/View Bounding Box From / Front	F1
View/View Bounding Box From / Bottom	F2
View/View Bounding Box From / Left	F3
Toggle between Camera and Sweeps Mode	V
View/Viewpoint/Center	Insert
View/Viewpoint/Reset	Home
View/Viewpoint/Zoom In	Page Up
View/Viewpoint/Zoom Out	Page Down
View/Viewpoint/Rotate Left	←
View/Viewpoint/Rotate Right	→
View/Viewpoint/Rotate Up	↑
View/Viewpoint/Rotate Down	↓
View/Viewpoint/Roll Left	Delete
View/Viewpoint/Roll Right	End
View/Viewpoint/Translate Left	Alt+←
View/Viewpoint/Translate Right	Alt+→
View/Viewpoint/Translate Up	Alt+↑
View/Viewpoint/Translate Down	Alt+↓
View/Movement/Normal	Ctrl+1
View/Movement/Fine	Ctrl+2
View/Movement/Very Fine	Ctrl+3
View/Movement/Ultra Fine	Ctrl+4
<i>decrease movement size by 1</i>	Shift+mvmt key(↑←↓→)
<i>decrease movement size by 2</i>	Ctrl+mvmt key(↑←↓→)
<i>decrease movement size by 3</i>	Shift+Ctrl+mvmt key(↑←↓→)
Exit from current edit mode	Esc

Optional Features

The Optional Features listed below are licensed on a per-wand basis via the license.lic license file that is provided with the FastSCAN II system. To view your license details select **License** from the FastSCAN II program **File** menu.

Refraction Correction

Refraction Correction compensates for the surface distortion resulting from scanning through glass and is applied as a “post process” after the scan has been completed. Scanning through glass was primarily developed to enable Orthotics and Prosthetics (O&P) practitioners to obtain high quality scans of the whole foot and lower leg while keeping them stable. This is achieved by placing the feet on a raised pane of glass and scanning from beneath.

Click on **Edit/Refraction Correction...** and a dialog box will appear. Fill in the information boxes and click **Do**.

Normal commercial glass has a Refractive index of approximately 1.52, however this may vary for low lead or tinted glass.

For more information on scanning through glass refer to the [Refraction Correction](#) Section or contact **Polhemus Limited** (www.polhemus.com).

(A license is required to enable this function.)

Cast Inversion Mode

The Cast Inversion Mode of FastSCAN II was developed to enable O&P practitioners to scan the inside surface of plaster casts. The data can then be archived or loaded into applicable O&P CAD software to enable modifications and/or fabrication of a pattern or prosthetic.

For more information on Cast Inversion Mode refer to the [Cast Inversion](#) Section or contact **Polhemus Limited** (www.polhemus.com).

(A license is required to enable this function.)

Export as AAOP/OP3 object

AAOP/OP3 is a 3D file format supported by a number of orthotics and prosthetics CAD packages.

(A license is required to gain access to the AAOP/OP3 Export Wizard.)

Sweep Auto Crop

The Sweep Auto Crop feature is an algorithm that automatically crops (removes) the parts of the sweeps so that they do not overlap. This process requires less filtering, preserving resolution. There are two algorithms that can be selected to perform the crop:

- **By best sweep:** The best sweep algorithm aggregates the (squared) point separations over the whole sweep and gives precedence to (retains) the sweep that has the least aggregated separation.
- **By best point:** The Best point algorithm ranks all points in all sweeps by resolution. Beginning with the point with highest resolution (least separation), a patch of radius Patch Radius is placed around this point and all points within that patch are retained.

Note that if this feature is used Register Sweeps becomes disabled for this scan as there is no longer any data to align overlapping sweeps.

(A license is required to enable this feature.)

FastRBF Extensions



A FastSCAN II scan (left) and the FastRBF™ surface (right). Small holes in the data, and the large gap between the embracing figures, have been filled automatically and smoothly. The topology of the statue (such as the gap between the hand and the throat) remain unchanged.

The FastRBF Extensions allow you to use the Polhemus Limited FastRBF engine from inside FastSCAN II. This enables these key scanning improvements:

- Automatic hole filling.
- Smooth extrapolation of the surface.
- Guaranteed closed, watertight surfaces.
- Preservation of scan detail.
- Surface meshes with highly uniform triangles.

The automatic hole filling and smooth extrapolation provided by the FastRBF engine can save many hours that would otherwise be spent laboriously repairing small holes and defects in scans. Accuracy and scan detail are maintained and the degree of accuracy to which a surface is fitted to the scan data can be specified without compromising the ability to fill holes. FastRBF surfaces are also more faithful to the raw scan data than those simplified with other methods. The ability to guarantee a closed, watertight surface makes FastRBF Extensions essential for rapid prototyping and is a unique capability in a laser scanner.

The previous images show an example of a large, complex scan processed using the FastRBF Extensions.

Licensing

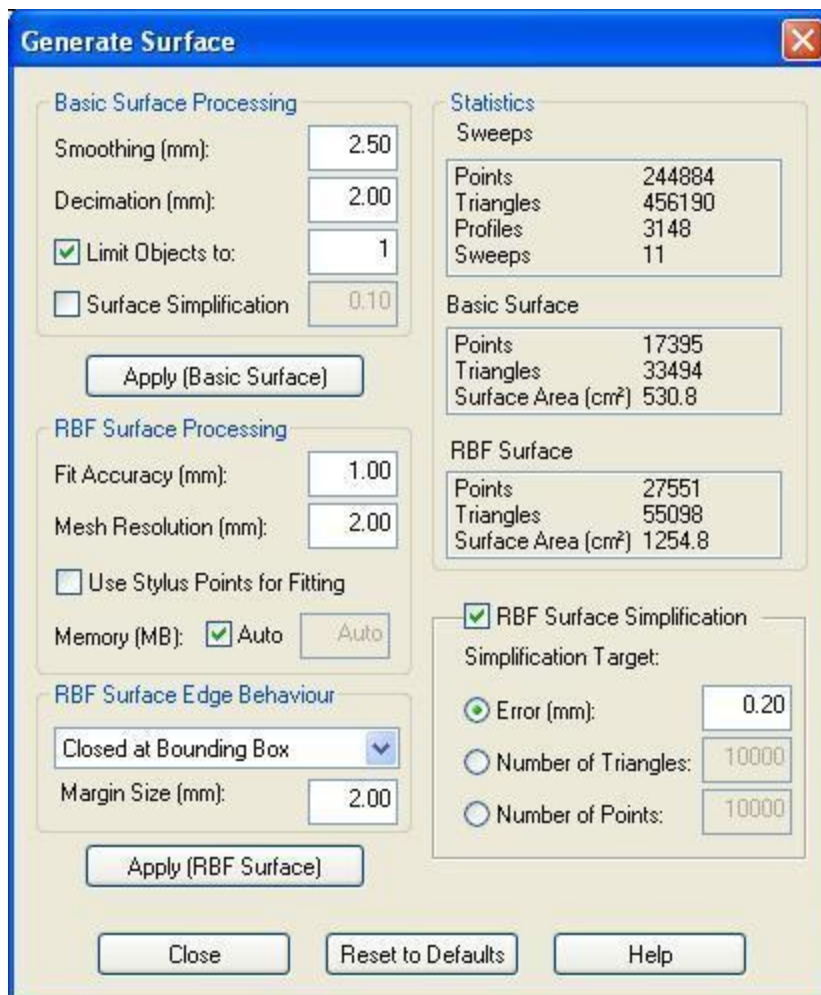
If the FastRBF Extensions license file is not present, or is invalid, the FastRBF Extensions will operate in demonstration mode. This allows you to process and save any scan but prevents you from exporting the RBF surface. The license file will become invalid if it is modified or when it expires.



Overview

To access the FastRBF Extensions scan some data (or open a previously scanned .fsm file), then open the **Generate Surface** dialog box (as below) by clicking on **Edit/Generate Surface** or its icon at the top of the viewing window (**Ctrl+G** also performs this function).

You must generate a [Basic Surface](#) before generating an [RBF Surface](#), as the points of the Basic Surface are passed to the FastRBF engine in order to generate the RBF Surface.

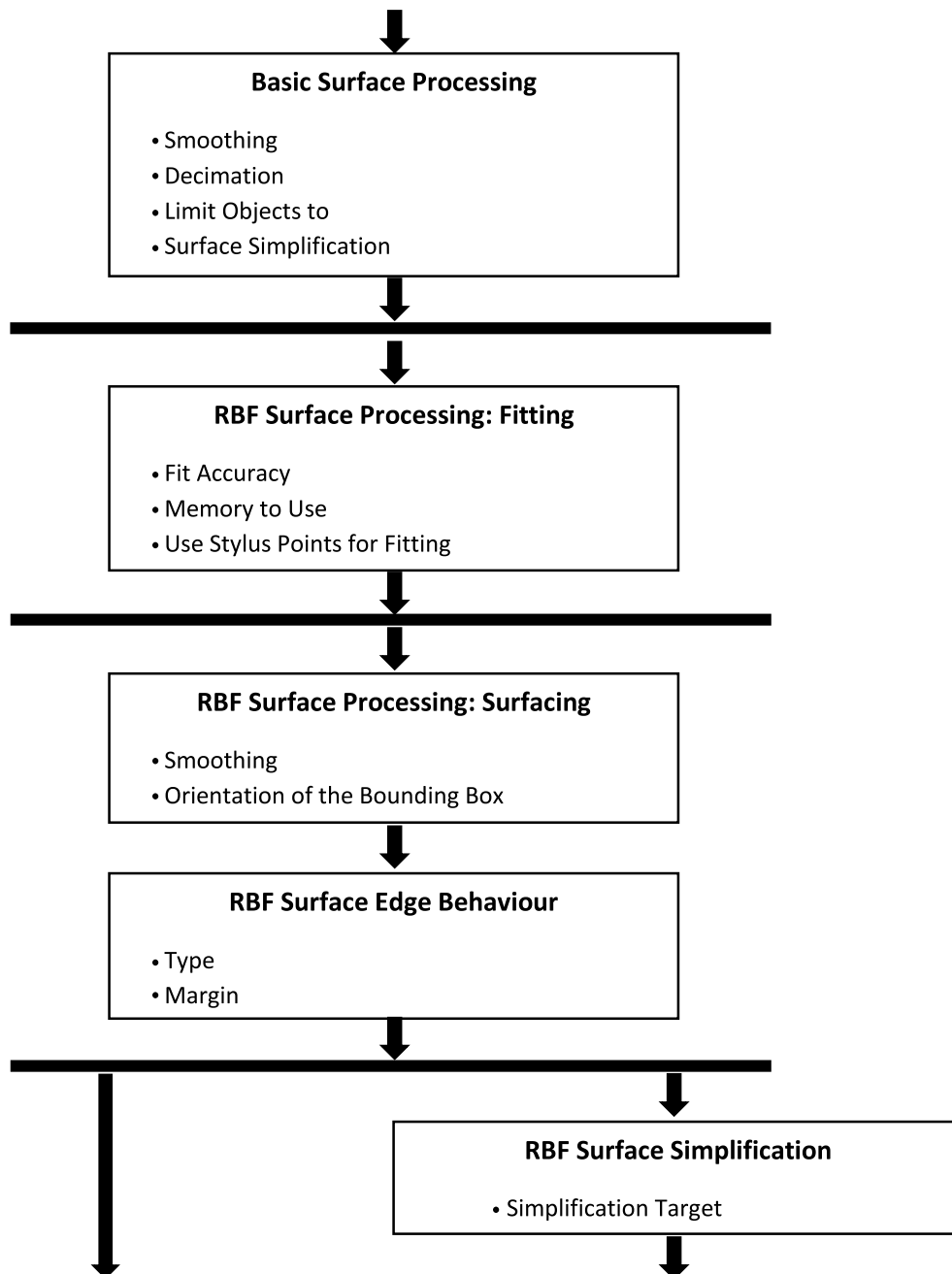


Generate Surface dialog box

Data Flow

The FastRBF process is divided into several sub-processes (as below). The output of the Fitting and Surfacing stages is cached. Therefore if you change the RBF Surface Simplification parameters, only the RBF Surface Simplification process needs to be repeated. In the Generate Surface dialog box the four subprocesses are:

- [Basic Surface Processing](#)
- [RBF Surface Processing](#)
- [RBF Surface Edge Behavior](#)
- [RBF Surface Simplification](#)



Data flow inside the FastRBF process. The heavy black lines indicate points where the data is cached. If parameters are changed at a particular point, only processes back to the previous line will be run again.



Generating A Basic Surface

Open the [Generate Surface](#) dialog box by clicking on **Edit/Generate Surface** or its icon at the top of the viewing window (**Ctrl+G** also performs this function).

Enter the desired values into the **Basic Surface Processing** section:

Smoothing

Smoothing eliminates noise from the raw scan data. Experiment to find a **Smoothing** value that gives the maximum level of detail while still giving the desired surface smoothness. “Noise” can show up as small bumps on both the Basic Surface and the RBF Surface (this may also be due to incorrectly merged sweeps - use **Sweep Registration** (refer to the [FastSCAN II Section](#) to attempt to solve this)).

Decimation

Decimation sets the distance between adjacent points in the data of the Basic Surface (these are later passed to the FastRBF engine). A smaller value—leading to more points—is suitable for generating “final” quality surfaces, but will take longer to process. A larger Decimation value will create fewer points, giving less detail but faster processing. Note that the level of detail in the RBF Surface is also influenced by the initial quality of the scan data, the **Fit Accuracy**, and the **Mesh Resolution**.

Limit Objects to

While scanning you may acquire pieces of data that are not part of the object. These objects will make FastRBF processing slower and will affect the Bounding Box used while surfacing. Check **Limit Objects** to and enter the number of objects you wish to keep. Data objects will be removed—smallest first—until only the specified number remain.

Surface Simplification

You can also reduce the complexity of the Basic Surface by activating simplification, which generates fewer triangles for roughly the same accuracy. This number controls the accuracy of the simplified mesh, i.e. it gives the maximum error from the original data. Simplifying the Basic Surface will speed up RBF fitting. Check the **Surface Simplification** box to enable this.



RBF Surface Processing

Fit Accuracy

Fit Accuracy specifies how closely the FastRBF function will try to fit to the input data. A small value will preserve more surface detail (and noise) but take longer to process (too small a value and the processing may take a very long time). A large value will create a smoother surface in less time (too large a value will remove all the detail).The images below show the same object processed at three different Fit Accuracy values.



(a) 0.1mm



(b) 0.5mm



(c) 2.0mm

Different Fit Accuracies (Mesh Resolution of 1.0 mm).

Mesh Resolution

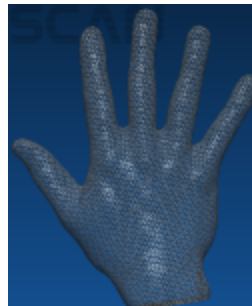
Mesh Resolution sets the approximate size of triangles in the RBF Surface. The images below show the same object at different mesh resolutions.

Memory to Use

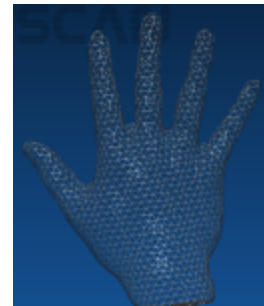
Specifies the amount of memory (MB) to be used internally in the Fit Accuracy stage. Allowing more memory to be used will speed up processing. Choose a value that is as large as possible but which will not exceed your available physical memory, also taking into account the memory required by the operating system and other applications. For example: if your computer has 1GB of memory and you won't be running many other applications while processing, try choosing 500 MB. If you choose a value that is too high, processing may be forced into virtual memory, making it much slower, or you may run out of memory, causing processing to fail.



(a) 0.1mm



(b) 2.5mm



(c) 5mm

Different mesh resolutions.

Use Stylus Points for Fitting

Stylus points and lines can be used as input for the RBF fitting (as well as the Basic Surface), by using a physical stylus to collect the points/lines on the surface where you were unable to scan. Check this option to treat the stylus points as scanned data during processing.



RBF Surface Edge Behavior

FastRBF surface processing can create a surface that continues out to infinity. The **RBF Surface Edge Behavior** setting controls how that surface is constrained to a fixed region in space.

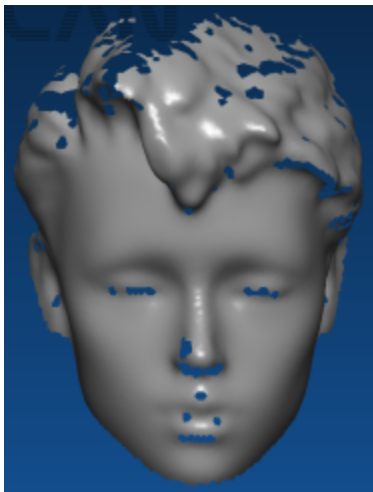
To orientate the front of the Bounding Box to the current screen view select **Set Bounding Box to View** from the **View** menu or press **Ctrl+B**. The Bounding Box encloses the perimeter of the data and may change size, dependent on the margin.

Trimmed to Data

The surface is trimmed so that holes and edges remain as they were in the raw data ((a) below).

Trimmed to Edges

The surface is trimmed as in **Trimmed to Data** but holes in the surface are filled in ((b) below).



(a) Sweeps

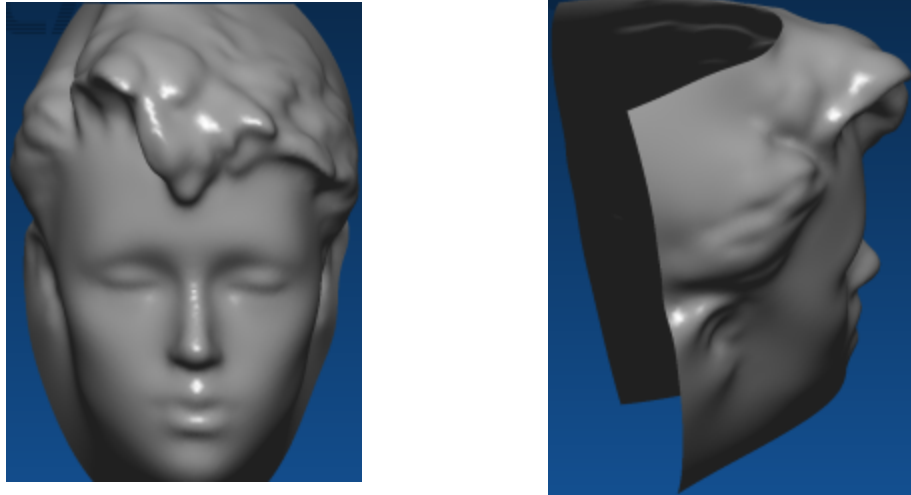


(b) RBF Surface Trimmed to Data

Trimmed to Data and Trimmed to Edges RBF surface processing

Open at Bounding Box

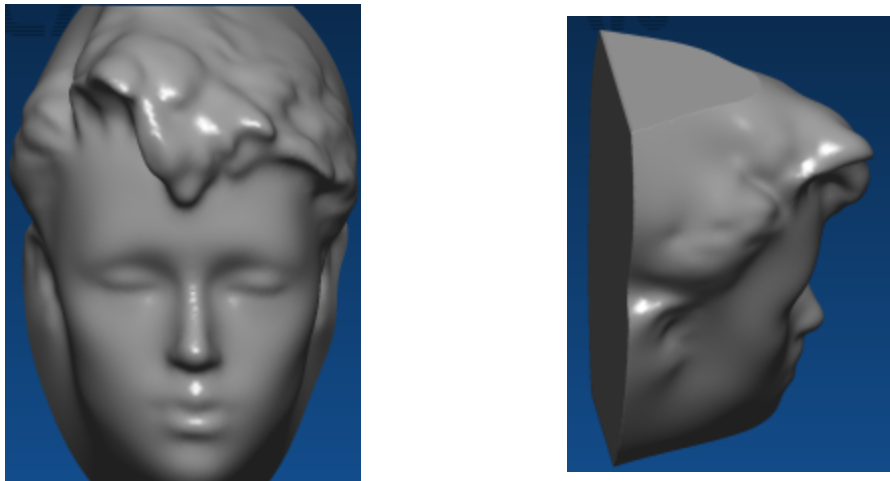
The object's surface edges are extended (using the last direction of the data), stopping with a smooth edge when they reach the Bounding Box (as below). Holes are filled in.



Two views of Open at Bounding Box RBF processing

Closed at Bounding Box

The object's surface edges are extended to, and around, the faces of the Bounding Box, creating a closed (watertight) object (as below).

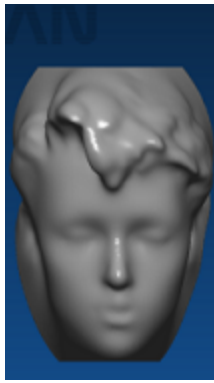


Two views of **Closed at Bounding Box** RBF processing

Margin Size

Use the Margin Size to set the desired distance between the RBF Surface and the Bounding Box or trim edge. For example, a Margin Size value of 20 when using "open" or "closed" edges will continue the surface for 20 mm in the direction the data was last going in, creating a new Bounding Box around the extended edges (as below). When using "trimmed" edges it will remove all points that are more than 20mm from all RBF Surface points.

Note: The Margin Size can be used to create a buffer zone around the edge of an object and may increase the size of the Bounding Box.



(a) 5mm



(b) 20mm



(c) 50mm

Different Surface Margin sizes.



RBF Surface Simplification

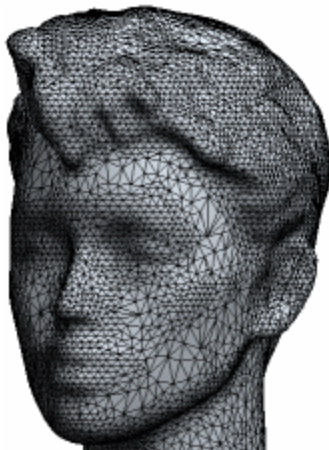
Simplification is used to reduce the complexity of the RBF Surface. **RBF Surface Simplification** uses features of the FastRBF method to create a simplified surface that is guaranteed to be accurate with respect to the original surface. This process produces excellent surfaces, but can be time consuming.

Simplification Target

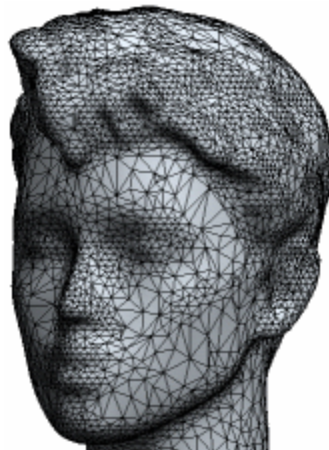
You can choose between three “targets” for RBF simplification. The simplifier will work until the specified target is reached (for extreme targets, processing may stop prematurely).

Error

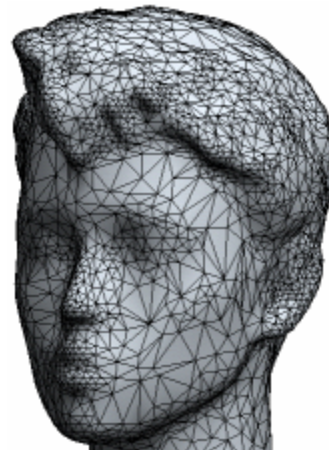
Simplifies until the error between the simplified and unsimplified surfaces reaches the specified value. The image below shows the same surface simplified to different error targets.



(a) 0.1mm (19 951 triangles)



(b) 0.2mm (12 222 triangles)



(c) 0.4mm (6 745 triangles)

Simplification with different error targets.

Number of Triangles

Reduces the output surface to the specified number of triangles. Extremely small values will generate meaningless surfaces.

Number of Points

Simplifies until the output surface is reduced to the specified number of points. Again, extremely small values will generate meaningless surfaces.

FastSCAN II Stylus

Many applications require the placement of points onto a 3D surface in addition to the captured 3D surface itself. This can be done using a **point digitizer**. Two different methods of point placement/digitization have been integrated into FastSCAN II:

1. The optical stylus—a non-contact marking device contained within the Wand.
2. Mark with Mouse—used to place points directly onto the captured surface by using your computer's mouse.

With all methods the digitized points and orientations (optional) are saved into the **.fsn** file, and in some instances can be integrated into export file formats, e.g. AAOP/OP3 file format.

Both Mark with Mouse and optical stylus use a common data structure and properties dialog box—they are simply different ways of applying reference points and lines to the surface.



Optical Stylus

The FastSCAN II Wand can be turned into a point digitizer, or **optical stylus**, by changing the mode the Wand is in. While in optical stylus mode the location of the (laser) point on the object's surface and the orientation of the Wand are recorded whenever the Wand's trigger is depressed.

Optical Stylus Setup

To setup the FastSCAN II Wand for use as an optical stylus:

1. Scan the object.
2. When you are ready to collect points or lines put the Wand into Point Mode, this can be done either using the Wand itself or through the Software (1 or 2 below):
 1. Put the FastSCAN II software into laser pointer mode by clicking on **Stylus/Laser Pointer Mode** or the **Laser Pointer Mode** icon on the toolbar (these options are only available when the correct license has been installed and the FastSCAN II software has been correctly initialized).
 2. Point the Wand 180° away from the Receiver and press the Trigger, this will Scroll through **Scan**, **Point** and **Line** Modes as indicated by the green indicators on the back of the [Wand](#).
3. The optical stylus is now ready for use.



Mark with Mouse

Mark with Mouse allows the user to place reference marks directly onto the surface of a scanned object. Unlike the mechanical and optical styli, which must be used at the time the object is being scanned, the Mark with Mouse function allows the user to place marker points and lines onto previously captured data.

See the [Mark with Mouse](#) section for comprehensive instructions on how to use this function.

Activating Mark-With-Mouse Mode

Mark with Mouse can be activated by selecting the Mark with Mouse option in the **Stylus** menu, or by pressing the Mark with Mouse icon on the toolbar. Mark with Mouse mode is indicated by the mouse

cursor changing into a cross-hair.

Note:

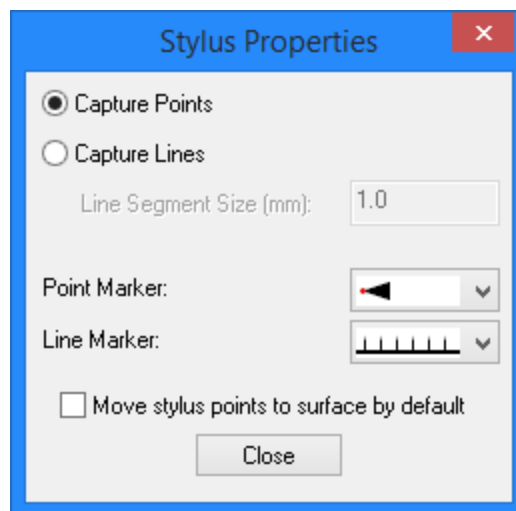
- There must be data on the screen and FastSCAN II must be in the **sweeps view mode** for the Mark with Mouse option to be active.
- The Mark with Mouse mode can be exited by pressing the **Esc** key or clicking on the Mark with Mouse icon a second time.

Placing Points and Lines with the Stylus

Once the wand is in either point or line mode, each click of the stylus button/trigger generates a marker (point or line) on the scanned object's surface.

Placing points

Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box (as below). Ensure that the **Capture Points** option is selected and the stylus is correctly setup.

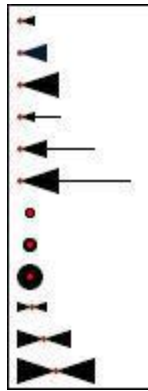


The Stylus Properties dialog box.

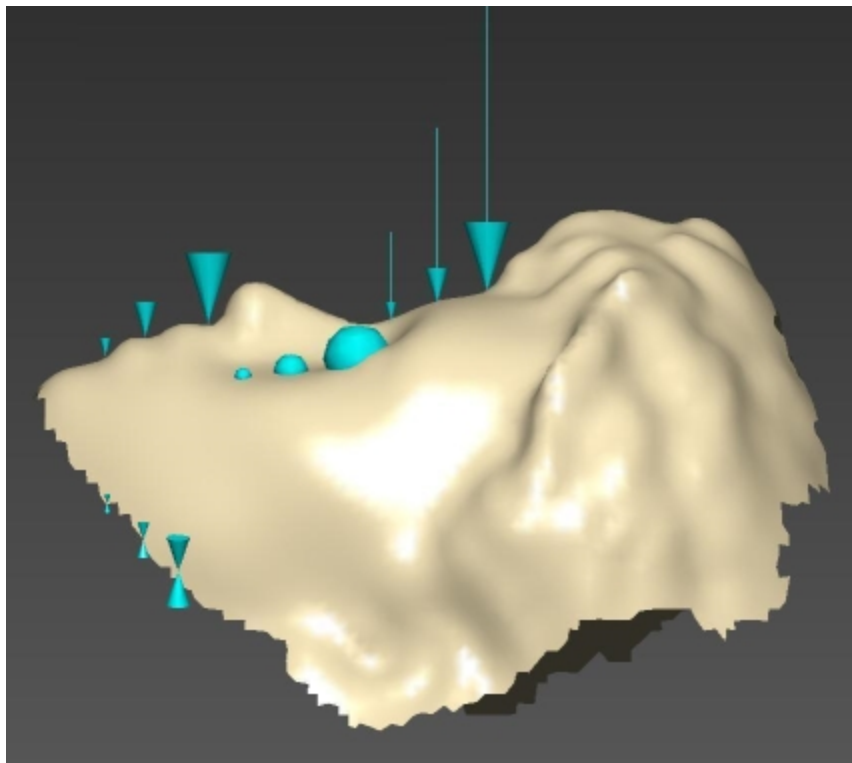
Ensure the feature you wish to place a point on is facing the front of the screen (rotate if necessary), then point the stylus at the desired location on the object and **press the button/trigger**. A single marker point will be placed on the surface of the object, normal to the stylus orientation.

Point options

Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box. Then click on the drop-down menu to the right of **Point Marker**. Select your preferred point style from the menu (as below).



The Point Marker options drop-down menu.



The different point options as applied to an object.

Placing lines

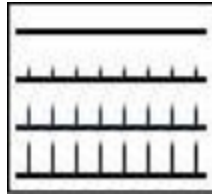
Click on **Stylus/Properties** to bring up the [Stylus Properties](#) dialog box. Ensure that the **Capture Lines** option is selected and the wand is in the correct mode.

Ensure the feature you wish to place a line on is facing the front of the screen (rotate if necessary), then point the stylus at the desired location on the object, **press the button/trigger and drag** in the desired direction to draw the line on the object surface.

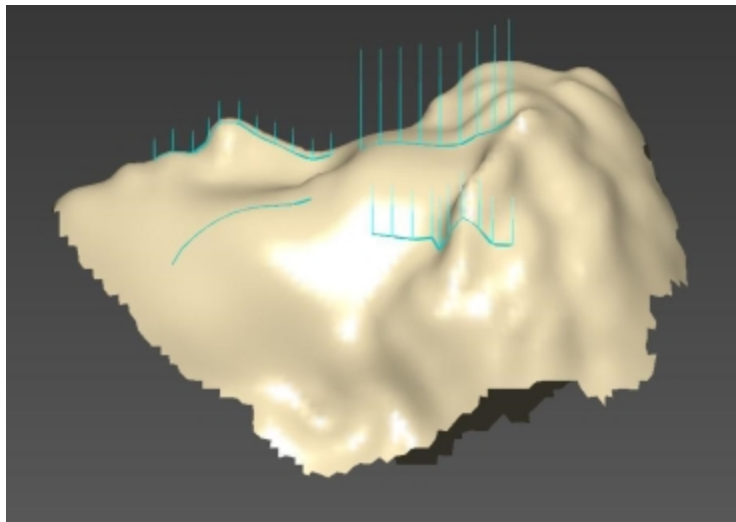
Line options

Click on **Stylus/Properties** to bring up the [Stylus Properties](#) dialog box. Then click on the drop-down menu to the right of **Line Marker**:. Select your preferred line style from the menu (as below).

Line segments (vertical “hairs” coming off the line, as shown in the images below) are the normals and represent the position and orientation of the stylus at that point of the line. The space between these can be user defined (according to the size required) in the **Line Segment Size (mm)**: entry box in the **Stylus Properties** dialog box. More points per millimeter gives a smoother line, less points a coarser one.



The Line Marker options drop-down menu.



The different line options as applied to an object.

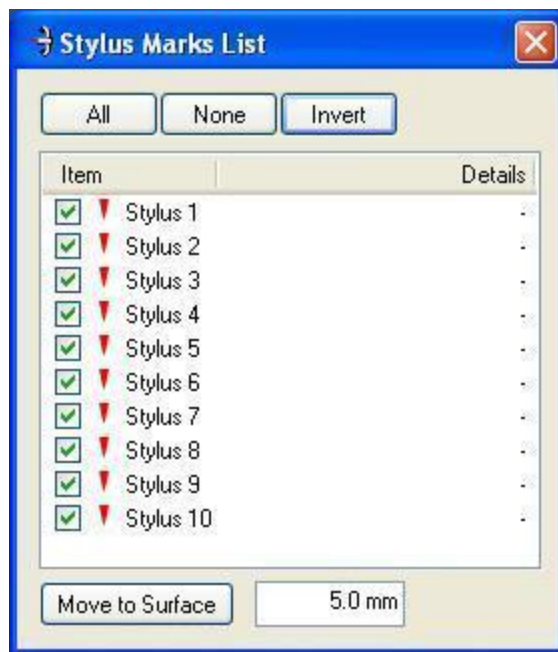
Removing Points & Lines

You can remove the last added stylus point/line by clicking on **Stylus/Undo Stylus Mark** or by double clicking the Wand trigger (if using the optical stylus—triple clicking will remove all applied point-s/lines—this function is enabled via **Settings /Wand**).



Viewing Options

The stylus points may be turned off to view a clean image. Click on **Edit/Stylus Marks List...** or the Stylus Marks List icon (or Ctrl+T) to bring up the **Stylus Marks List** dialog box (as below). Select **None** or uncheck individual boxes in the list to view the object without the (selected) points.



The **Stylus Marks List** dialog box.

Hidden points or lines are ignored when processing and exporting, but are saved by default when you save in **.fsn** format.

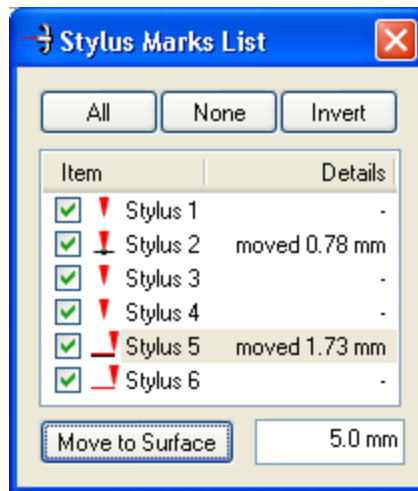
Clicking on **Invert** will uncheck all checked stylus boxes and check those previously unchecked.

Left-clicking the mouse on a stylus number in the **Stylus Marks List** will turn the selected point/line red. Select more than one point/line by holding down **Shift** or **Control** while selecting points.

Moving Points and Lines

The Sweeps, Basic Surface and RBF Surface are located in subtly different positions and the placed points may not be exactly touching a particular surface. The **Move to Surface** button (as below) moves a placed point onto the closest part of the surface (within a range)—this is useful if a point is required to lie *exactly* on the surface. As the Sweeps, Basic and RBF Surfaces are not exactly the same, points may move to slightly different places on each.

The range is set by entering a distance into the box beside the **Move to Surface** button.



The Stylus Marks List dialog box with moved and unmoved points and lines.

Highlight the stylus point(s)/line(s) that you want to **Move to Surface** in the **Stylus Marks List** and click on the **Move to Surface** button. The point(s)/line(s) will move to the closest part of the surface within range. If no part of the surface is within range then the point(s)/line(s) will not be moved.

When a stylus point/line has been moved to the surface, the symbol next to it in the **Stylus Marks List** changes and the distance it was moved will be displayed in the **Details** column (as above). The images below show a close up view of the symbols in the **Stylus Marks List** next to points and lines, before and after they are moved to the surface.

Alternatively, simply **double click the mouse** on an item in the **Stylus Marks List**. It will be automatically moved to the surface, or, if already previously moved, will be moved back to its original position.

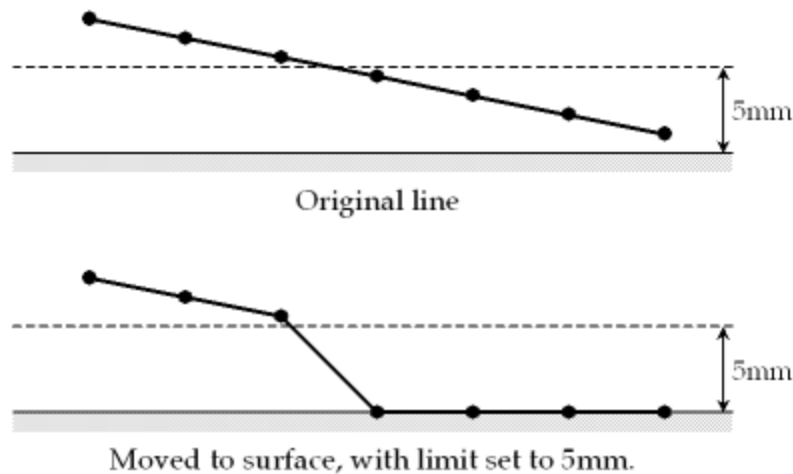


The **point symbols**: original placement (left) and moved to surface (right).



The **line symbols**: original placement (left) and moved to surface (right).

When **Move to Surface** is selected, only those samples that are close enough to the surface are moved. This may create discontinuities where the line moves off the surface (as below). If some point(s)/lines are not moved, increase the maximum move distance. Even if not all parts of a line are moved, the line will still be marked as being on the surface; to recalculate its position, switch **Move to Surface** off and then on again. Lines containing a large number of sample points may take some time to move.

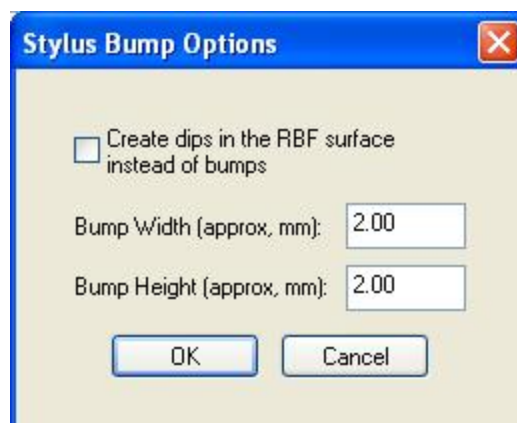


A line partially moved onto the surface.

Stylus Mark Bumps (and Dips)

Bumps and dips can be added to the surface of an object, in the same positions as previously placed points and lines. These are useful as reference points for milled or extruded objects, or for passing reference points/lines to a program that will not allow the exporting of stylus points/lines within the file.

Click on **Edit/Stylus Mark Bumps...** to bring up the **Stylus Bump Options** dialog box (as below).

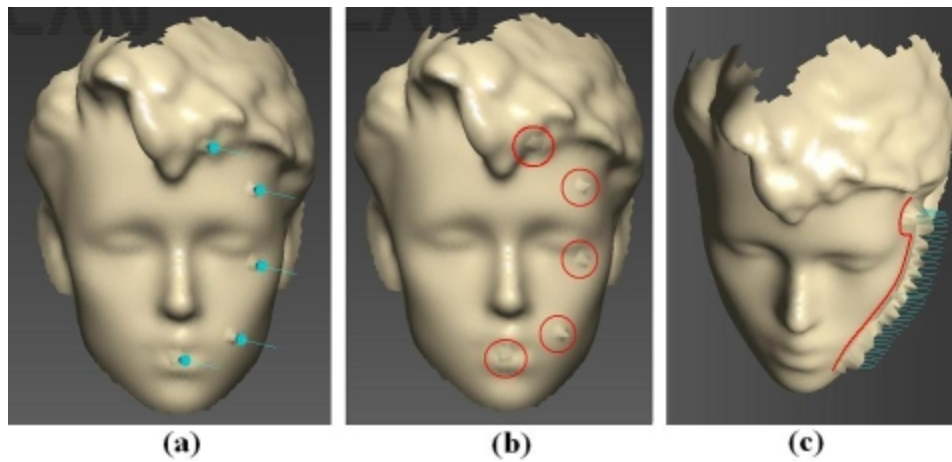


The **Stylus Bump Options** dialog box.

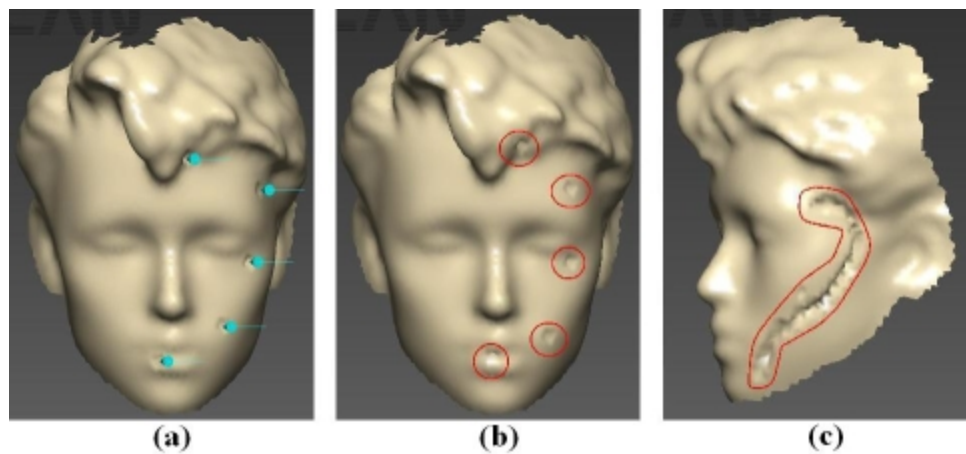
Enter the desired bump/dip width and height (**mm only**) into the **Bump Width** and **Bump Height** entry boxes and click on **OK**. Bumps are created by default—check the **Create dips in the RBF surface instead of bumps** box to create dips.

The bumps/dips will appear on the object in the same positions as the previously applied points and lines (as shown in images below). A point/line must be visible in order for a bump/dip to be applied and will remain visible after application. Open the **Stylus Marks List** dialog box and uncheck the relevant points/lines to see the bumps/dips without the points/lines present.

To remove a bump/dip, uncheck the associated point/line in the **Stylus Marks List** dialog box, then reapply bumps/dips to the object. The bumps/dip without a marker or line present will then be removed.



Bumps applied to an object, on points (a & b (hidden)) and lines (c).



Dips applied to an object, on points (a & b (hidden)) and lines (c (hidden)).

The Stylus menu

- **Undo Stylus Mark:** Removes the most recently placed point or line.
- **Redo Stylus Mark:** Reapplies the most recently removed point or line.
- **Automatic Viewpoint:** Centers the screen view on the marker point or line when a point or line is placed.
- **Beep on Collect:** Each time a point or line is placed a small **Beep** is emitted.
- **Laser Pointer Mode:** Enables or disables **Laser Pointer** mode (if available).
- **Mark with Mouse:** Activates **Mark with Mouse** mode (a tick will appear next to it).
- **Properties:** Launches the [Stylus Properties dialog box](#).

Exporting

All stylus data is saved along with the sweeps, when the **.fsn** file is saved. In some instances it is also integrated into export file formats, e.g. AAOP. The stylus data may also be exported independently of the scanner data.

Export Stylus Points Dialog Box

To save stylus point/line locations, select **File/Export As/Stylus Points**. If you have moved some stylus points to the surface, the on-surface locations will be saved for the exported/currently visible surface (not the original point/line locations).

The **Export Stylus Points** dialog box is shown in the image below. The points/lines data can be exported as Comma Separated Values (**.csv**) or ASCII text (**.txt**).

Coordinate System

As when exporting surfaces, stylus data can be exported in either the Screen View, Tracker Reference or Bounding Box coordinate systems.

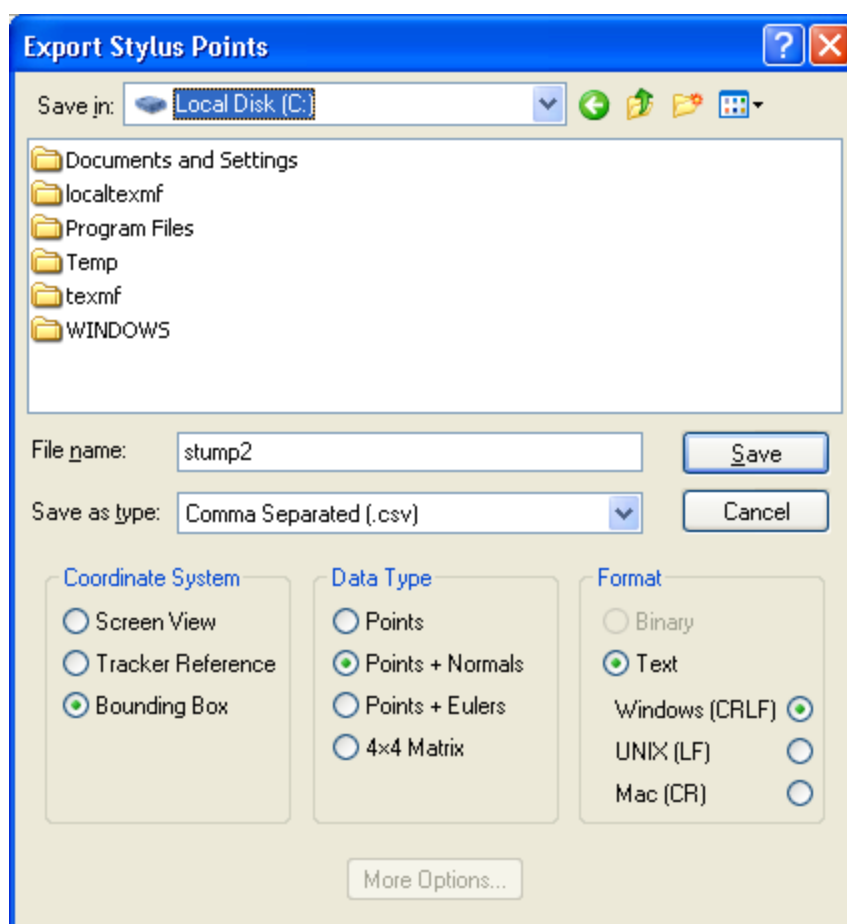
Data Type

Select from four **data types** to control what data is saved:

- **Points:** Saves only the x, y and z values.
- **Points + Normals:** Also saves the stylus orientation as the three elements—dx, dy and dz—of the vector pointing in the same direction as the stylus.
- **Points + Eulers:** Saves the orientation of the stylus as three Euler angles.
- **4 x 4 Matrix:** Saves the complete orientation matrix of the stylus in row-major order (the first four numbers are the first row, the next four numbers the second row, etc).

Format

The **text** format is automatically selected when exporting point/line data. In addition you can select which operating system is being used with the file: **Windows**, **Unix** or **Mac**.



The **Export Stylus Points** dialog box.

CSV Export Format

CSV (Comma Separated Values) is a simple, portable spreadsheet format, able to be used with any common spreadsheet software. The CSV export format contains one row for each sample. Hidden points and lines will not be included. A point will be a single sample; a line will be a series of samples. The column headings in the file depend on the **data type** that you export.

Columns exported across all four **data types** are:

- **item**: The item number of the point or line. Each point, and the whole of each line, counts as a single item.
- **line index**: If the sample is a line, the index position of that sample in the line. This is blank if the sample is a point.
- x, y, z: Spatial coordinates of the sample.
- **on surface**: **TRUE** if the sample has been moved to the surface, **FALSE** if not.

Columns displayed with the **Points + Normals** data type are:

- dx, dy, dz: The vector giving the direction of the stylus orientation for the sample.

Columns displayed with the **Points + Eulers** data type are:

- **alpha, beta, gamma** The Euler angles giving the orientation of the stylus for the sample.

Columns displayed with the 4 x 4 **Matrix** data type give the 16-element orientation matrix of the stylus (in row major order—the sample location (x, y and z coordinates) is a part of this matrix).

The image below shows a sample CSV export file, using **Points** data type, containing two points (items 1 and 2) and part of a line (item 7), when loaded into Excel.

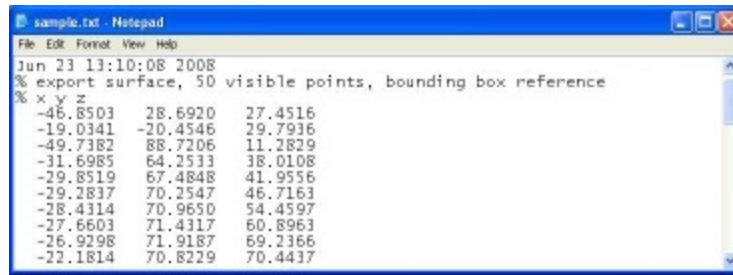
	A	B	C	D	E	F	G	H
1	CSV stylus data file created by FastSCAN V4.0.5 on Mon Jun 23 13:05:11 2008							
2	(export surface, 50 visible points, bounding box reference)							
3	item	line index		x	y	z		on surface
4								
5	1			-46.8503	28.692	27.4516		TRUE
6	2			-19.0341	-20.4546	29.7936		FALSE
7	7	1		-49.7382	88.7206	11.2829		FALSE
8	7	2		-31.6985	64.2533	38.0108		FALSE
9	7	3		-29.8519	67.4848	41.9556		FALSE

A CSV export file loaded into Excel.

ASCII Export Format

The ASCII export format (as below) is similar to, but simpler than, the CSV format. It uses white-space separated fields and comment lines start with %. The column headings "item", "line index" and "on

surface” are not included, so there is no way to determine whether a sample point is on the surface or part of a line. If this extra information is not needed the ASCII format may be easier to use.



```
sample.txt - Notepad
File Edit Format View Help
Jun 23 13:10:08 2008
% export surface, 50 visible points, bounding box reference
% x y z
-46.8503 28.6920 27.4516
-19.0341 -20.4546 29.7936
-49.7382 88.7206 11.2829
-31.6985 64.2533 38.0108
-29.8519 67.4848 41.9556
-29.2837 70.2547 46.7163
-28.4314 70.9650 54.4597
-27.6603 71.4317 60.8963
-26.9298 71.9187 69.2366
-22.1814 70.8229 70.4437
```

An ASCII text file.

Mark with Mouse

The Mark with Mouse™ function is a feature of FastSCAN II that allows the user to place reference marks directly on to the surface of a scanned object. Unlike the optical stylus option (which must be used at the time the object is being scanned) the Mark with Mouse function **allows the user to place marker points and lines onto previously captured data**.

Mark with Mouse, the Stylus and Laser Pointer all use a common data structure and properties dialog box—they are simply different ways of applying reference points and lines to an object's surface.

Note: Stylus points and lines cannot be placed where no data is present when using the Mark With Mouse function.

The Mark with Mouse mode can be used in conjunction with the optical stylus.



Activating Mark with Mouse Mode

For FastSCAN II Mark with Mouse can be enabled by selecting **Stylus/Mark with Mouse**, or by pressing the **Mark with Mouse icon**. The mouse arrow will change into a cross-hair to indicate that FastSCAN II is in Mark with Mouse mode.

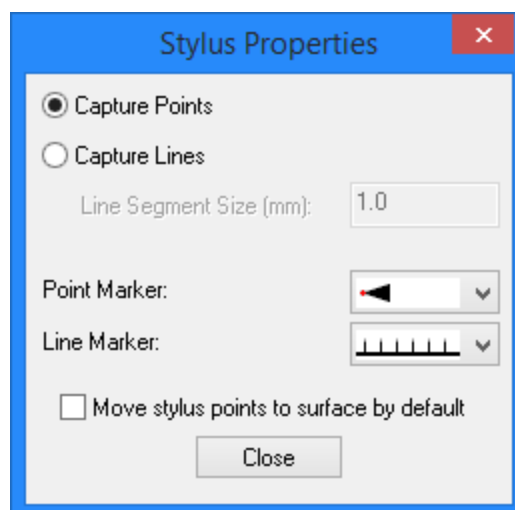
Mark with Mouse mode can be exited by pressing the **Esc** key or pressing the **Mark with Mouse icon** a second time.



Applying Marker Points and Lines

Placing points

Ensure the feature you wish to mark is facing the front of screen (rotate if necessary) and enable Mark with Mouse mode.



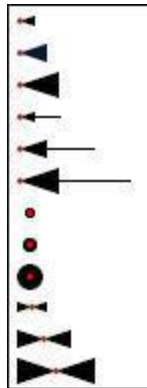
The Stylus Properties dialog box.

Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box (as above). Ensure that the **Capture Points** option is selected. Then, using the mouse, center the Mark with Mouse **cross hair** over the

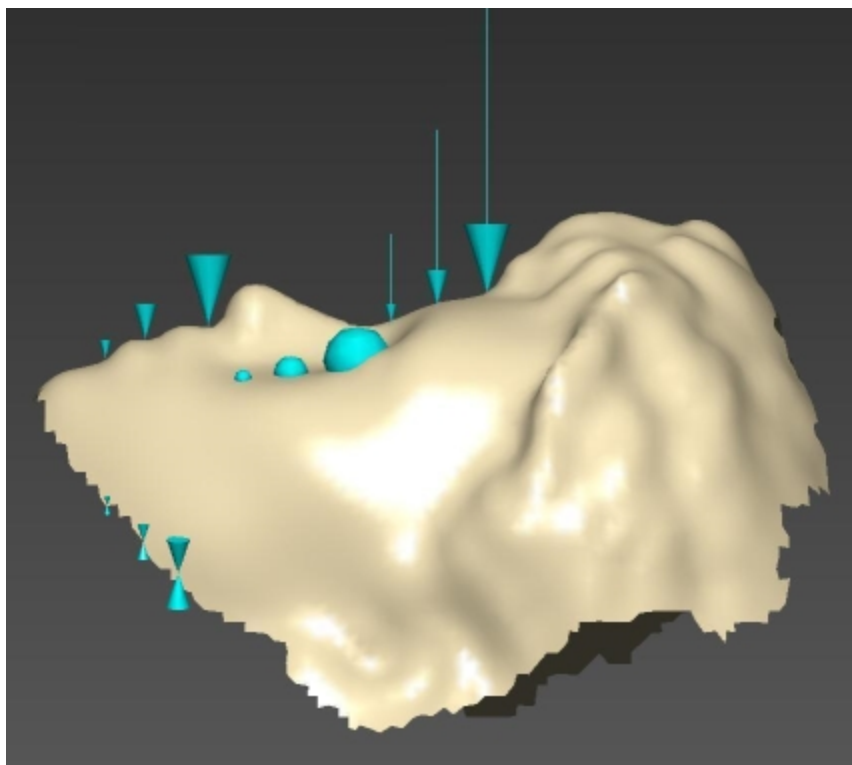
desired location and press the left mouse button. A single marker point will be placed on the surface of the object in the center of the cross hair, with the tail of the marker **set normal to the current screen view**.

Point options

Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box. Then click on the drop-down menu to the right of **Point Marker**:. Select your preferred point style from the menu (as below).



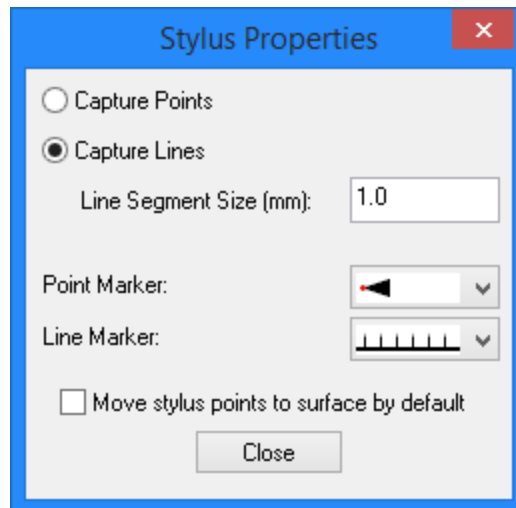
The Point Marker options drop-down menu.



The different point options as applied to an object.

Placing lines

Ensure the feature you wish to place a line on is facing the front of screen (rotate if necessary) and enable Mark with Mouse mode.

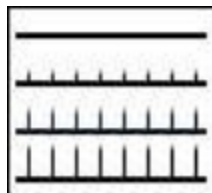


The Stylus Properties dialog box.

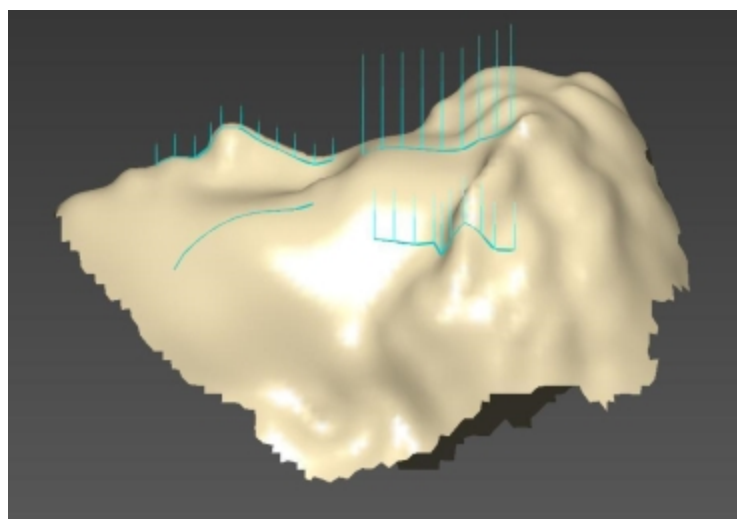
Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box (as above). Ensure that the **Capture Lines** option is selected. Then, using the mouse, center the Mark with Mouse **cross hair** over the desired location for the beginning of the line. **Press-and-hold the left mouse button** while dragging the mouse and move the cross hair in the desired direction to create the line on the object surface.

Line options

Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box. Then click on the drop-down menu to the right of **Line Marker**:. Select your preferred line style from the menu (as below).



The Line Marker options drop-down menu.

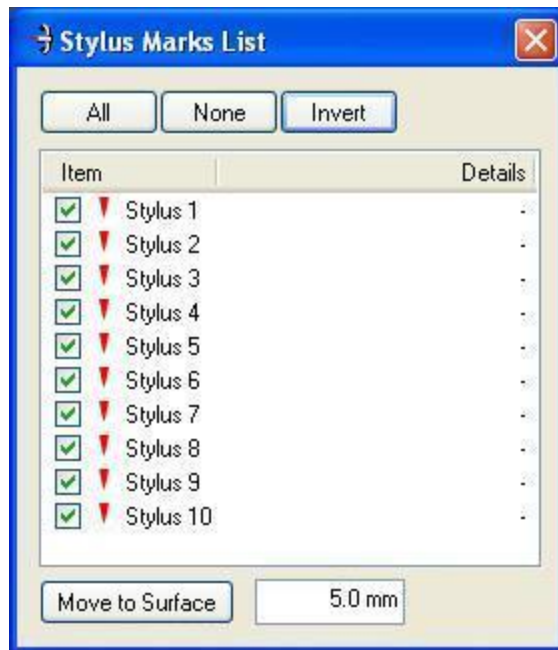


The different lines options as applied to an object.



Viewing Options

The stylus points/lines may be turned off to view a clean image. Click on **Edit/Stylus Marks List...** (Ctrl+T) or the Stylus Marks List icon, to bring up the **Stylus Marks List** dialog box (as below). Select **None** or uncheck individual boxes in the list to view the object without the (selected) points/lines.



The **Stylus Marks List** dialog box.

Clicking on **Invert** will uncheck all checked stylus point/line boxes and check those previously unchecked.

Left-clicking the mouse on a stylus number in the **Stylus Marks List** will turn the selected point/line red. Choose more than one point/line by holding down **Shift** or **Control** while selecting points/lines.

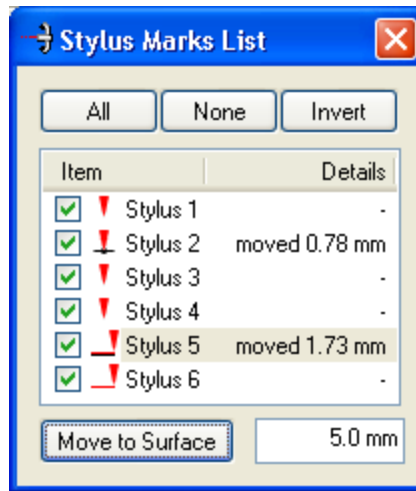
Moving Points and Lines

The Sweeps, Basic Surface, and RBF Surface are located in subtly different positions as they are not exactly the same and the placed points may not be exactly touching a particular surface. The **Move to Surface** button (as below) moves a placed point onto the closest part of the surface (within a range)—this is useful if a point is required to lie exactly on the surface.

The range is set by entering a distance into the box beside the **Move to Surface** button.

Highlight the stylus point(s)/line(s) in the **Stylus Marks List** and click on the **Move to Surface** button. The point(s)/line(s) will move to the closest part of the surface within range. If no part of the surface is within range then the point(s)/line(s) will not be moved.

When a stylus point/line has been moved to the surface, the symbol next to it in the **Stylus Marks List** changes and the distance it was moved will be displayed in the **Details** column (as below). Close up views of the symbols in the **Stylus Marks List** next to points and lines, before and after they are **moved to surface** are shown underneath.



The Stylus Marks List dialog box with moved and unmoved points and lines.



The **point symbols**: original placement (left) and moved to surface (right).



The **line symbols**: original placement (left) and moved to surface (right).

Stylus Mark Bumps (and Dips)

Bumps and dips can be added to the surface of an object, in the same positions as previously placed points and lines—useful as reference points for milled or extruded objects, or passing reference points/lines to a program that will not allow the exporting of stylus points/lines within the file.

Click on **Edit/Stylus Mark Bumps...** to bring up the **Stylus Bump Options** dialog box (as below).



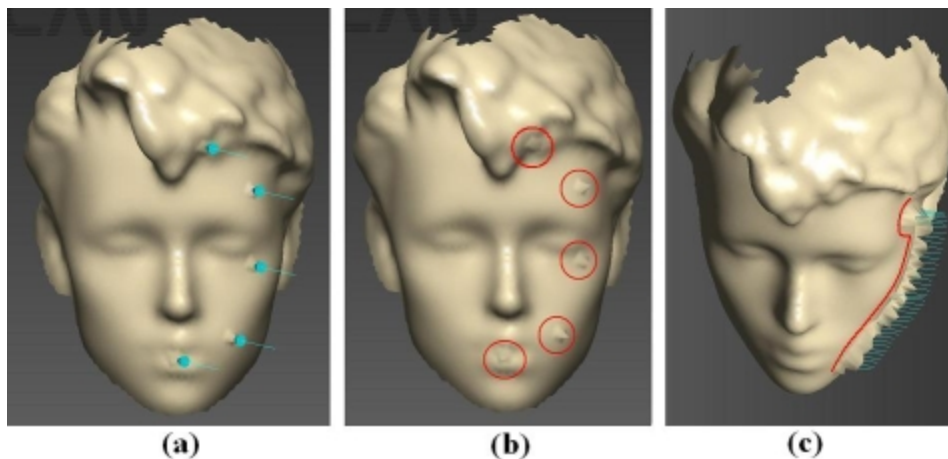
The **Stylus Bump Options** dialog box.

Enter the desired bump/dip width and height (**mm only**) into the **Bump Width** and **Bump Height** entry boxes and click on **OK**. Bumps are created by default—check the **Create dips in the RBF surface instead of bumps** box to create dips.

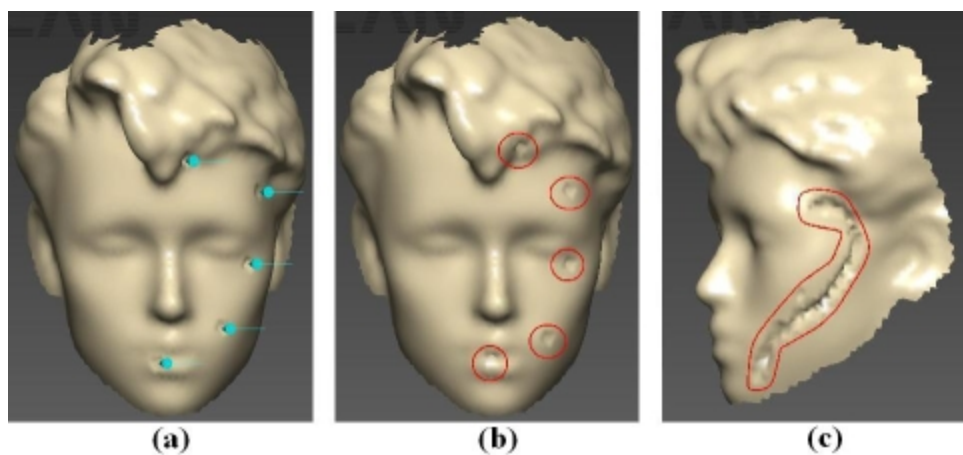
The bumps/dips will appear on the object in the same positions as the previously applied points and lines. A point/line must be visible in order for a bump/dip to be applied.

To remove a bump/dip, uncheck that stylus point/line in the **Stylus Marks List** dialog box, then reapply bumps/dips to the object. The bumps/dip without a marker or line present will then be removed.

The images below show the appearances of bumps and dips when they are applied to an object.



Bumps applied to an object, on points (a & b) and lines (c). Note: Stylus points and lines have been hidden via the **Stylus Marks List**.



Dips applied to an object, on points (a & b) and lines (c). Note: Stylus points and lines have been hidden via the **Stylus Marks List**.

The Stylus menu

- **Undo Stylus Mark:** Removes the most recently placed point or line.
- **Redo Stylus Mark:** Reapplies the most recently removed point or line.
- **Automatic Viewpoint:** Centers the screen view on the marker point or line when a point or line is placed.

- **Beep on Collect:** Each time a point or line is placed a small **Beep** is emitted.
- **Laser Pointer Mode:** Enables or disables **Laser Pointer** mode (if available).
- **Mark with Mouse:** Activates **Mark with Mouse** mode (a tick will appear next to it).
- **Properties:** Launches the [Stylus Properties dialog box](#) .

Export Options

See the [FastSCAN II Stylus](#) Section for full details on exporting points created with Mark with Mouse.

Clipping

Clipping enables removal of extraneous data from around the edges of a scanned object, such as the surface that it was scanned on (a table for example).

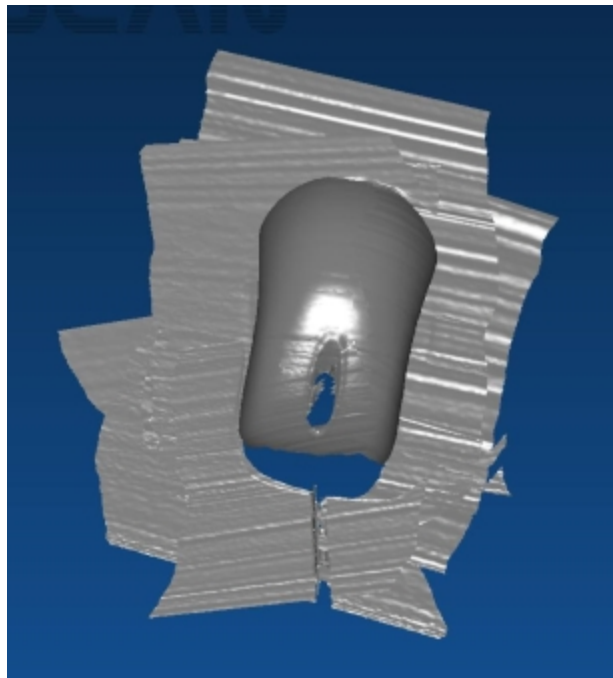
In addition, by scanning an object on a malleable or “shape changing” surface, the detail of the object’s underside can be recreated by separately scanning the (molded) base surface after scanning the object, and then processing the data with the Clipping function.

Clipping

Clipping (Automatic Baseline)

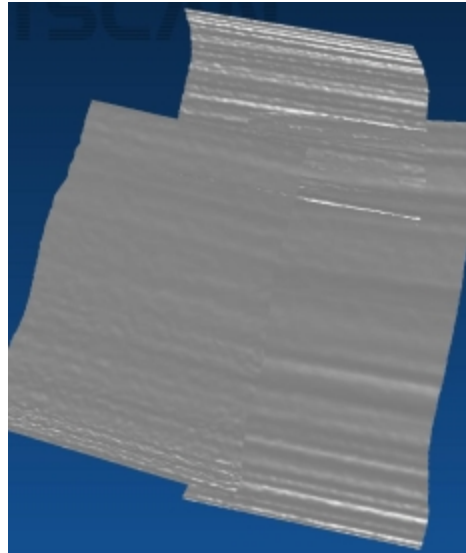
After scanning an object a separate group of sweeps can be used as a baseline from which to remove extraneous data.

1. Setup FastSCAN II and scan the object as normal (below—a computer’s mouse on a table). If the underside of the object has features that are wanted in the scan, then ensure it is sitting on a soft surface that will mold to it.



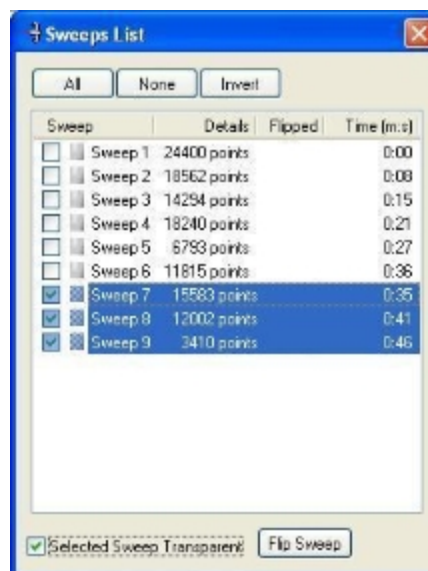
The scanned object sweeps.

2. When the object has been scanned satisfactorily, remove it from the scanning area, taking care not to disturb the Receiver or to alter the shape of the base surface (if it is on a soft surface that has molded in the shape of the base of the object).
3. Scan the surface area where the object was sitting to create the **baseline surface sweeps** (as below—the table under the mouse). Take note of how many sweeps are used to do this (in this case, three).



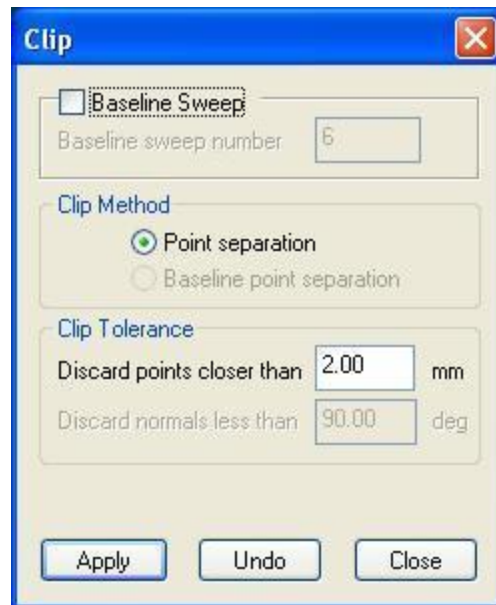
The baseline surface sweeps.

4. Open the **Sweeps List** dialog box (**Edit/Sweeps List** or **Ctrl+W**)(as below).



The **Sweeps List** dialog box.

5. Select the sweeps used to scan the base surface (as above). **Left-click the mouse** on the sweep's listing, pressing **Shift** or **Ctrl** to select multiple sweeps. The check boxes to the left of each sweep show or hide the sweep. Sweeps can be flipped even when not shown.
6. Click on the **Flip Sweep** button (as above) to flip the sweeps—this flips the normals of the selected sweeps (the base surface) —these sweeps are then automatically nominated as the baseline for the Clipping function. In addition, when surface processing occurs, the details of the base of the object will be in the correct orientation, rather than inside out.
7. Select **Edit/Clipping...** to open the **Clip** dialog box (as below).



The **Clip** dialog box.

8. Leave the **Baseline Sweep** box unchecked (the flipped sweeps will be used as the baseline). The **Clip Method** will default to **Point separation** (as above).
9. Under **Clip Tolerance** select the distance from the baseline within which you wish data to be removed from, and enter into the **Discard points closer than** entry box (as above).
10. Click **Apply**. Object sweep points within the **Clip Tolerance** range of the baseline will be deleted. The baseline sweeps' points that have those object sweep points near them will also be deleted. Baseline sweep points with no object points near them (within the **Clip Tolerance** range) will remain (as below).



The object after clipping (Sweeps List dialog box inset).

For example, if the object was scanned on a table, there will be data points from the table present in both the [object sweeps](#) and the [baseline \(flipped\) sweeps](#), lying in the same plane.

Some of the object sweeps' data points from the table's surface will fall within the **Clip Tolerance** range of the baseline—these points will be deleted—other parts of the object sweeps (the object itself) will lie outside the range and not be deleted.

Any baseline (flipped sweeps) data points that have object data points within the Clip Tolerance range of them will also be deleted. Since most object surface points are not within the **Clip Tolerance** range of the baseline underneath them, the baseline data lying **under** the object is not deleted (the black data under the mouse - shown above), effectively creating a base for the object.

Some outlying data (baseline sweeps with no object data near them within the set range) may still be present after Clipping and may need to be manually selected and deleted (outlying black data in the above image). Alternatively, setting the **Limit Objects to:** value to **1** or **2** can perform this function.

11. The object can now be processed through to the Basic and RBF surface stages (as below).



The basic surface, generated from an object with Clipping applied.

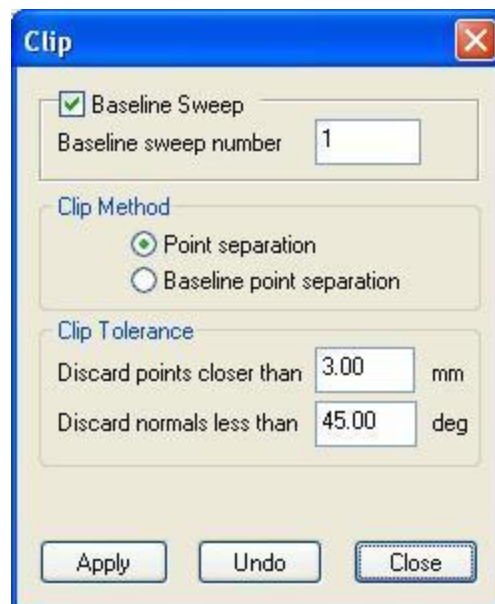
Clipping (Nominated Baseline Sweep)

[Clipping](#), as previously explained, can leave a “seam” due to points on the side of the object getting clipped away with the extraneous surface data. The **Baseline Sweep** method avoids this by preventing points that obviously lie on the object surface from being clipped, through introduction of another parameter.

An individual sweep is nominated as the baseline for use in the Clipping function. This baseline sweep's orientation information is set as typical of those points to be clipped, and only points orientated similarly (within certain parameters) to those of the baseline sweep will be clipped.

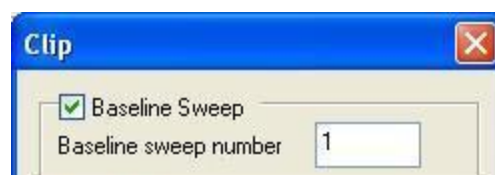
The **Baseline Sweep** method uses the angles of the data points' normals in addition to the distances between points, to select which points will be clipped. Both requirements (Discard points closer than and Discard normals less than) need to be fulfilled in order for points to be deleted. The baseline sweep will always be deleted in full.

This method avoids clipping points away from the side of the object, as they will (theoretically) lie at a different orientation to the baseline sweep's points.



The **Clip** dialog box with **Baseline Sweep** checked.

1. Perform the first two steps of [clipping](#).
2. After the object has been removed from the scanning surface, perform a single sweep along the surface to use as the baseline sweep (for specifying typical orientation information for Clipping). Note which number sweep this is.
3. Select **Edit/Clipping...** to open the **Clip** dialog box (as above).
4. Check the **Baseline Sweep** box (as below) to enable trimming of points with similar orientation to the baseline sweep. This will make both options under **Clip Method** available.



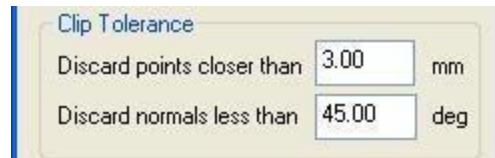
The **Baseline Sweep** section of the **Clip** dialog box .

5. Enter the number of the sweep you wish to use as the baseline into the **Baseline sweep number** entry box within the **Clip** dialog. When Clipping is applied this sweep will automatically be removed.

Clip Tolerance

Clip Tolerance sets the parameters relative to the baseline sweep, within which points will be clipped. Both parameters need to be met for a point to be clipped.

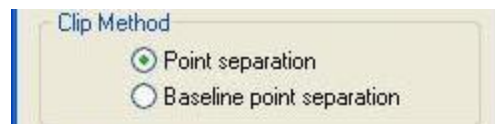
- **Discard points closer than** sets the distance from the baseline sweep (and flipped sweeps, depending on the **Clip Method** selected) within which points will be clipped.
- **Discard normals less than** sets the angle of the object sweeps' points' normals to the baseline sweep's points' normals, less than which points will be clipped.



The **Clip Tolerance** section of the **Clip** dialog box .

Clip Method: Point separation

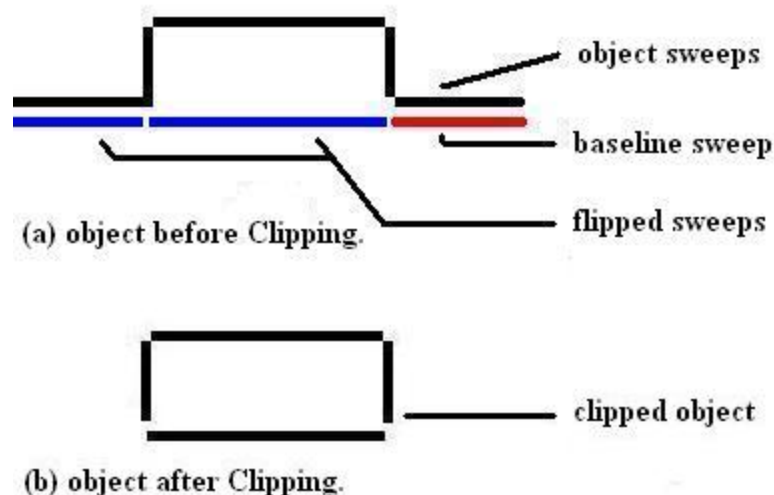
Choosing **Point separation** enables the Clipping function to apply both parameters entered under **Clip Tolerance** to points above and below the baseline sweep and flipped sweeps.



The **Clip Method** section of the **Clip** dialog box .

Note: Ensure that sweeps that make up the base of the object, and/or areas where you wish clipping to occur, have been flipped in the **Sweeps List** dialog box before commencing Clipping. Flipping the sweeps enables the Clipping function to check near those sweeps for points to be clipped.

- Under the **Clip Tolerance** section in the **Clip** dialog box, enter the desired values into the **Discard points closer than** and **Discard normals less than** entry boxes.
- Click **Apply**. Object sweep points that fit the parameters set under **Clip Tolerance** will be clipped, including the flipped sweeps' points that lie under them. The baseline sweep is always clipped, in full (as below).

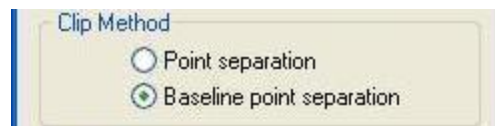


Clipping with **Clip Method: Point separation**

Clip Method: Baseline Point separation

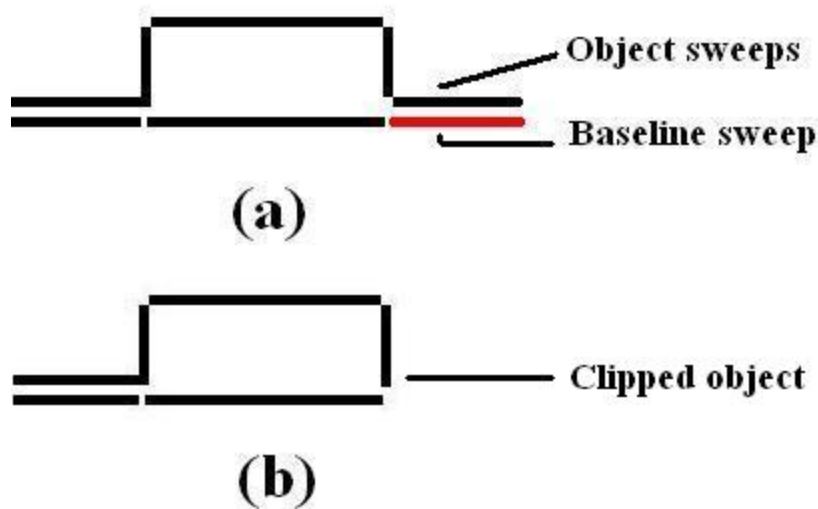
Choosing **Baseline point separation** means the Clipping function will take both parameters entered under **Clip Tolerance** and apply them to points within the region of the baseline sweep only.

As only one sweep is used as the baseline (there are no flipped sweeps utilized in this method), it is better suited to small objects, and objects that do not require a base surface/bottom. Larger objects may need to be clipped several times, with a different nominated baseline sweep each time.



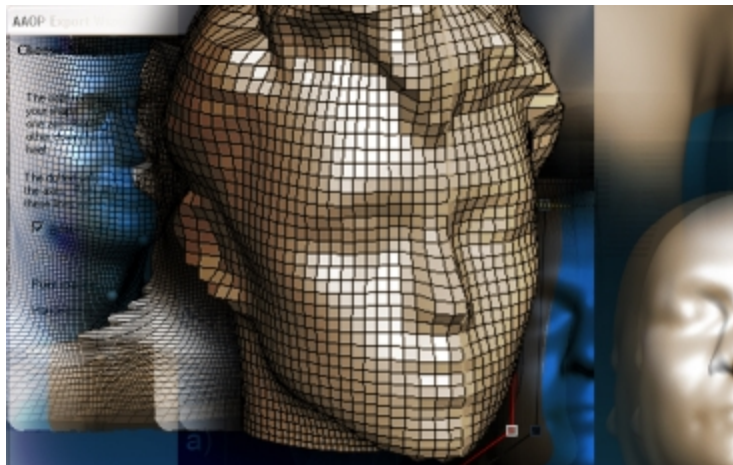
The **Clip Method** section of the **Clip** dialog box .

- Under the **Clip Tolerance** section in the **Clip** dialog box, enter the desired values into the **Discard points closer than** and **Discard normals less than** entry boxes.
- Click **Apply**. The object sweep points, within the region of the baseline sweep, that fit the parameters listed under **Clip Tolerance** will be clipped, as well as the baseline sweep (as below).



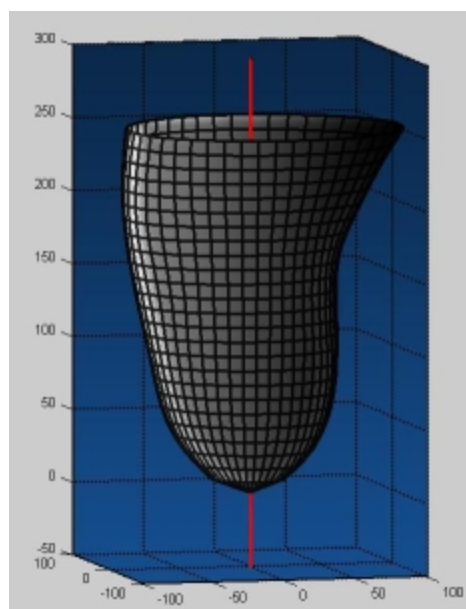
Clipping with **Clip Method: Baseline point separation**.

AAOP Export Wizard



The American Academy of Orthotists and Prosthetists (AAOP) file format is a three dimensional format supported by a number of Orthotics and Prosthetics (O&P) CAD packages. The AAOP Export Wizard™ is a means of generating AAOP files; it aids the user in converting the 3D scan data (as captured by the handheld laser scanner) into the form required for the AAOP package.

The Structure of the AAOP file



The 3D data of an AAOP file.

An AAOP object is divided into vertical and horizontal “slices”. Data is sampled at regularly spaced, user defined intervals **around** the vertical axis, e.g. every 4° for example, to create the vertical slices, and at user defined distances **along** the vertical axis to create the horizontal slices. A 3D data point is located where the slices intersect. There must be one 3D point at each angular spacing about the axis.

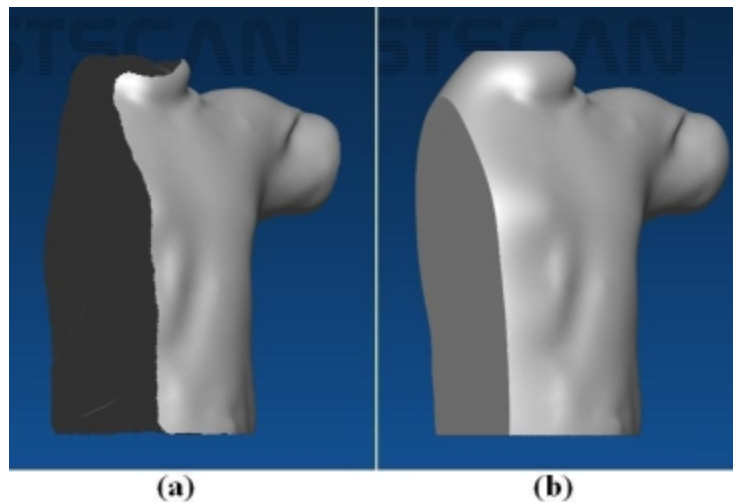
A key requirement of the AAOP object is the existence of a single axis (marked in red) that passes vertically through the object.

This axis must:

- remain within the object for its entire length
- only exit the topmost or the lowermost part of the data.

Therefore, while an AAOP file can be used to efficiently describe a residual limb, it cannot be used to describe a typical banana (for example), as a single axis that passes through a banana for its entire length cannot be drawn. An **OP3** (or **Divergent axes**) object is used for this purpose, in which the axis is bent through three points and a curve created for the “slices” to follow.

An AAOP file cannot be used to describe an “open” scan, such as the shoulder shown in (a) below. However, it is possible to close over the hole (via RBF surfacing) that is present in such a scan before entering the AAOP Export Wizard and in this way an AAOP file can be generated. Some of the data in the AAOP file will be not be physically meaningful, although this is usually (but not always) obvious.



Shoulder scan (a) unusable for AAOP file generation until it has been processed into a closed surface. (b) with the RBF Surface generated. Note that the surface in (b) contains extrapolated areas that do not correspond to parts of the patients body.



Generating the AAOP File

It is necessary to generate an RBF surface before accessing the AAOP Export Wizard, to close any holes that may be present in the scan data. It is also worthwhile aligning the object to face forwards and upwards with regard to the computer screen to aid the [automatic alignment function](#).

Using the AAOP Export Wizard

Open the AAOP Export Wizard by selecting **File/Export As/AAOP/OP3 Object...** (or click on the **Export As** icon and select **AAOP/OP3 object...** from the drop-down menu). This is only accessible if the correct license is installed and the RBF Surface has been generated.

Select Object Type

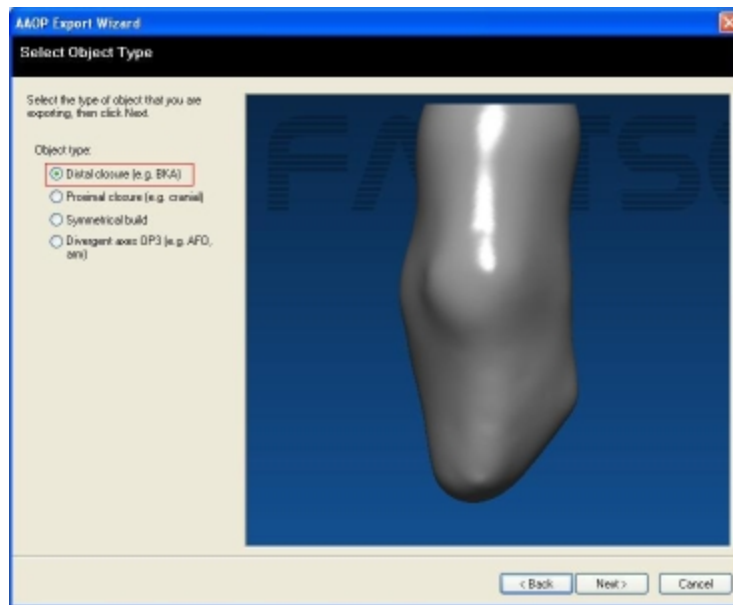
The first AAOP Export Wizard window is headed [Select Object Type](#) and requires selection of which end of the scanned object is closed, to aid the conversion process. There are four options:

- [Distal closure](#): The object is closed at the **inferior** end (bottom), i.e. a residual limb.
- [Proximal closure](#): The object is closed at the **superior** end (top), i.e. a head.
- [Symmetrical build](#): The object requires slicing and mirroring, i.e. a torso.
- [Divergent axes OP3](#): The object requires the axes to be bent, i.e. an arm or a leg.

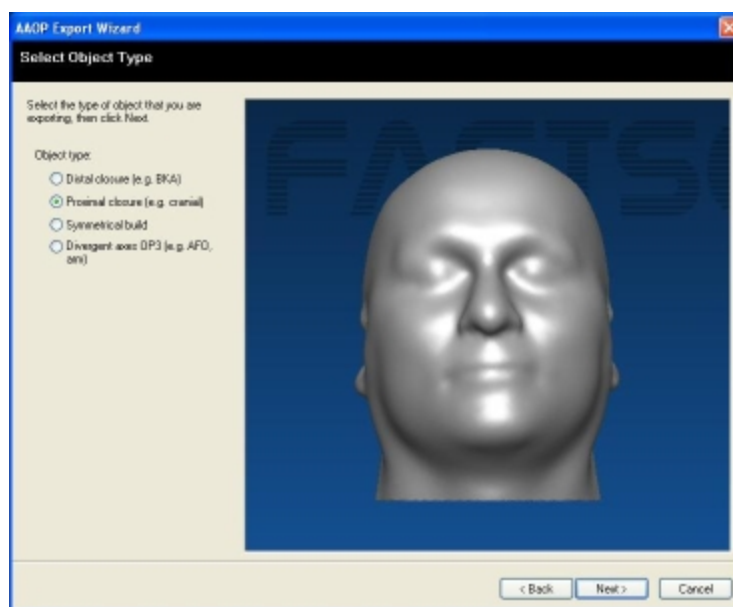
Distal closure and **Proximal closure** follow the same path to generate an AAOP file, with the only difference being that the vertical limits are set in relation to whether the object is closed at the [superior or inferior end](#).

[Symmetrical build](#) and [Divergent axes](#) follow separate processing paths to the **Distal closure** and **Proximal closure** options.

Once the object type is selected, click on the **Next** button to proceed.



The Select Object Type window (Distal closure).



The Select Object Type window (Proximal closure).

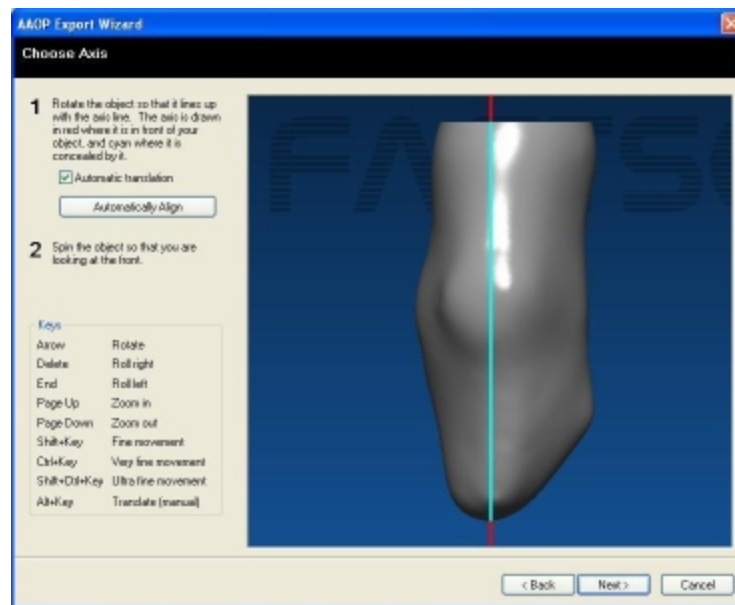
Distal & Proximal closure Object Types

Selecting **Distal closure** or **Proximal closure** will take you directly to the **Choose Axis** window (Next Section).

Choose Axis

The Choose Axis window (below) enables the user to align the object (Distal or Proximal closure) along a vertical axis, either automatically or manually.

Objects that are reasonable approximations of a cylinder usually work well with automatic alignment—simply click on the **Automatically Align** button. Use of the Automatically Align button also guarantees that the axis will pass through the extreme limit of the closed part of the surface.



The Choose Axis window, following automatic alignment—Distal Closure.

If the axis is not sitting within the object as required, manual alignment should be performed.

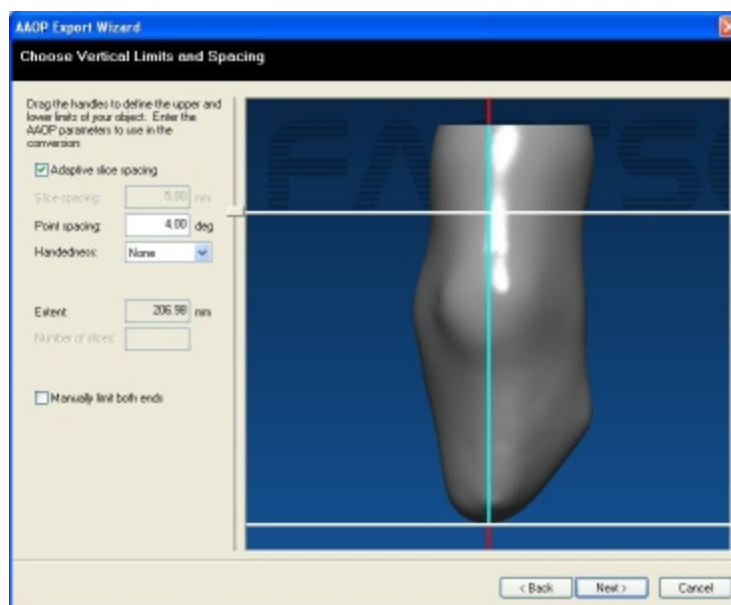
To manually align, rotate the object using the keys listed under the **Keys** heading at the left of the window. Use **Page Up** and **Page Down** to fit the object within the viewing window. If the **Automatic translation** box is checked, the object will automatically translate following any rotation, so that the axis passes through the most extreme limit of the closed part of the object. The placement of the object relative to the axis will need to be checked to ensure it fulfills [AAOP file requirements](#).

Ideally have the object facing towards the “front”, as CAD packages commonly use this information when loading the file.

Once the object is aligned, click on the **Next** button to proceed.

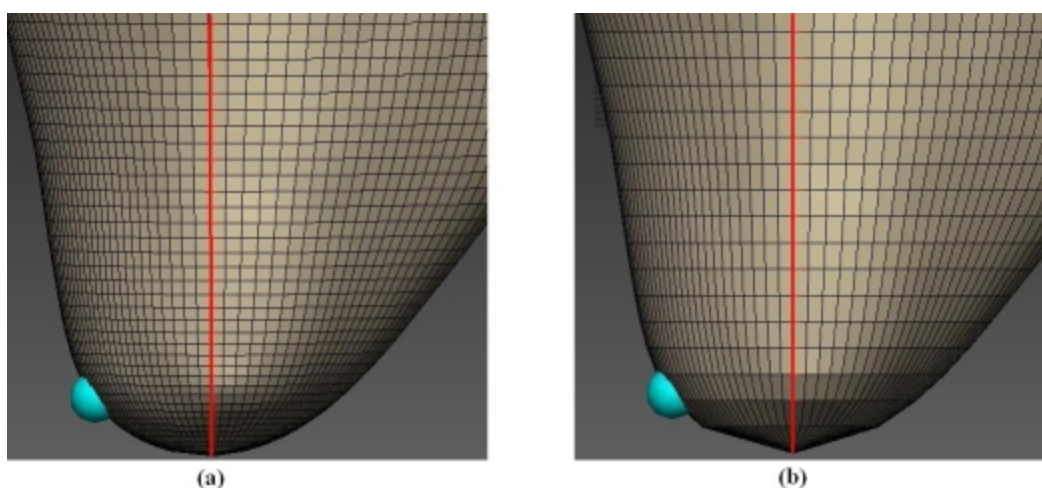
Choosing Vertical Limits and Spacing

The Choose **Vertical Limits and Spacing** window (below) is used to select **Vertical Limits** and other user definable parameters.



Check Vertical Limits and Spacing window.

- Adaptive slice spacing: enables the AAOP Export Wizard to place more points (and therefore create more horizontal slices) along the vertical axis in areas of greater detail, i.e. where there is a greater density of data points in the file from the FastSCAN II software. Slices in these areas will not necessarily be evenly spaced. The images below show an AAOP object both with and without Adaptive slice spacing applied.



An image (a): **with** Adaptive slice spacing checked; (b): **without** Adaptive slice spacing checked (**slice spacing** of 5 mm).

- **Slice spacing:** the spacing between the (horizontal) slices of the AAOP file in millimeters. ((b) above) shows an AAOP object with **slice spacing** of 5 mm.
- **Point spacing:** the angular spacing **around** the vertical axis at which points are sampled on each slice. This is extended vertically up and down to create the vertical slices.
- **Handedness:** can take the value of **None** (the default), **Left**, or **Right**, to indicate to the CAD package if the object is a left foot or right foot, etc. The **Choose one:** option lets the AAOP Export Wizard select this option.

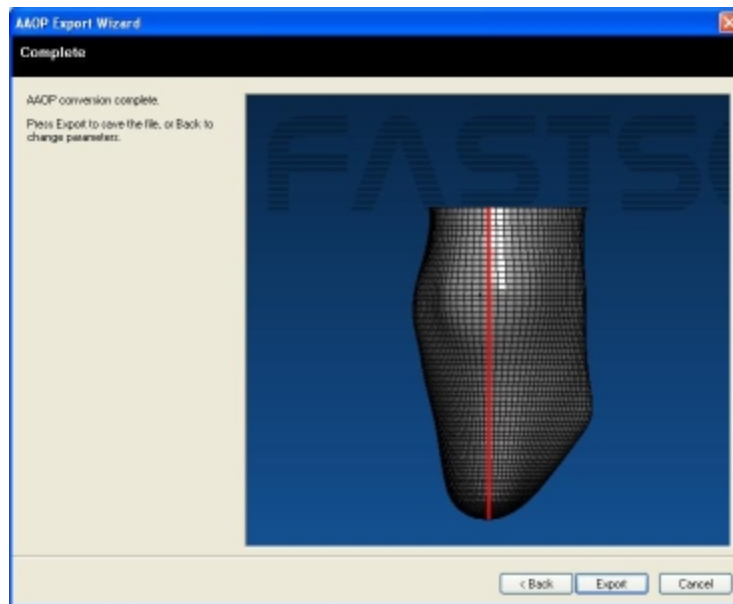
Horizontal sliders appear across the object in the [Choose Vertical Limits and Spacing](#) window and can be moved in order to limit the vertical extents of the data; bearing in mind that the sliders must be

positioned so that data exists around all sides of the axis within the slider limits. **Left-click and drag** the mouse on a slider button to move it up or down.

One slider is usually deactivated as the default setting (according to the object type selected in the first panel—the slider at the closed end of the object). It can be activated by clicking on the **Manually limit both ends** check box.

The distance between the sliders is shown in the **Extent:** box and the number of slices between the sliders in the **Number of slices:** box (if **Adaptive slice spacing** is checked the **Number of slices:** box will not display a value).

Click on the **Next** button to generate the AAOP object (as below).



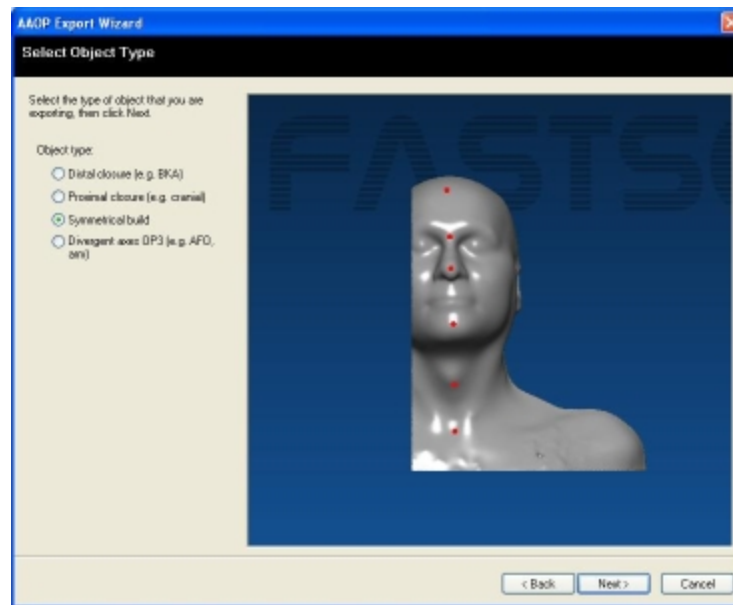
The completed AAOP object—Distal Closure.

Note: If the requirements of the AAOP format have not been met a warning will be shown. In this case click back through the AAOP windows to identify and remedy the problem—for example, the slider(s) may need moving closer together, or the axis may need realigning.

Symmetrical build Object Types

Some applications require the AAOP file to be symmetrical (where each half of the object is a mirror image of the other half). Before entering the AAOP Export Wizard it is necessary to use the Laser Pointer mode/Mark With Mouse to collect at least three points to describe the reflection plane (collecting a minimum of six points is recommended). Points may be added within the AAOP Export Wizard however they may not be as accurate.

Select **Symmetrical build** in the **Select Object Type** window (as below) and click on **Next**.



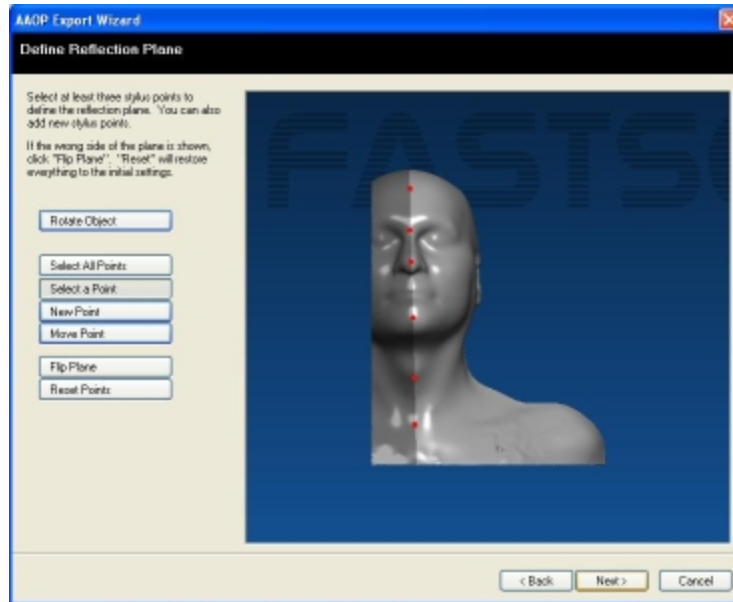
The Select Object Type window. Symmetrical build.

Define Reflection Plane

In the **Define Reflection Plane** window (as below) a darkened area on the object's surface is defined by points placed on the object (usually down its center) and this area is removed to enable mirroring of the remaining section. Points previously placed within FastSCAN II will be carried across into this window, or points may be added at this stage.

A selection of buttons are used to place points for locating the reflection plane:

- **Rotate Object:** Click the button, then **left-click and drag** the mouse over the object in the window to rotate it into the desired position.
- **Select All Points:** All placed points are used in defining the reflection plane.
- **Select a Point:** Click the button, then **left-click** the mouse on a point to select it for being used in defining the reflection plane. A point applied outside of the wizard will be red in color if it has not yet been moved and pink in color after it has been moved, while a point not being used will be light blue in color.
- **New Point:** Click the button, then **left-click** the mouse on the location on the object where a point is desired. A newly applied point will be pink in color.
- **Move Point:** Click the button, then **left-click on a point and drag** the mouse to move the point to a new location.
- **Flip Plane:** Click the button to change the side of the object that will be mirrored in the reflection plane.
- **Reset Points:** Deletes all points added from within the AAOP Export Wizard and moves previously applied points back to their original positions.



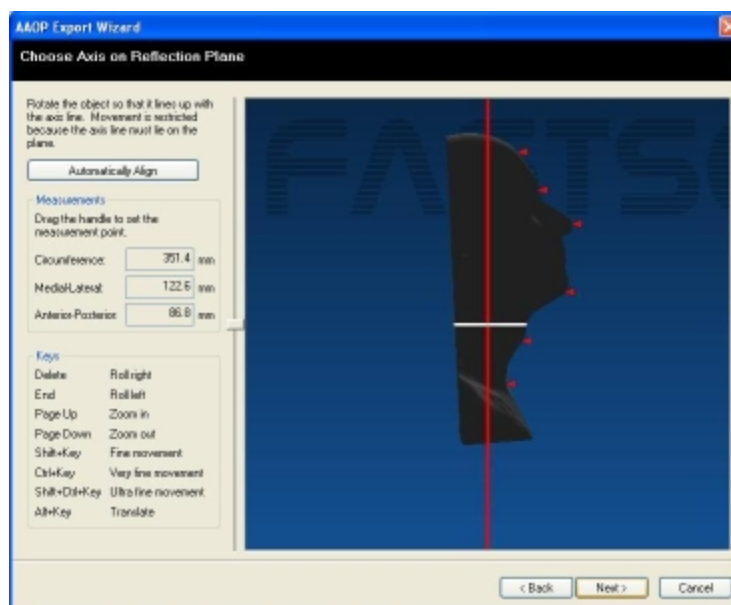
The Symmetrical build Define Reflection Plane window during creation of a mirrored AAOP file—the 3D data is sliced along the plane defined by the six points in red.

When the desired points have been placed and the area to be removed correctly defined, click **Next** to go to the **Choose Axis on Reflection Plane** window (as below). If the darkened area is on the wrong side of the object click on **Flip Plane** to switch it with the light area of the object.

Choose Axis on Reflection Plane

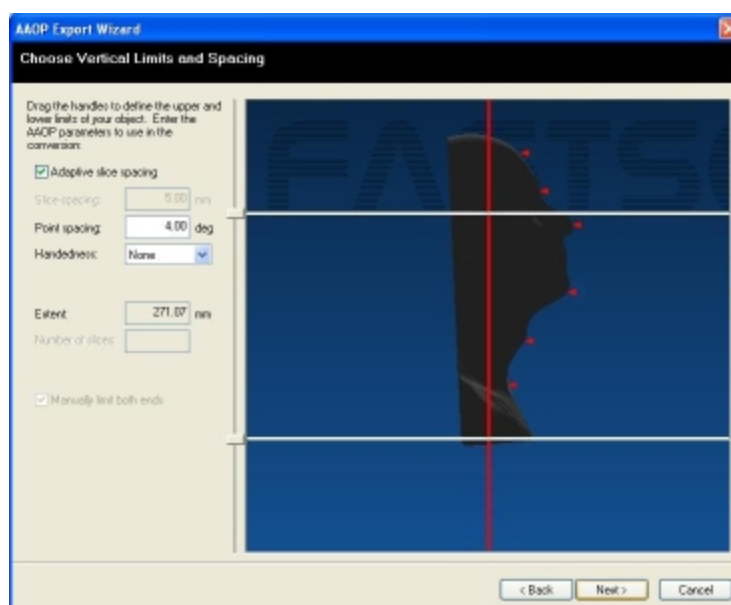
Align the object so the axis plane (red line) lies in the desired position along the reflection plane. **Right-clicking** the mouse on a point will cause the axis plane to relocate through the center of that point. Use the keyboard keys listed at the bottom left of the window to orient the object as desired.

The **measurement point** is the white line defining a section through the object perpendicular to the axis. This can be moved up and down the axis to a desired location by **left-clicking and dragging** the “handle” to the left of the window. Measurements are given around and across the object at this point.



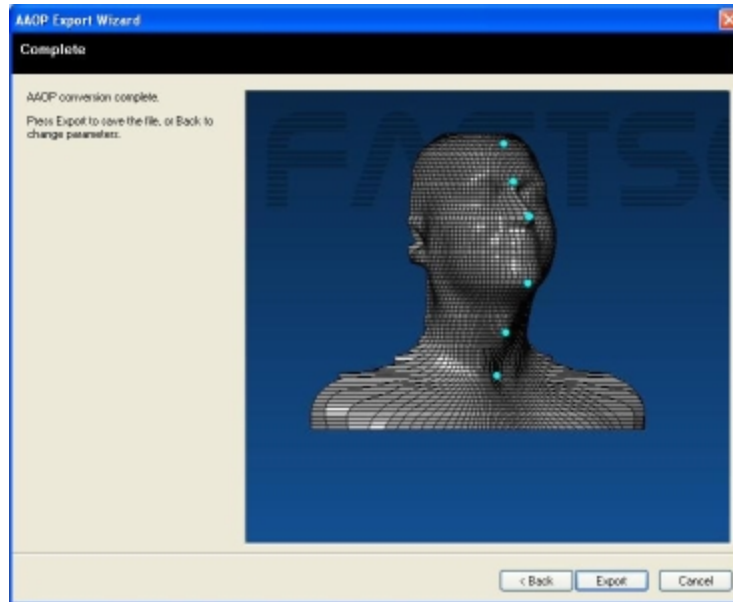
The Choose Axis on Reflection Plane window.

Click **Next** to proceed to the **Choose Vertical Limits and Spacing** window (as below).



The Choose Vertical Limits and Spacing window.

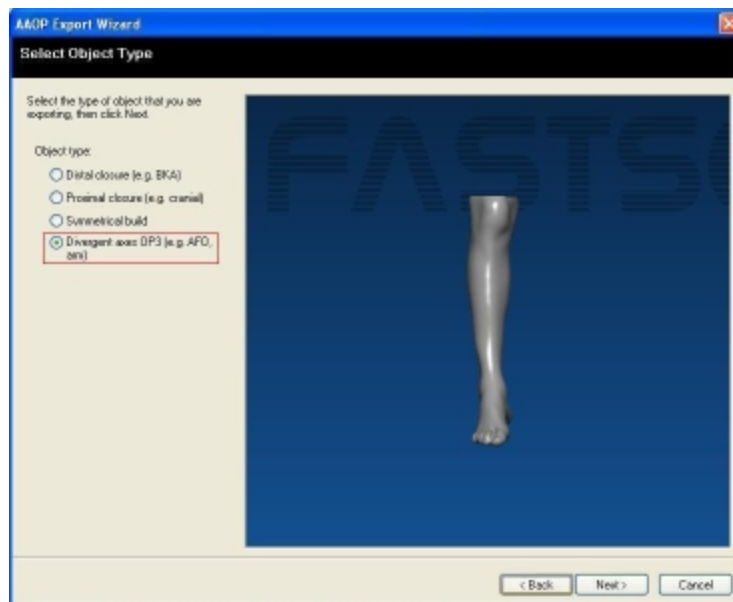
The remainder of the AAOP Export Wizard for **Symmetrical build** objects follows the same path as for [Distal closure and Proximal closure objects](#), with the exception that some of the object movement in subsequent panels is restricted, as the axis must lie in the plane that you have defined. The image below shows the result of the symmetrical build.



The Symmetrical Build Complete window with the mirrored image.

Divergent axes Object Types

The **Divergent axes** option in the first panel of the AAOP Export Wizard allows you to bend the axis through an object like the joint of an arm or leg. Before entering the AAOP Export Wizard it is suggested that the object is aligned so it is facing “forwards” and “upwards”, i.e. for a leg the knee and foot would be facing out towards you and the leg itself aligned vertically (as below).

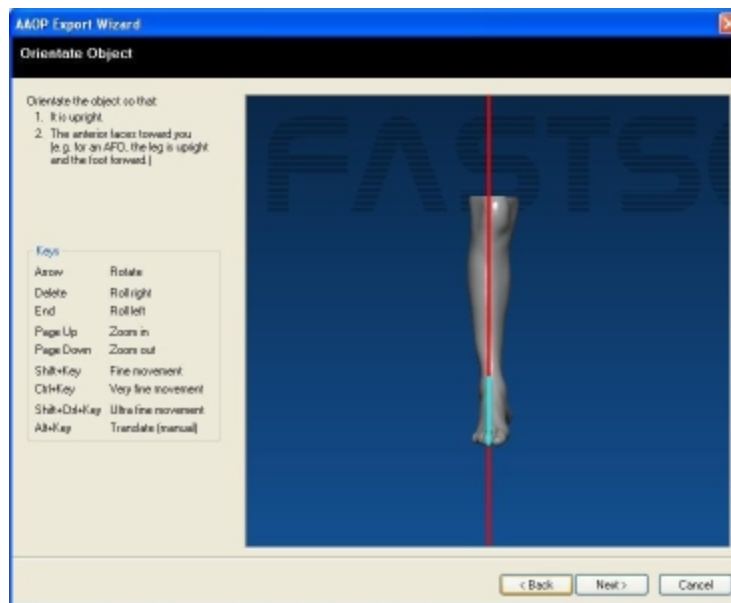


The Select Object Type window—Divergent Axes.

Orientate The Object

The **Orientate Object** is for aligning the object vertically and so its extremities (i.e. toes) are facing forward. If the object has been orientated correctly within FastSCAN II then it will only need to be aligned so that the vertical axis runs through the center of the object. Do this by translating the object to the

left or right using the corresponding keys shown in the image below. Left-clicking the mouse on any point of the surface will cause the vertical axis to be placed through that point and the object to be moved so that point is at the center of the window.



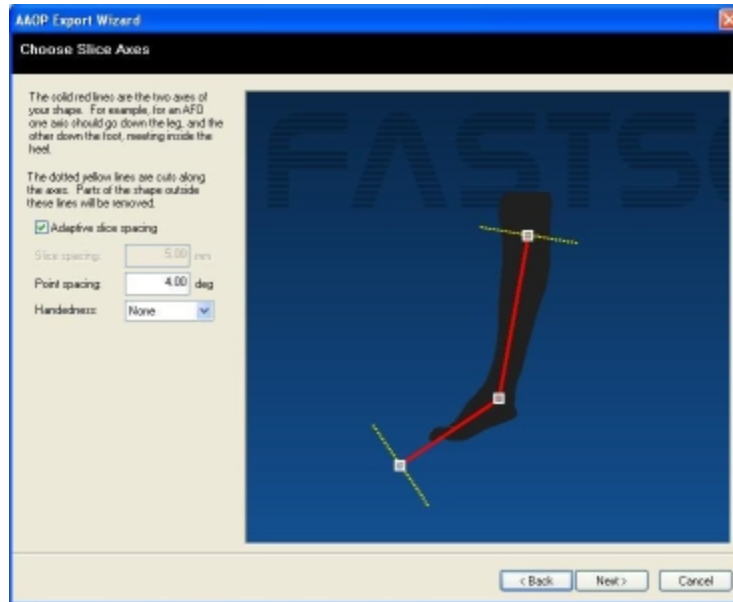
The Orientate Object window.

Choose Slice Axes

The **Choose Slice Axes** window (image below) enables the positioning of two joined axes (the two red lines) within an angled shape, by moving any of three positioning markers (the white squares).

The points of the axes may be positioned anywhere in relation to the leg and the shape of the divergent axes determines the curve path the slices follow. The upper and lower points of the axes (shown with a yellow dotted line) delimit the area to be processed, for example, in the image below the knee will be removed from the final AAOP object, while the toes will remain.

The [slice spacing options](#) are also set in this window.

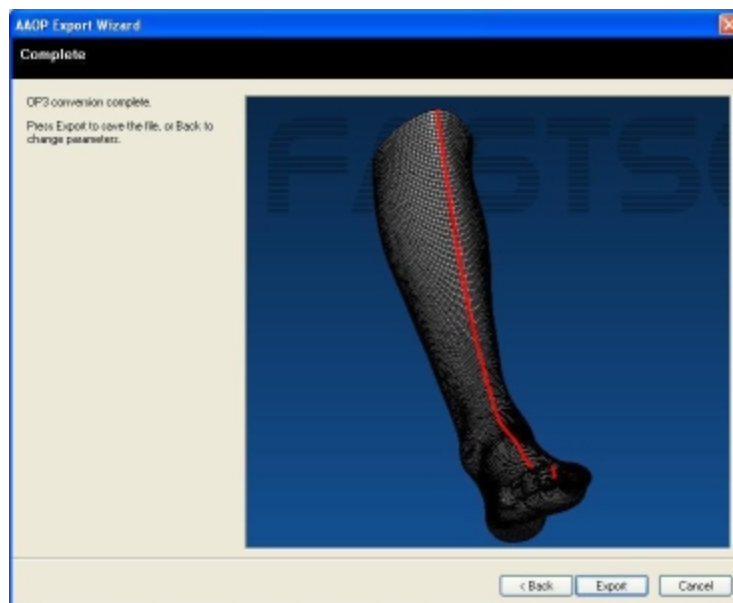


The Choose Slice Axes window.

Click **Next** to generate the **OP3** object (an **.op3** file)(as below).

Saving the AAOP/OP3 file

The **Complete** window will be displayed after file generation. Click on the **Export** button to save the AAOP file onto your computer via the **Export AAOP File** dialog box. AAOP files take the extension **.aop**—this will be automatically appended, while the **Divergent axes** file will save with the extension **.op3**.



The Choose Slice Axes window.

In the **Export AAOP File** dialog box ticking the **Put labels on stylus points** check box will number the stylus points in sequence form: S001, S002, etc, and these labels will be viewable from within your CAD package.

Once saved, you will be returned to the **Complete** panel. From here click on the **Back** button to move through the steps, or **Cancel** if done.

For help on any aspect of AAOP Export Wizard please contact sales@polhemus.com.

Cast Inversion



The Cast Inversion™ feature for FastSCAN II has been developed to enable Orthotics and Prosthetics (O&P) practitioners to scan the inside surface of plaster casts, enabling the direct creation of a CAD model from the cast. The file can then be loaded into suitable O&P CAD software to facilitate modifications and/or fabrication of a pattern or prosthetic, as well as easily archived.

Overview

To scan the inside surface of a plaster cast using the hand held laser scanner it is first necessary to split the cast in two, to provide access to the inside surfaces of the cast. The Cast Inversion feature of FastSCAN II is then used to invert and seamlessly re-join the two scans of the split cast, creating a complete CAD model.

The procedure is broken down into a series of steps shown below:

1. Decide on a suitable strategy for marking up reference points (these points are used in the re-joining process) and splitting the cast into two pieces.
2. Scan the two halves and identify the previously marked reference points.
3. Use the Cast Inversion feature to invert and re-join the scans.
4. Create the final model, using the standard FastSCAN II surfacing options.



The process of scanning a plaster cast

The Process

Preparation For Scanning

1. Decide where best to split the cast and mark the path where the cut is to be made. Generally the best results will be obtained by cutting the cast into two approximately equal pieces, in such a way as to allow maximum unimpeded visual access to the inside surfaces.



Vertical lines on the front of the cast.

2. Place a number of reference marks along the cutting path—these marks will be used later by the Cast Inversion feature to assist in rejoining the two scanned surfaces. The reference marks can easily be placed by drawing a number of short (20-50 mm long) lines perpendicular to the cutting path, with a part of each line remaining on either side of the cast after it is split in two. Typically six to eight lines spaced around the full perimeter are sufficient (as above and below).



Vertical lines on the back of the cast.

3. The cast can now be cut (as cleanly as possible) along the previously defined cutting line. Any reduction in the cross section of the cast (due to saw blade thickness) can be compensated for later in the Cast Inversion process. To ensure a high quality scan clean away any loose material from around the edges of the cast.



The split cast.

4. The previously applied reference marks need to be highlighted so that they will appear on the scanned surface. This can be done in several ways:
 - **Method 1:** Place thin strips of tape (2–3 mm wide and at least 15 mm long) on the edges of the split cast, directly above the reference marks, so that the tape sticks out (shown below). The tape strips will be picked up during the scanning process and are easy to identify when processing the scans.
 - **Method 2:** Apply electronic markers using the Optical Stylus (if available).



Shows the split cast with tape markers placed on edges.

Scanning

1. Place the two halves of the cast side by side on a matte black cloth with the Receiver placed between them, as shown below.



The Receiver between the two halves of the cast.

Note:

- The (matte) black cloth ensures that the surface of the table is not picked up during the scanning process.
- It is useful to cover the Receiver and cable with another black cloth or place it directly under the main cloth (as below).
- It is very important that neither the two parts of the cast or the Receiver move during the scanning process (the cast halves may require some form of support to stop them rocking).
- Ensure that the table or surface on which the scanning takes place is nonmetallic— a small wooden table is recommended.



Scanning the cast with the Receiver covered.

2. Carefully scan the inside surface of both halves of the cast, including the top surface of the rim and the markers. Take care not to scan the outside surfaces of the cast or any other unwanted objects within the scanner's range (as above).
3. The optical stylus can now be used to digitize the reference markers (the cast halves and receiver must not be moved from their original positions). To use Mark With Mouse to perform this function, refer to the following section.

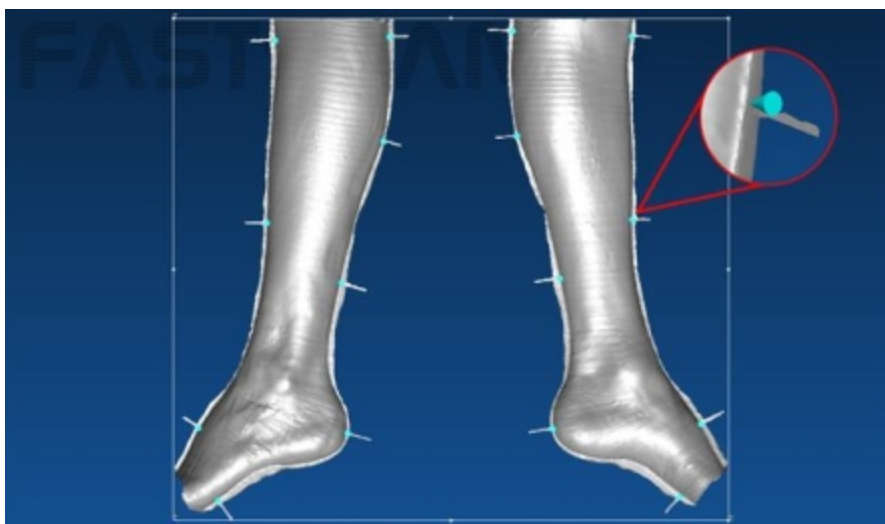


Scan aligned with the bounding box set to view.

Digitizing the Scanned Reference Marks

Digital reference points need to be defined based on the position of the tape or drawn markers.

Note: If the **optical stylus** was used to locate the reference markers then this section can be skipped.



The placed stylus points.

Use the **Mark with Mouse** function to place reference points on the edges/rim of the scanned cast halves (directly over the previously applied tape or drawn markers). [Align the scanned image on screen](#), then click on **View/Set Bounding Box To View**. Zoom in on the tape or drawn markers and place a marker on each point (as above).

Note: Whether using the **optical stylus** or the **Mark with Mouse** mode to define the reference points, it is important that the location of these points be accurately identified to successfully recombine the two halves of the cast into a single image.

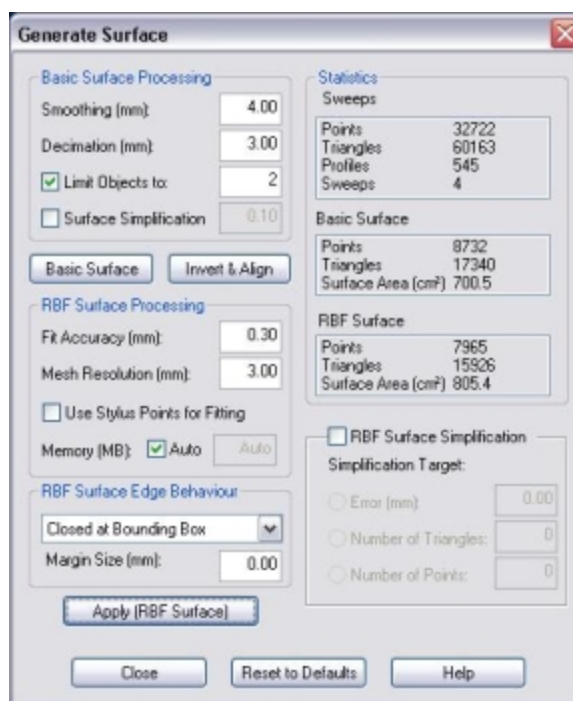
Applying Cast Inversion

1. Select **Edit/Cast Inversion Mode** to activate Cast Inversion mode (a tick will appear next to it).
2. Select **Edit/Generate** or click on the **Generate** icon (Ctrl+G) to bring up the **Generate Surface** dialog box (as below). Enter the desired settings and click **Basic Surface** to apply.

Note: The default parameters can be used as a starting point, however more suitable settings to enter in the **Generate Surface** dialog for a typical **Ankle-Foot Orthosis (AFO)** might be:

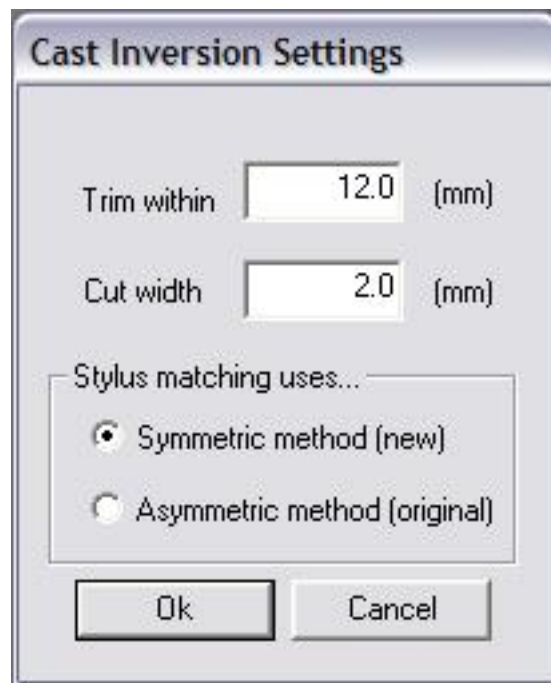
	Small Highly Detailed AFO	Large AFO
Smoothing	4.0mm	10.0mm
Decimation	3.0mm	6.0mm

Limit Objects to: must remain on **2** and **Surface Simplification** is not required.



The Generate Surface dialog box with the **Invert & Align** button active.

- If the Basic Surface looks satisfactory then save the file. The **Invert & Align** button will become active (within the **Generate Surface** dialog). Click on the **Invert & Align** button to bring up the **Cast Inversion** dialog box (as below). **Note:** The **Invert & Align** button will not be available unless **Cast Inversion Mode** has been selected.

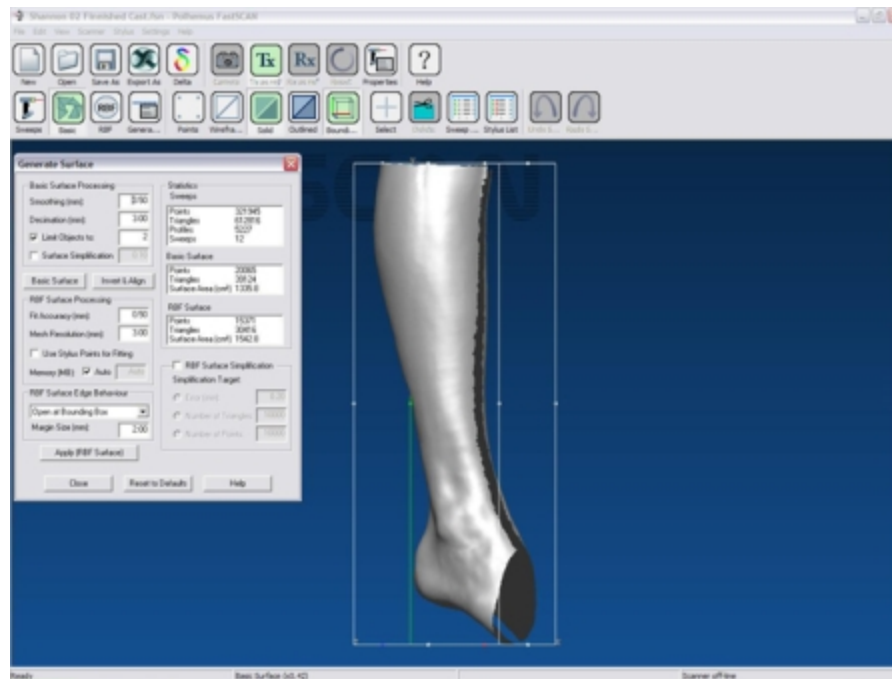


Cast Inversion Settings.

Three parameters must now be set:

- a. **Trim within:** This is used to remove noisy data that may have appeared around the edges of the scans (due to cutting debris, etc.), ensuring that when the scans are rejoined the resulting RBF surface has a clean fit.
 - **Note:** The number entered is the total width of the noisy data region from which the data is removed: i.e. a **10 mm Trim within** value will remove **5 mm from the edge of each half** of the scanned object.
 - b. **Cut width:** This is used to compensate for the loss of cast material that will have occurred if the cast was cut with a saw blade—it is generally set to the width of the blade.
 - c. **Stylus matching uses...:** Stylus matching should usually be set to **Symmetric method (new)**. This tells the Cast Inversion software that there are equal numbers of reference points on each half of the cast scan. If, for some reason, there are unequal numbers of reference points on the cast scan halves, then use **Asymmetric method (original)**.
4. Click the **OK** button to continue.

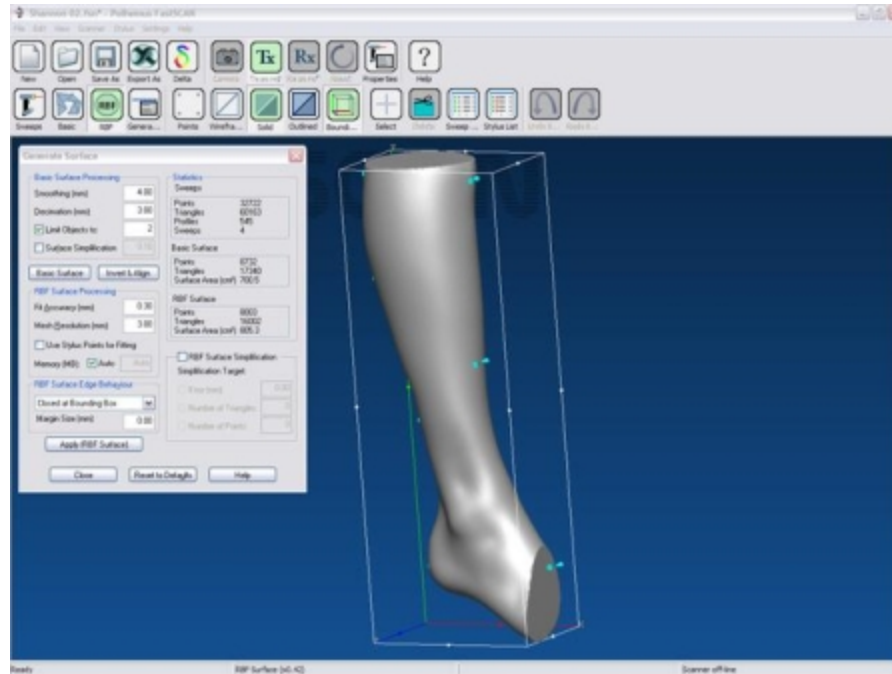
Any data in the set back area will now be removed and the scan adjusted for the thickness of the saw blade (if required). Now orientate the scans as shown below.



The object after Cast Inversion.

The Final Surface

Process the data using the RBF Surface Processing function within the **Generate Surface** dialog box (this should still be open) to produce the final surface.

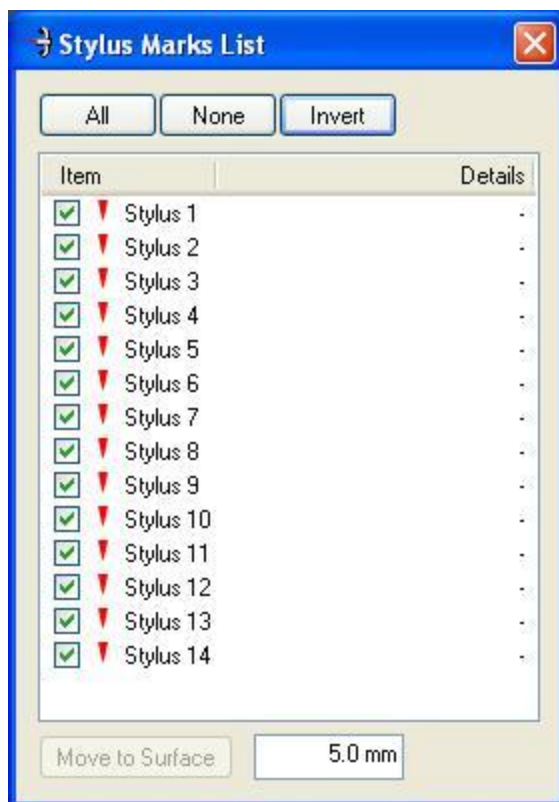


The final RBF surface ready for exporting.

Note:

- Fit Accuracy should be between 0.3mm (Small Highly Detailed AFO) and 0.5mm (Large AFO).
- Mesh Resolution should be consistent with that of the Basic Surface: i.e. the decimation value should be the same as that used in the Basic Surface.

- If Trim to Edges is selected the Margin Size must be set to a larger value than the gap between the scans.
- The stylus points may be turned off to view a clean image. Click on **Edit/Stylus Marks List...** (Ctrl+T) to bring up the **Stylus Marks List** dialog box (as below). Select **None** or uncheck individual boxes in the list to view the object without the (selected) points. Clicking on **Invert** will uncheck all checked stylus point boxes and check those previously unchecked. **Left-clicking** the mouse on a stylus number in the **Stylus Marks List** will turn the selected point red. Choose more than one point by holding down **Shift** or **Control** while selecting points.



The Stylus Marks List dialog box.

Note: Cast Inversion is an optional feature of FastSCAN II and requires a separate license.

Getting Help

For help on any aspect of Cast Inversion please contact sales@polhemus.com.

Refraction Correction



Refraction Correction™ compensates for the distortion resulting from scanning through glass. It was primarily developed to enable Orthotics and Prosthetics (O&P) practitioners to obtain high quality scans of the whole foot and lower leg. The completed file can be used directly with suitable CNC tooling to fabricate a pattern or prosthetic.

By **resting** a foot, hand or other object on a sheet of glass (the stage) during scanning, movement and artifacts can be greatly reduced, while at the same time allowing full 360° access for the scanner.

The Process

When scanning through glass using the hand held scanners it is necessary that the subject to be scanned is comfortable (if a person) and in a position that allows the area of interest to be scanned easily.

Refraction Correction is applied as a **post process** after the scan has been completed.

The user inputs the following information:

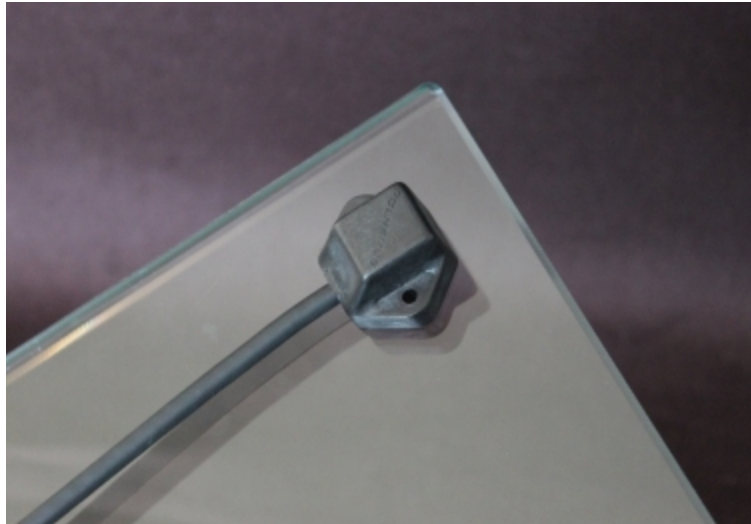
- the thickness of the glass
- the refractive index (typically 1.52 for commercial leaded glass)
- the Receiver size
- the Receiver/object relationship (same side of glass/opposite side of glass).

The overall resolution and smoothness of the re-joined surface is controlled by the standard FastSCAN II surface generation parameters.

Scanning Setup

For Refraction Correction to work correctly the Receiver must be mounted on the sheet of glass that will be used as the stage when scanning. It can be mounted on whichever side of the glass is most convenient.

The image below shows the Receiver attached to the top of the glass sheet. The Receiver can also be mounted to a part of the subject if desired (for example, the knee) to reduce error due to subject movement.



The Receiver attached firmly to the top of the glass sheet.

Scanning



Scanning the base of the foot through glass.



Scanning the remainder of the leg.

Object Positioning

It is important that the subject is able to sit or stand comfortably (as below) so that there will be as little movement as possible for the duration of the scanning process (typically 30–90 seconds). It is also important that the user be able to access and scan the entire area of interest comfortably.



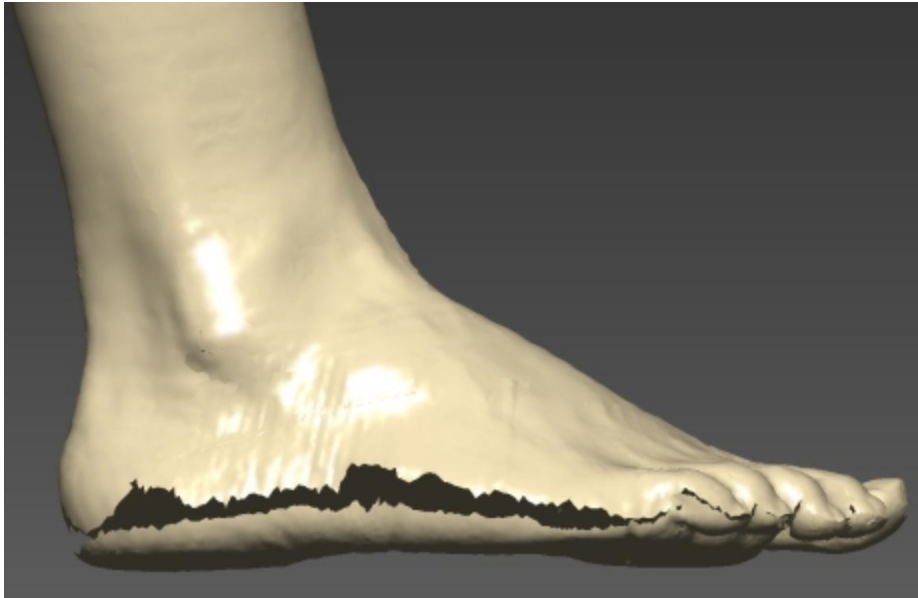
Typical setup for scanning foot and lower leg.

Processing

Processing the data is a simple three step procedure consisting of:

1. correcting the optical distortion caused by the glass
2. editing the data
3. applying an RBF surface if required.

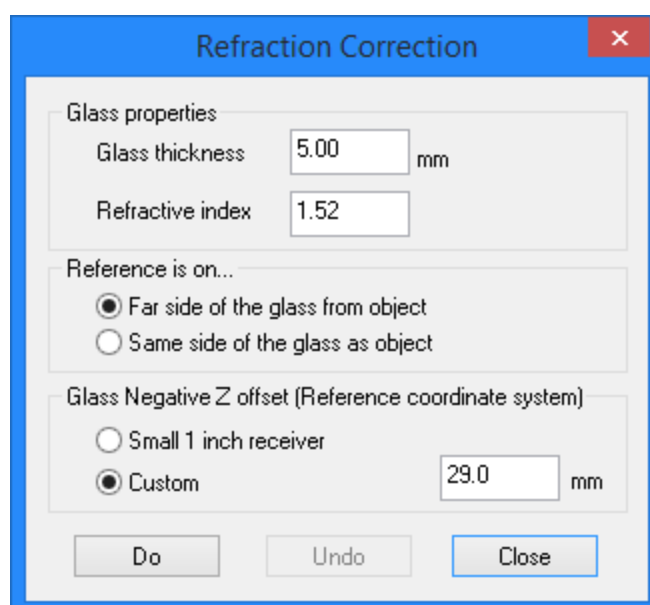
Note: The amount of distortion visible is affected by the thickness of the glass and the quality of the scan. Sometimes a large gap may be obvious, while on other occasions the part of the scan performed through glass may overlap with the part scanned normally, with no gap apparent.



The scan with the disjointed area clearly visible (in Sweeps view).

In the image above the base of the foot is separated from the rest of the scan (scanned normally). The gap is exaggerated due to the refraction caused by the glass and can be corrected by using Refraction Correction:

1. Click on **Edit/Refraction Correction...** to open the **Refraction Correction** dialog box (as below) and fill in the parameters.
 - **Glass thickness:** Enter the thickness of the glass.
 - **Refractive index (RI):** Typically, normal commercial glass has an RI of approximately 1.52, however for low lead and tinted glass this may vary.
 - **Reference is on...:** Select the side of the glass that the Receiver was placed on during the scanning process.
 - **Glass Negative Z offset (Reference coordinate system):** Select the size of Reference Receiver being used during scanning—**Small 1 inch receiver** or **Custom**.

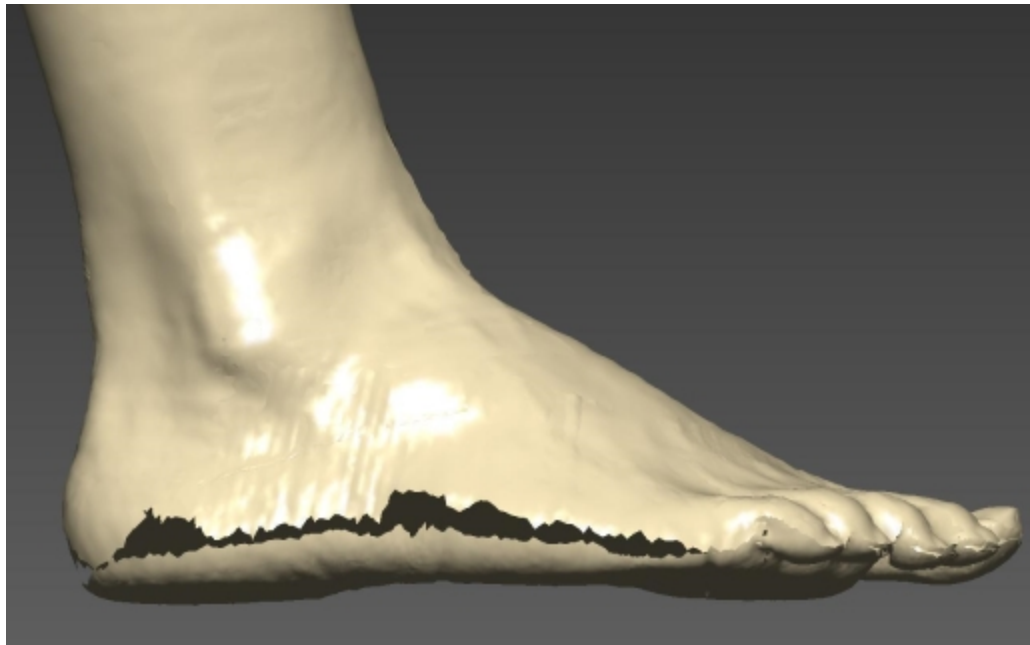


The Refraction Correction dialog box.

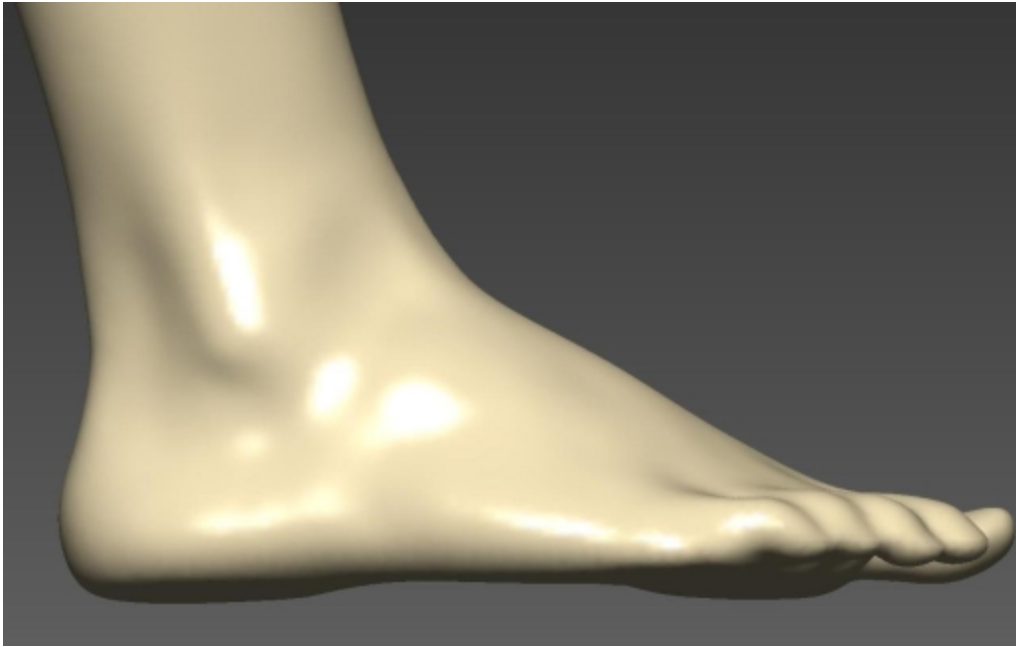
2. To apply Refraction Correction press **Do**. In the following image the base of the foot has moved up to its correct position, with the gap having narrowed and joined in some places.
3. Delete any unnecessary data. Then click on **Edit/Generate Surface** (or the **Generate Surface** icon/**Ctrl+G**) to open the **Generate Surfaces** dialog box and apply the Basic and RBF surfaces (completed object shown below). Then save the object.

Note: Some artifacts may appear on the scan at acute angles; these are due to reflections on the glass and will most likely disappear when the surface is processed.

For help with any aspect of Refraction Correction please contact sales@polhemus.com.



The realigned scan. Note the gap has decreased (and closed at the little toe).



The completed object (RBF surface view).

Note: Refraction Correction is an optional feature of FastSCAN II and requires a separate license.

Appendices

The appendices include:

- [Appendix A: Troubleshooting/ FAQs](#)
- [Appendix B: Safety Guidelines](#)
- [Appendix C: Distributors](#)
- [Appendix D: Customer Service](#)
- [Appendix E: Conditions of Transfer and End-User License Agreement for FastSCAN II Product Suite](#)

Appendix A: Troubleshooting/ FAQs

Q. The status bar of the FastSCAN II program continues to show ‘Scanner offline’— what has gone wrong?

A.

Run through the following checklist:

- Ensure you do not have another FastSCAN II program still running from an earlier session (possibly minimized).
- Ensure that power is getting to the SEU. The ‘SYS’ light on the front panel should be on.
- Ensure that power is getting to the Wand. The Power light on the Wand should be on.
- Check connections of all the cables.

Q. I have just performed a scan and there is nothing on the screen. Why?

A.

Possibly the scanned surface is out of view. Try centering the scan—select **Center** from the **View/Viewpoint** menu (or point the Wand at the area you wish to view and pull the trigger to the Preview position). If you are new to scanning, check that you are holding the trigger in the Scanning position when scanning so the Laser Indicator on the Wand is illuminated Green.

If the object still does not appear then you may be holding the Wand too close or too far away from the object while scanning, preventing the camera from recording the movement of the laser. Keep the Wand about 10-15 cm from the object when scanning.

Q. My scanned image is upside-down on the screen and I can’t get it the right way up. How can I fix this?

A.

The **hemisphere of operation** is not defined correctly. Switch off the SEU and switch it on again. Then go through the procedure for [Running FastSCAN II](#).

Q. I have “floating” fragments of surfaces in my scan that are unrelated to the object— what’s happening?

A.

The Wand’s camera may occasionally view a bright, broad spectrum light source (e.g., sunlight from a window) that mimics the light of the laser. It is advisable to keep windows shuttered, avoid bright lights above and behind the scanning area, and to set the sensitivity control as low as possible. To check whether extraneous light is being detected, select **View/Camera** (which displays what the camera is seeing), and cover the laser. Anything visible in the display is then due to extraneous light.

Q. How close do I need to keep the components of the FastSCAN II system?

A.

To ensure both high resolution and high accuracy, keep the Wand close to the object’s surface

during scanning, but no closer than 80mm to keep within the camera's field of view. If you are using the Receiver, parts of the surface closer to it will scan more accurately. Try to keep the Receiver close to the Wand, as accuracy deteriorates with distance, but no closer than 100mm to avoid signal overload. The maximum separation of any two components is about 750 mm, but for best results, keep them as close as possible.

- Q.** When I generate a Basic Surface, it has “bumpy” or “crystalline” patches—what is wrong?
- A.** Successive sweeps over the same part of the surface have not merged properly. Try using **Apply Registration**. If the result is still unsatisfactory you may need to repeat the scan.
- Q.** How far away do I have to keep metal objects from the scanner?
- A.** The presence of metal objects while scanning interferes with the tracking of the Wand and degrades performance. As long as you keep any large metal objects at least 1 m from the Wand, the Receiver, and the object you are scanning, they should not pose a problem.

Appendix B: Safety Guidelines

FCC Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause interference, in which case the user will be required to correct the interference at his own expense.

CE Mark



CE-Mark. EU Declaration of Conformity

WEEE Mark



Waste Electrical and Electronic Equipment (WEEE) Symbol.
Unit may be returned to the manufacturer for recycling and disposal under the WEEE EC Directive.

Laser Warning

A laser produces the red light emitted by this product. The laser is a specialized form of light source and although the power of the laser is very low, the laser light is concentrated into a very narrow

beam. This property makes it useful in many applications, but also requires that precautions be taken to avoid damage to your eyesight.

Lasers are grouped into different classes according to the degree of potential hazard they present. Class 1 lasers are safe under any circumstances, this laser is a Class 1 laser.

The laser output from the Wand has a Peak Power Output of 0.39 milliwatts at a wavelength of 670 nanometers. It is a **Class I** Product in compliance with IEC 60825-1:2007, and a **Class I** Product in Compliance with 21 CFR 1040.10.

Do not stare into the beam as it can damage the retina at the back of the eye. The eye has an aversion to such bright light, and the natural reflex of someone exposed to the beam is to either blink or look away. Usually this happens so quickly that no harmful effects occur. Prolonged staring into a reflection of the beam from a mirror or shiny metal surface may also be harmful, but a more diffuse reflection, off skin for example, is not hazardous.

For safe operation of this device, the following precautions should be taken:

- Never stare into the beam.
- If the device is used to obtain body profiles, warn subjects not to stare into the beam. Young children, or subjects whose natural aversion reflex may be dulled due to medication or a medical condition, may be advised to wear a blindfold or some other form of eye protection.
- Operate the device so that it is pointing away from windows, doors, mirrors and other shiny reflective surfaces, and areas where other people are working.
- There are no controls, adjustments or user serviceable parts that can affect the laser output. In the event of equipment failure, return the Wand to the manufacturer or agent for repair and servicing.

The product includes the following safety features:

- The laser is only activated when the spring-loaded trigger is depressed.
- An indicator light is illuminated when the laser is operating.
- All controls can be operated without direct viewing of the beam.
- Warning labels and a label indicating the laser aperture are attached to the Wand in the positions indicated on the following images in **Warning Labels and Locations**:

Caution: Use of controls and adjustments, or performance of procedures other than those specified in this manual may result in hazardous laser radiation exposure.

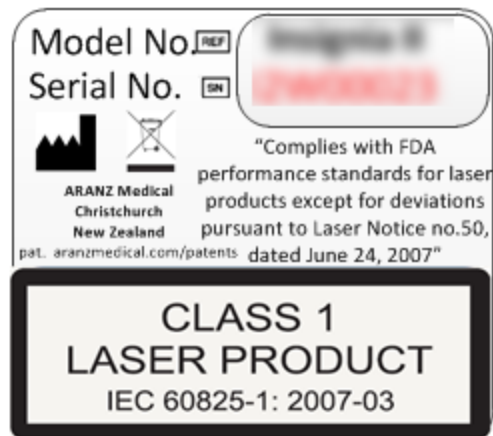
Electrostatic Discharge

Should the Scanning Wand suffer an Electrostatic Discharge (ESD) event, such as from static the system may reboot. Scanning can resume after reconfiguring the hemisphere setup.

Warning Labels and Locations



The Wand with product label and laser aperture circled.



The product label stating Laser Class details

Appendix C: Distributors

Master Distributor: POLHEMUS
PO Box 560, 40 Hercules Drive, Colchester, VT 05446
United States of America
Ph. 802/655-3519
Fax. 802/6551439
<http://www.polhemus.com>

Australia:
ARANZ Medical, StormFX Pty Ltd
www.aranzmedical.com
www.stormfx.com.au

Austria:
EST, Engineering Systems Technologies
GmbH &Co. KG
www.est-kl.com

Belgium:
Immersion SA, IMAQs
www.immersion.fr www.imaqs.com

Brazil:
Absolut Technologies
www.abs-tech.com

Canada:

China:

AD3R Technologies
www.ad3r.com

Beijing 6DOF Technologies Co Ltd
Tech Trend International Ltd
www.6dof.com.cn sales@ttil.com.hk

Croatia:
VR Logic
www.vrlogic.com

Denmark/Finland:
Contact sales@polhemus.com

France:
CADvision S.A.S, Immersion SA
www.cadvision.fr

Germany: VR Logic, EST Engineering Systems
Technologies GmbH & Co. KG
www.vrlogic.com www.est-kl.com

Greece/Cyprus:
Contact sales@polhemus.com

Hong Kong:
Techtrend International Ltd
sales@ttil.com.hk

India:
CAD Engineering Services
maanavendra@gmail.com

Ireland:
Contact sales@polhemus.com

Italy:
Unocad S.R.L, GEA Media Group S.R.L
www.unocad.it www.geamedia.com

Japan:
KBK-Kyokuto Boeki Kaisha Ltd
www.kbk.co.jp/cesd/polhemus.htm

Luxemborg:
IMAQS
www.imaqs.com

Malaysia:
Interactive Dreams Pte Ltd
www.id-dreams.com/020115/044/ welcome
frame.htm

Netherlands:
IMAQS
www.imaqs.com

New Zealand:
ARANZ Medical
www.aranzmedical.com

Portugal:
Aplein Ingenieros S.A
www.apleiningenieros.com/

Singapore:
Interactive Dreams Pte Ltd
www.id-dreams.com/020115/044/ welcome
frame.htm

NORCAM Engenharia E Design Industrial LDA

www.norcam.pt/norcam/index.html

South Korea:
Jek Co Ltd
idkwon@jek.co.kr

Spain:
Aplein Ingenieros S.A
www.apleiningenieros.com/

Sweden:
Contact sales@polhemus.com

Switzerland:
EST Engineering Systems Technologies GmbH & Co. KG

www.est-kl.com

Taiwan:

PC from Expert/Apexsun
www.pcexpert.com.tw

Thailand:

Contact sales@polhemus.com

Turkey:

Contact sales@polhemus.com

United Kingdom:

Virtualis Limited
www.virtualis.com

Appendix D: Customer Service

If you encounter any problems with your FastSCAN II system, help is just a telephone call away. Call (800) 357-4777 (U.S. and Canada) and ask for Customer Service. For the most part, our Customer Service engineers can handle your problems over the telephone and get you back into the fast lane right away. If the problem requires repair of your instrument, the Customer Service engineer will issue you a Return Merchandise Authorization (RMA) number. Polhemus Limited strongly suggests retaining the original shipping container for your FastSCAN II system in the event that the instrument may require repair. Please do not return any instrument without an RMA number, as it will not be accepted. If your instrument is still under warranty, Polhemus Limited will repair it free of charge according to the provisions of the [warranty](#) as stated in this document. The proper return shipping address is:

Polhemus Limited
40 Hercules Drive
Colchester, Vermont, 05446
United States of America



PO Box 560, 40 Hercules Drive
Colchester, VT, 05446
United States of America

Telephone (voice):	(802) 655-3159
Toll Free (USA & Canada):	(800) 357-4777
Email:	sales@polhemus.com

<http://www.polhemus.com/>

Software upgrades for licensed users are available from www.polhemus.com.

Appendix E: Conditions of Transfer and End-User License Agreement for FastSCAN II Product Suite

Effective Date: 1 July 2015

IMPORTANT – READ CAREFULLY: This Conditions of Transfer and End User License Agreement (CTEULA) constitutes a legal agreement between you and ARANZ MEDICAL LIMITED, covering (1) the sale or leasing of the **Hardware**, and (2) the licensing of the **Software**, in the FastSCAN II product suite.

This CTEULA also covers the circumstance in which Hardware is loaned by AML to you for evaluation, research or other purposes.

PLEASE READ THIS CTEULA CAREFULLY BECAUSE USING THE HARDWARE OR SOFTWARE WILL BE DEEMED TO BE ACCEPTANCE THAT THEY ARE BEING USED ON THE FOLLOWING TERMS.

Part 1: General Terms

1. **Defined Terms.** As used in this CTEULA, the following terms have the following meanings:

AML (also **we, us** or **our**) means ARANZ Medical Limited.

Hardware (also sometimes referred to as the **Device**) means one or more units of the FastSCAN II device.

Module means an add-on, option or new module, which is associated with a Software product but is licensed for an additional license fee.

Update means a subsequent release of a Software product which AML may offer to license holders with a current paid up Support Contract at no additional license fee and may include bug fixes and new functionality.

Order Form means the contract, quotation or purchase order accepted by AML or its distributors designating which units of Hardware (if any) are being sold, leased or loaned to you and which units of Software (if any) are being licensed to you.

Products means, collectively, any Hardware sold, leased or loaned to you and any Software licensed to you.

Software means collectively the Driver Software and the Device Software; and also includes Updates and Modules with respect to each of same. The **Driver Software** means the executable code version of the driver software provided for installation on a Work Station that acquires and exports three dimensional surface images and data generated by the Device, as such Driver Software may be modified by AML from time to time. The **Device Software** means the executable code version of the firmware, operating system and other software installed on the Device itself; as such Device Software may be modified by AML from time to time.

Support means the support services that AML provides to license holders of the Software who have paid for a Support Contract for the current support period (see Part 2, the Terms of Use for more detail).

Support Contract means the annual contract that the holder of a license of the Software must purchase as a precondition to receiving Support and Updates during a support period (see Part 2, the Terms of Use for more detail).

Work Station means an input/output device to be used by a single person at any time and consisting of personal computer hardware.

You or **your** means the person or entity that purchases, leases or borrows the Device and/or holds a license of the Software.

12. **Protection of Proprietary Rights:** You acknowledge that all right, title and interest in the Software and all Proprietary Rights in the Hardware and the Software are vested in AML or its licensors, and you agree that you will not dispute such ownership nor claim any intellectual property rights relating to the Hardware or the Software or any enhancements or modifications of the Hardware or the Software. For the purposes of this CTEULA, "**Proprietary Rights**" means all intellectual or industrial property rights in the Hardware and the Software and all rights to patents, trade marks, trade names, inventions, designs, trade secrets, copyright and know-how relating to the origin, manufacture, programming, operating and/or servicing of the Hardware and the Software and any enhancements or modifications of the Hardware or the Software. You must maintain all intellectual property notices appearing on the Products and must not remove the same. You must notify AML immediately if you know of any circumstances that suggest that any person may have unauthorised knowledge, possession or use of the Products.

13. **Data:** You will be exclusively responsible for security and integrity of data generated by the Products, including regular back up of data.
14. **Government Licenses of Software.** No Government procurement regulation or contract clauses or provision will be considered a part of any transaction between the parties under this Agreement unless its inclusion is required by statute, or mutually agreed upon in writing by the parties in connection with a specific transaction. The technical data and computer software covered by this license is a “Commercial Item,” as that term is defined by the FAR 2.101 (48 C.F.R. 2.101) and is “commercial computer software” and “commercial computer software documentation” as specified under FAR 12.212 (48 C.F.R. 12.212) or DFARS 227.7202 (48 C.F.R. 227.7202), as applicable. This commercial computer software and related documentation is provided to End Users for use by and on behalf of the U.S. Government, with only those rights as are granted to all other End Users under the terms and conditions in this Agreement. Use for or on behalf of the U.S. Government is permitted only if the party acquiring or using this software is properly authorized by an appropriate U.S. Government official. This use by or for the U.S. Government clause is in lieu of, and supersedes, any other FAR, DFARS, or other provision that addresses government rights in the computer software or documentation covered by this Agreement. All copyright licenses granted to the U.S. government are coextensive with the technical data and computer software licenses granted in this Agreement. The U.S. Government will only have the right to reproduce, distribute, perform, display, and prepare Derivative Works as needed to implement those rights.
15. **Liability:** AML will not be liable under the law of tort, contract or otherwise for any direct, indirect or consequential loss or damage, including any loss of profits, however caused, arising out of the use of the Hardware or Software. If any limitation of liability in this Agreement is invalid for any reason and AML becomes liable for loss or damage that would otherwise have been excluded, such liability will be limited to the total amount actually paid by you for the Hardware and the Software.
16. **Notice:** Any notice to be given in terms of this CTEULA must be made in writing, email or by facsimile transmission sent to the address notified by either party to the other from time to time. Any communication by email or facsimile transmission will be deemed to be received when transmitted to the correct email or facsimile transmission address of the recipient and any communication in writing will be deemed to be received when left at the specified address of the recipient.
17. **Force Majeure:** AML will not be liable to you for any delay or failure of AML to perform its obligations hereunder if such delay or failure arises from cause or causes beyond the reasonable control of AML.
18. **Assignment:** You may not assign or transfer this Agreement or any of the rights or obligations under this Agreement without the prior written consent of AML.
19. **Agreement:** This Agreement constitutes the entire agreement of AML and you with respect to the subject matter hereof and supersedes any and all prior negotiations and agreements. This Agreement may not be changed or modified through the Order Form or any other documentation issued by a distributor. This Agreement may be revised by AML from time to time. By paying support fees or by accepting any Update or Module offered by AML, you will be deemed to have agreed to, and will be bound by, all the terms and conditions of this Agreement in its then most current form. No variation to the terms of this Agreement made by you will be binding on AML unless it is in writing and signed by both parties. The Products are supplied with the user interface and supporting documentation in English only. We may perform any of our obligations under these CTEULA through a distributor or agent.
20. **Governing Law:** This Agreement is subject to the laws of New Zealand and you agree to submit to the exclusive jurisdiction of the New Zealand courts.

Part 2: Terms of Use

Section 1 - Hardware Warranty

Overview

Each Device is covered by a limited warranty (the **Limited Warranty**) for a period of 12 months from the date the Device is delivered to you. The Order Form may offer you the option of purchasing a warranty extension, pursuant to which the Limited Warranty may be extended for either an additional 12 or an additional 24 months (a **Warranty Extension**); but the annual rate charged for the Limited Warranty for the Device will increase as the age of the Device increases and we reserve the right to not offer warranty extension on any Device. A Warranty Extension is available only if all units of the Device purchased by you are under warranty.

Scope of Limited Warranty

The Limited Warranty covers failure of the Device due to manufacturing error or component failure, but expressly excludes any damage or failure that could reasonably be considered to result from: (i) negligence or misuse of the Device, including dropping of the Device, (ii) improper operation, use, storage, repair or maintenance of the Device, (iii) any modification to the Device not performed by us, or (iv) connection of the Device to other equipment or software to which it is incompatible.

All other representations or warranties (statutory, express or implied except any which may not lawfully be excluded) with respect to the Device are expressly excluded. Without prejudice to the generality of the foregoing, the implied warranties of merchantability and fitness for a particular purpose are excluded. We will not be liable to you under the law of tort, contract or otherwise for any direct, indirect or consequential loss or damage, including any loss of profits, however caused, arising out of the use of, loss of use of or disrepair of the Device. If any limitation of liability is invalid for any reason and we become liable for loss or damage that would otherwise have been excluded, such liability will be limited to the total amount actually paid by you for the Device.

Warranty Procedure

In order to receive warranty service for a Device, the Limited Warranty for that Device must be in effect on the date on which a warranty claim is lodged by you. You may lodge a warranty claim by email or by calling our technical support line during Support hours. When a warranty claim is lodged, we will assign your warranty claim a Case Number. In most cases it will be necessary for you to ship the Device to us for evaluation of your warranty claim. If your warranty claim is covered by the Limited Warranty, we will repair or replace the damaged or defective article and will pay for shipping in both directions. If your warranty claim is not covered by the Limited Warranty, you will be responsible for all shipping costs, and if you elect to proceed with repair, you will be responsible for the cost of repair at our usual rates as then in effect.

Section 2 - Software – Warranty Disclaimer

Where the Products purchased by you include a license of Software, the Software is licensed to you “as is” and all representations or warranties (statutory, express or implied except any which may not lawfully be excluded) are expressly excluded. Without prejudice to the generality of the foregoing, the implied warranties of merchantability and fitness for a particular purpose are excluded. You acknowledge that the Software operates in a predictive manner relative to input of which AML has no control over the collection, use or interpretation, and you accept the entire risk as to the use and the results of the use of the Software in the terms of correctness, accuracy, reliability and performance. You also accept the entire risk as to any conflict between Driver Software and other software on the hardware on which the Driver Software is installed.

Section 3 - Driver Software

Installation

The Driver Software is either supplied on a CD or downloaded from the internet at the sole choice of AML, and must be separately installed on each Work Station running the Driver Software. The software includes installation instructions for a person skilled in computer system administration to carry out the installation process.

System Requirements

We will provide minimum specifications for the Work Stations running the Driver Software. You are responsible at your expense for the purchase and maintenance of the Work Stations. You are responsible at your expense for all other hardware and network infrastructure at your site including any remote locations, and for any network data connection costs.

Work Station limitations

Each license of The Driver Software is restricted to use only on a single Work Station. You agree not to exceed this limitation.

Section 4 - Software – Technical Support Policies

These Technical Support Policies apply to technical support (**Support**) that we provide for the Software.

Support Contracts

Each license of the Software will only be entitled to Support during periods that license is under a current Support Contract. You will not be entitled to Support or Updates for any license of Software for which a Support Contract is not purchased. Further, you acknowledge that without Support and Updates the functionality of the Software will not progress and may degrade over time.

When a Unit of the Device is covered under the one-year Limited Warranty, or when a Unit of the Device is covered under a Warranty Extension, that Limited Warranty or Warranty Extension includes a Support Contract for the Software associated with that Device for the warranty period; once a Unit of the Device goes off warranty the Customer must purchase a Support Contract at AML's applicable rates in order to receive Support services for the Software associated with that Device.

Provision of Support

Support is provided through email and telephone during our designated Support hours current at that time. Support hours are available on request. We will provide you with a telephone number and email address for you to use in seeking Support. You are responsible for all telecommunications charges (telephone, internet, etc) you incur in contacting us for Support. If a voicemail answers your call or you do not receive a response to your email request during your business hours, we will endeavor to respond by the close of business on the next business day. The person contacting us for Support on your behalf must be knowledgeable about the relevant Product and your environment in order to assist us in analyzing and resolving service requests, and must have a baseline understanding of the problem you are encountering and an ability to reproduce the problem in order to assist us in diagnosing and triaging the problem.

Scope of Support

Support that we provide is remote assistance with technical questions about the Products. It also includes Updates as defined below. Support does not include training, product integration, project integration, project implementation, consulting, data review, data processing, data correction or user administration services but these services may be available for additional fees either directly by us or through our distributors or agents. Support services are delivered in English only.

Updates and Modules

Updates with respect to the Software may be offered from time to time. Updates are offered to license holders of those Products if your license is in effect, with a current paid Support Contract in effect, during the period the release is first offered. Updates and installation instructions are made available by download and you will be responsible for copying, downloading and installing the Updates. If we offer you an Update, but you do not accept it, we will have no obligation to provide Support of older versions. We may offer you Modules from time to time, subject to your payment of such additional license fees and agreement to any terms and conditions applicable to the Module. All Updates accepted by you and all Modules purchased by you will form a part of the Software licensed to you and be subject to this CTEULA.

Lapsed Support

If Support lapses because you have failed to purchase a Support Contract prior to the commencement of an offered Support period, and you subsequently wish to be reinstated in the Support program, you must:

- a. pay all support fees that would have been payable during the period Support was lapsed had you kept a Support Contract in place on a continuous basis.
- b. update your Software to the latest major release.

De-support

We may choose to discontinue Support of the Software (or any release of the Software) at any time in the future; however, we will not discontinue Support for a period for which you have already purchased a Support Contract.

Use of Information

You recognize that in the course of receiving Support, you or your representatives may furnish data or other information to us or to our distributors or support agents. By furnishing such information you irrevocably consent to the use, transfer and processing of this information by us, our distributors and agents for support purposes and keeping you apprised of Support and Update information.

Contact Us

We value your business and want you to experience success with FastSCAN II. If for any reason you are not satisfied with the Support you receive, please contact us at quality@aranzmedical.com.

