FastSCAN™ Stylus

User Manual

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Unit 4, 15 Washington Way
Sydenham, Christchurch, 8011
New Zealand

PO Box 3894
Christchurch, 8140
New Zealand

www.aranz.com
www.fastscan3d.com

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1 Introduction

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**. Three different methods of point placement/digitization have been integrated into FastSCAN:

1. The **mechanical stylus**—a pen like instrument for placing points on the surface of an object.
2. The **optical stylus**—a non-contact marking device contained within the Wand.
3. **Mark with Mouse**™—used to place points directly onto the captured surface by using your computer's mouse.

Note: Both the mechanical stylus and the optical stylus are licensed features of FastSCAN™. The Mark with Mouse™ feature is incorporated with both licensed options.

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.

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

1.1 Mechanical Stylus

The mechanical stylus (Figure 1) is an optional extra and can be purchased at any time from your distributor. It contains an electromagnetic tracker and is used in a similar manner to a pen—the location and orientation of the mechanical stylus tip is recorded whenever the mechanical stylus button is depressed.

Note: The mechanical stylus plugs into the 'Reference' port of the FastSCAN™ PU, and therefore the optical stylus must be used in Receiver is Reference mode.

Figure 1: The mechanical stylus.

1.1.1 Mechanical Stylus Setup

Note: Ensure the mechanical stylus is connected **before** scanning the object.

To set up the mechanical stylus:

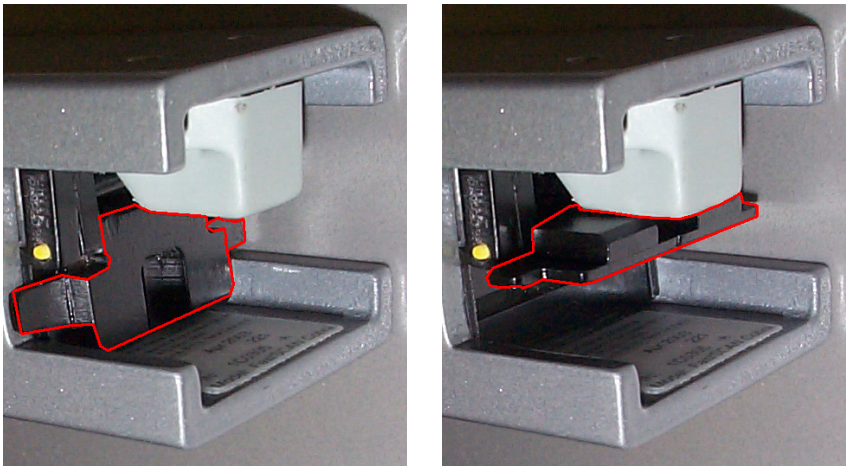
1. Ensure the PU is off, connect the mechanical stylus to the reference receiver port, then switch the PU back on.
2. Ensure **Scanner/Transmitter is Reference** is checked in the FastSCAN™ software.
3. Pull the Wand trigger and go through the FastSCAN™ setup procedure, then scan the object.
4. When you are ready to use the mechanical stylus, press the mechanical stylus button once. You will be prompted to **set up the stylus hemisphere** in a similar manner to setting up the Wand hemisphere; point the mechanical stylus at the Transmitter and push the mechanical stylus button.
5. The mechanical stylus is now ready for use.

If the mechanical stylus hemisphere setup does not work correctly, choose **Stylus/Reset Hemisphere** and repeat Step 4.

1.2 Optical Stylus

The FastSCAN™ Wand can be turned into a point digitizer, or **optical stylus**, by use of the optical shutter (Figure 2). 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.

The optical stylus shutter can be purchased at any time from your distributor and requires an additional license to be installed.



(a) (b)

Figure 2: The optical stylus shutter with: (a) the shutter positioned for optical stylus mode, and (b) the shutter positioned for normal scanning mode.

1.2.1 Optical Stylus Setup

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

1. Scan the object.
2. When you are ready to collect points or lines, put the Wand's optical stylus shutter into the down position as shown in Figure 2(a)—this changes the laser

line into a point.

3. Put the FastSCAN™ 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™ software has been correctly initialized).

4. The optical stylus is now ready for use.

1.3 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™ manual for comprehensive instructions on how to use this function. The Mark with Mouse™ license comes with the mechanical and optical styli licenses.

1.3.1 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™ 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.

2 Placing Points and Lines with the Stylus

Note: For the remainder of this manual, **stylus** will cover the mechanical and optical forms.

Once the stylus is correctly setup (Sections 1.1.1 or 1.2.1), each click of the stylus button/trigger generates a marker (point or line) on the scanned object's surface (although the mechanical version can also place points anywhere in "space").

2.1 Placing points

Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box (Figure 3). Ensure that the **Capture Points** option is selected and the stylus is correctly setup (Section 1.1.1 (mechanical) or 1.2.1 (optical)).

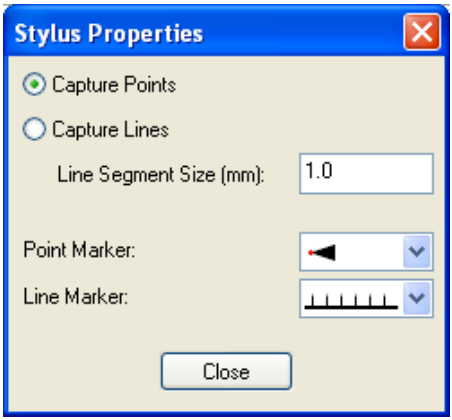


Figure 3: The Stylus Properties dialog box.

Ensure the feature you wish to place a point on is facing the front of the screen (rotate if necessary), then touch/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.

2.1.1 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 (Figures 4 & 5).

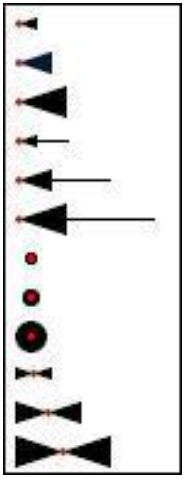


Figure 4: The Point Marker options drop-down menu.

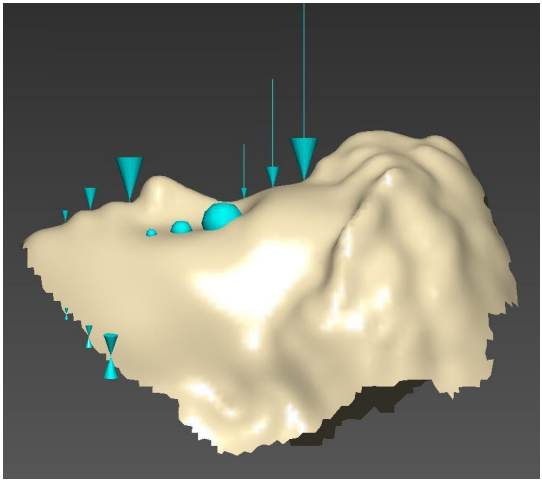


Figure 5: The different point options as applied to an object.

2.2 Placing lines

Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box (Figure 3). Ensure that the **Capture Lines** option is selected and the stylus is correctly setup (Sections 1.1.1 or 1.2.1).

Ensure the feature you wish to place a line on is facing the front of the screen (rotate if necessary), then touch/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.

(a) Line capture. (b) The resulting scan.

Figure 6: Using the mechanical stylus to place a line.

2.2.1 Line options

Click on **Stylus/Properties** to bring up the **Stylus Properties** dialog box (Figure 3). Then click on the drop-down menu to the right of **Line Marker:**. Select your preferred line style from the menu (Figures 7 & 8).

Line segments (vertical "hairs" coming off the line, see Figures 7 & 8) 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.

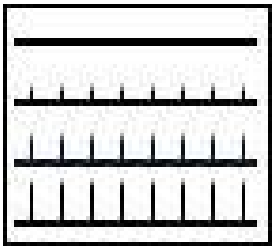


Figure 7: The Line Marker options drop-down menu.

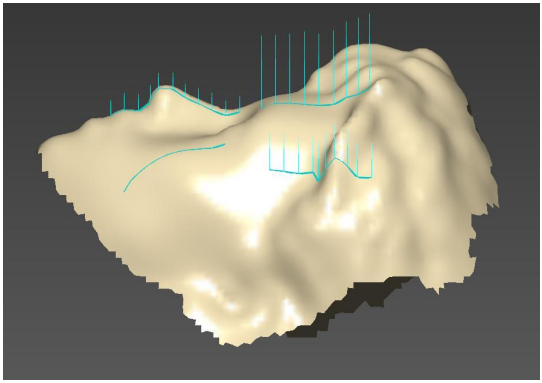


Figure 8: The different line options as applied to an object.

2.2.2 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 points/lines—this function is enabled via **Settings /Wand**).

2.3 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 (Figure 9). Select **None** or uncheck individual boxes in the list to view

the object without the (selected) points.

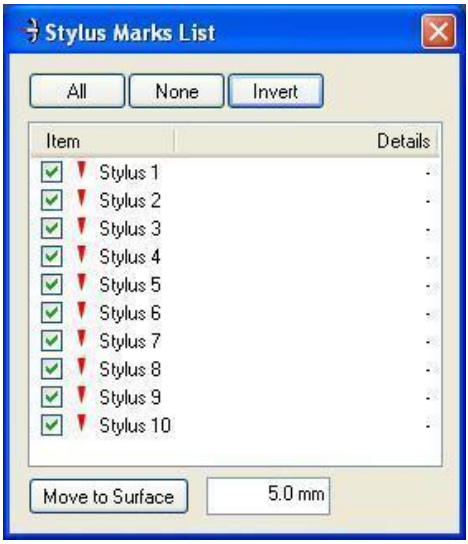


Figure 9: The **Stylus Marks List** dialog box.

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.

2.3.1 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 (in Figure 10) 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.

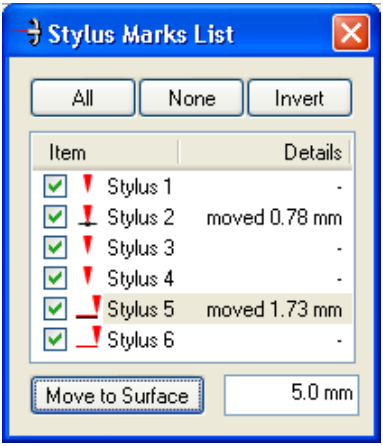


Figure 10: The Stylus Marks List dialog box with moved and unmoved points and lines.

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 (Figure 10). Figures 11 & 12 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.

Figure 11: The **point symbols**: original placement (left) and moved to surface (right).

Figure 12: 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 (Figure 13). If some points/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.

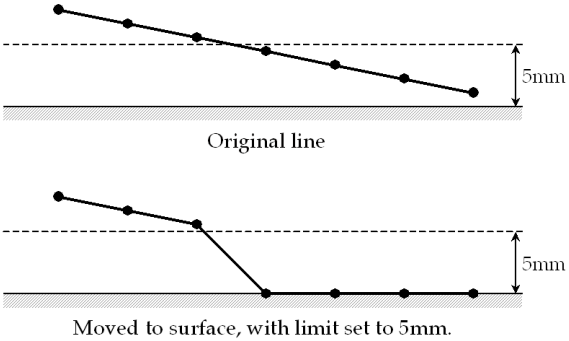


Figure 13: A line partially moved onto the surface.

2.4 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 (Figure 14).

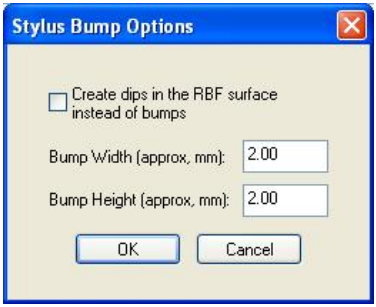


Figure 14: The **Stylus Bump Options** dialog box.

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 (Figures 15 & 16). 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.

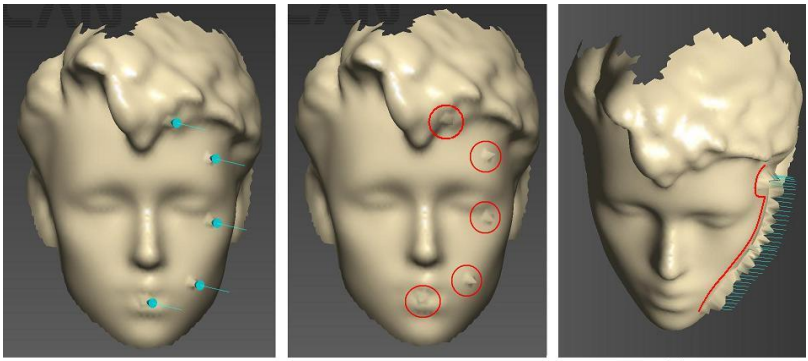


Figure 15: Bumps applied to an object, on points (**a & b** (hidden)) and lines (**c**).

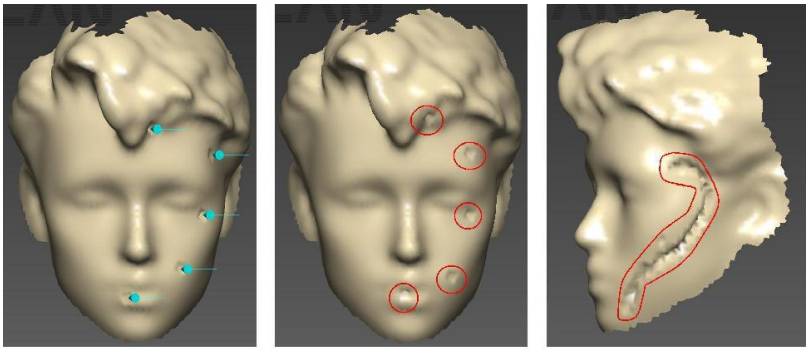


Figure 16: Dips applied to an object, on points (**a & b** (hidden)) and lines (**c** (hidden)).

2.5 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).
- **Reset Stylus:** This function is for resetting the Mechanical Stylus hemisphere (in case of moving to far from the setup).
- **Properties:** Launches the **Stylus Properties** dialog box (Figure 3).

3 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.

3.1 Export Stylus Points Dialog Box

To save stylus point/line locations, select **File/Export As/Stylus Points** (the FastSCAN™ software will automatically ask if you want to save stylus data whenever you export a surface). 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 Figure 17. The points/lines data can be exported as Comma Separated Values (**.csv**) or ASCII text (**.txt**).

3.1.1 Coordinate System

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

3.1.2 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.
- 4×4 **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).

3.1.3 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**.

3.1.4 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

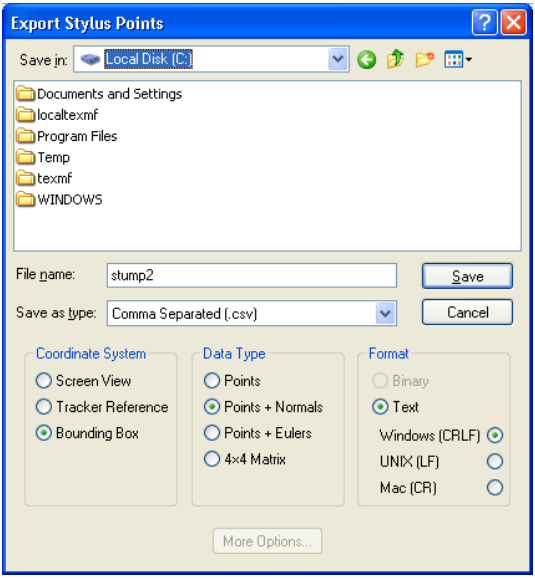


Figure 17: The **Export Stylus Points** dialog box.

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 4×4 **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).

Figure 18 shows a sample CSV export file, using **Points** data type, containing two points (items 2 and 3) and part of a line (item 5), when loaded into Excel.

Microsoft Excel - sample.csv

File Edit View Insert Format Tools Data Window Help

O24

	A	B	C	D	E	F	G	H
1	CSV stylus data file created by FastSCANtatus V4.0.5 ctatus on Mon Jun 23 13:05:11 2008							
2	(exporttatus surface, 50 visible points, bounding boxtatus 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

Figure 18: A CSV export file loaded into Excel.

3.1.5 ASCII Export Format

The ASCII export format (Figure 19) 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
% exporttatus surface, 50 visible points, bounding boxtatus 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
```

Figure 19: An ASCII text file.