FastRBF™ Extensions

for FastSCAN™

printed March 2014

Revision 1.0

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Contents

Figure 1: A FastSCAN™ 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.

1 Introduction

The FastRBF™ Extensions allow you to use the FarField Technology FastRBF™ engine from inside FastSCAN™. 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.

Figure 1 (previous page) shows an example of a large, complex scan processed using the FastRBF™ Extensions.

1.1 Licensing

The FastRBF™ Extensions are licensed on a per-wand basis via the `FastSCAN.lic` license file that is provided with the FastSCAN™ system. To view your license details select **License** from the FastSCAN™ program **File** menu.

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 any scan but prevents you from saving the RBF surface. The license file will become invalid if it is modified or when it expires.

2 FastRBF™ Extensions

2.1 Overview

To access the FastRBF™ Extensions scan some data (or open a previously scanned **.fsn** file), then open the **Generate Surface** dialog box (Figure 2) 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 (Section 3) **before generating an RBF Surface** (Section 4), as the points of the Basic Surface are passed to the FastRBF™ engine in order to generate the RBF Surface.

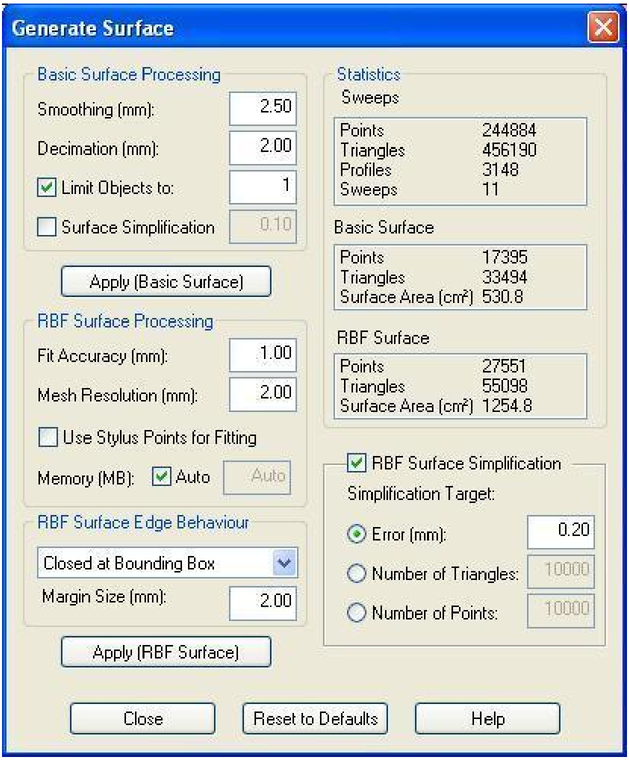


Figure 2: Generate Surface dialog box

2.2 Data Flow

The FastRBF™ process is divided into several subprocesses (Figure 3). 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**—Section 3
- **RBF Surface Processing**—Section 4
- **RBF Surface Edge Behavior**—Section 5
- **RBF Surface Simplification**—Section 6

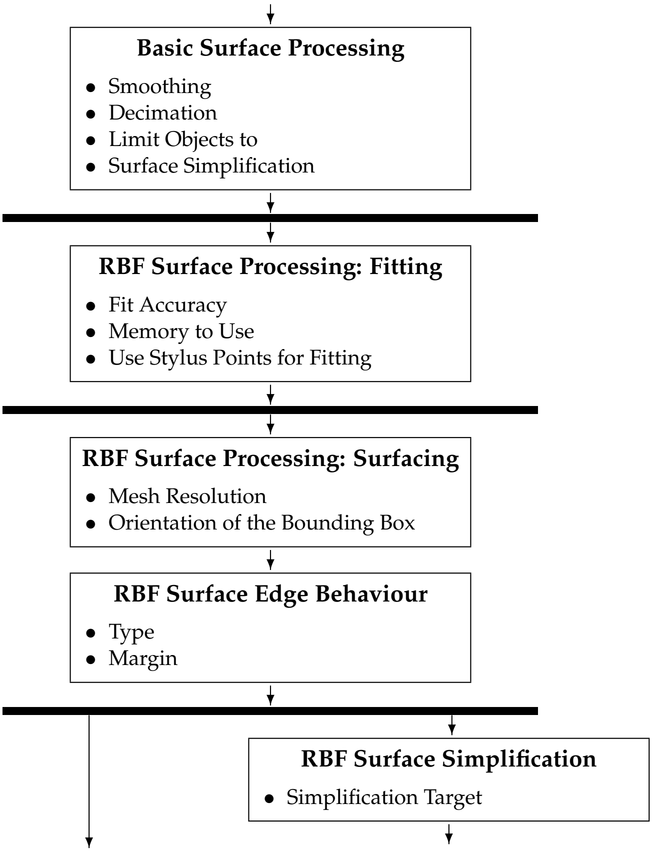


Figure 3: Data flow inside the FastRBF™ process. The heavy black lines indicate points where the data is cached. If parameters are changed at a particular point, only processes back to the previous line will be run again.

3 Generating A Basic Surface 

Open the **Generate Surface** dialog box (Figure 2) 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:

3.1 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™ Manual) to attempt to solve this).

3.2 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**.

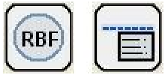
3.3 Limit Objects to

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.

3.4 Surface Simplification

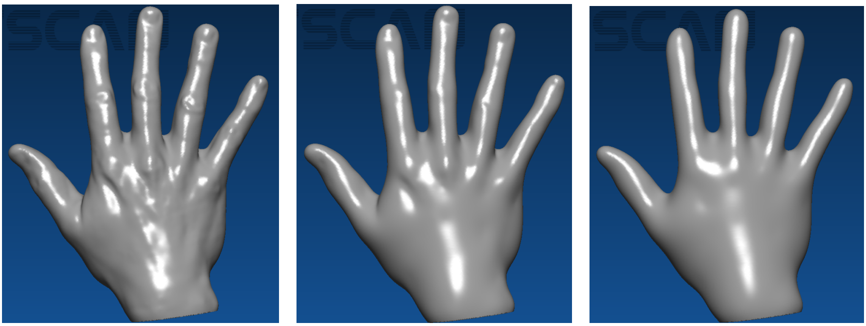
You can also reduce the complexity of the Basic Surface by activating simplification, which generates fewer triangles for roughly the same accuracy. This number controls the accuracy of the simplified mesh, i.e. it gives the maximum error from the original data. Simplifying the Basic Surface will speed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

4 RBF Surface Processing



4.1 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). Figure 4 shows the same object processed at three different Fit Accuracy values.



(a) 0.1 mm (b) 0.5 mm (c) 2.0 mm

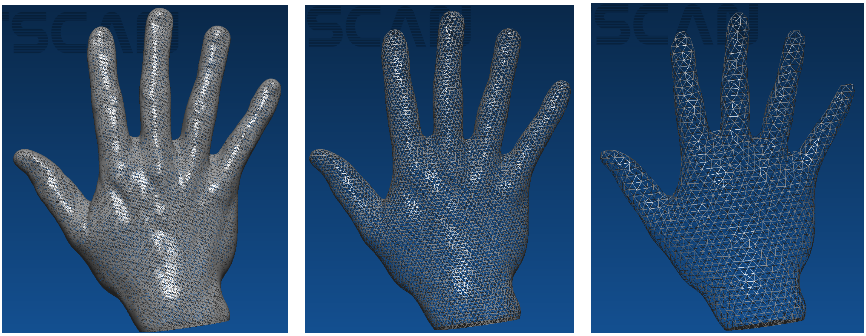
Figure 4: Different Fit Accuracies (Mesh Resolution of 1.0 mm).

4.2 Mesh Resolution

Mesh Resolution sets the approximate size of triangles in the RBF Surface. Figure 5 shows the same object at different mesh resolutions.

4.3 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



(a) 0.1 mm (b) 2.5 mm (c) 5 mm

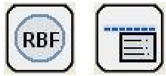
Figure 5: Different mesh resolutions.

taking into account the memory required by the operating system and other applications. For example: if your computer has 1 G 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.

4.4 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.

5 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.

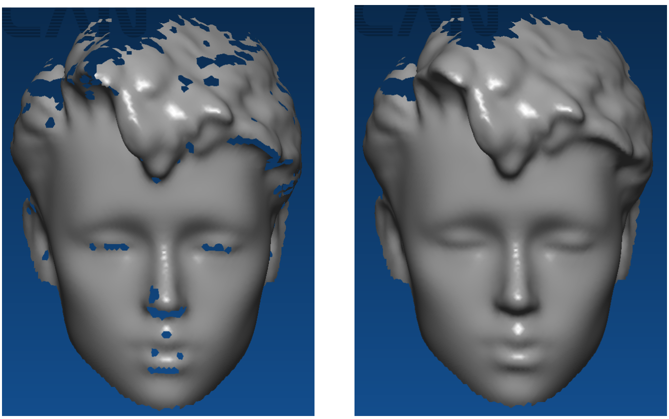
To orientate the front of the Bounding Box to the current screen view select **Set Bounding Box to View** from the **View** menu or press **Ctrl+B**. The Bounding Box encloses the perimeter of the data and may change size, dependent on the margin.

5.1 Trimmed to Data

The surface is trimmed so that holes and edges remain as they were in the raw data (Figure 6).

5.2 Trimmed to Edges

The surface is trimmed as in **Trimmed to Data** but holes in the surface are filled in (Figure 6).



(a) Sweeps (b) RBF Surface Trimmed to Data

Figure 6: **Trimmed to Data** and **Trimmed to Edges** RBF surface processing

5.3 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 (Figure 7). Holes are filled in.

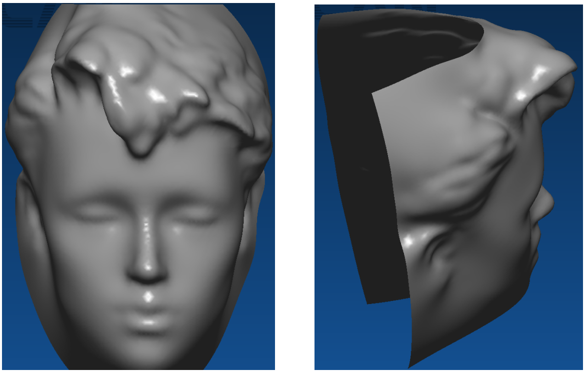


Figure 7: Two views of **Open at Bounding Box** RBF processing

5.4 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 (Figure 8).

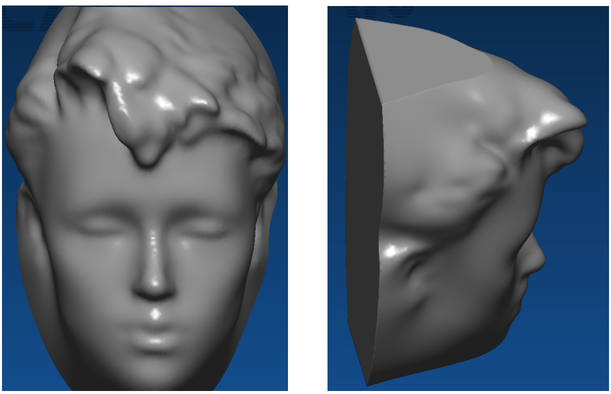
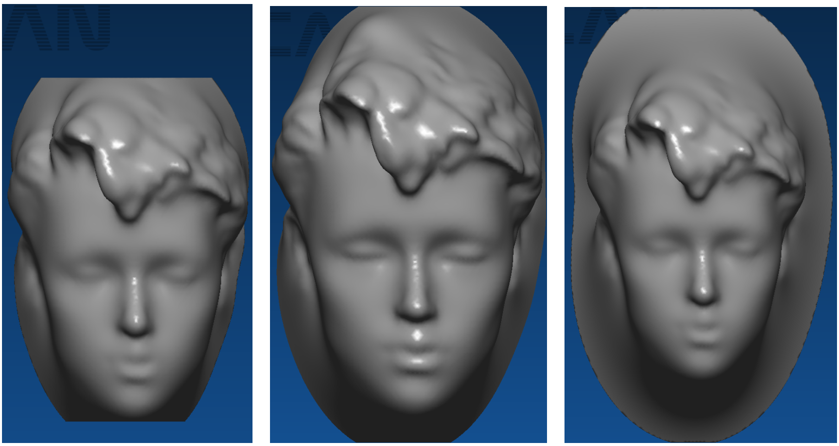


Figure 8: Two views of **Closed at Bounding Box** RBF processing

5.5 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 (Figure 9). When using "trimmed" edges it will remove all points that are more than 20 mm 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) 5 mm (b) 20 mm (c) 50 mm

Figure 9: Different Surface Margin sizes.

6 RBF Surface Simplification

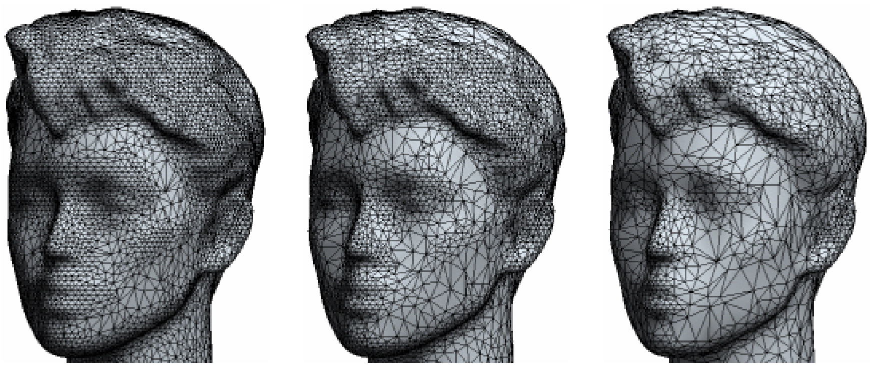
Simplification is used to reduce the complexity of the RBF Surface. **RBF Surface Simplification** uses features of the FastRBF™ method to create a simplified surface that is guaranteed to be accurate with respect to the original surface. This process produces excellent surfaces, but can be time consuming.

6.1 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).

6.1.1 Error

Simplifies until the error between the simplified and unsimplified surfaces reaches the specified value. Figure 10 shows the same surface simplified to different error targets.



(a) 0.1 mm (19 951 triangles) (b) 0.2 mm (12 222 triangles) (c) 0.4 mm (6 745 triangles)

Figure 10: Simplification with different error targets.

6.1.2 Number of Triangles

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

6.1.3 Number of Points

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

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