

## Scans from Polhemus FastSCAN are used to Simplify Modeling 3D Data in SolidWorks

### Background

The project involved the digitization of the heads of two detailed, anatomically correct dolls, and importing the scans into SolidWorks™ for manipulation. The Polhemus FastSCAN handheld scanner, with the FastRBF Extensions, was used both for scanning the dolls, and for exporting an appropriate solid model into SolidWorks.



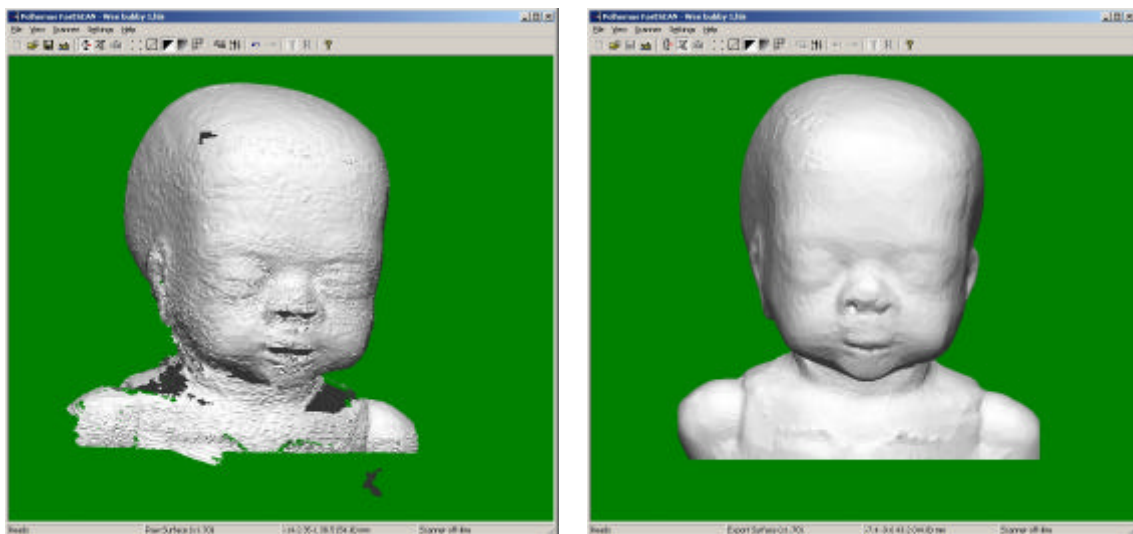
Foetal doll (left) and newborn doll (right).

### Scanning

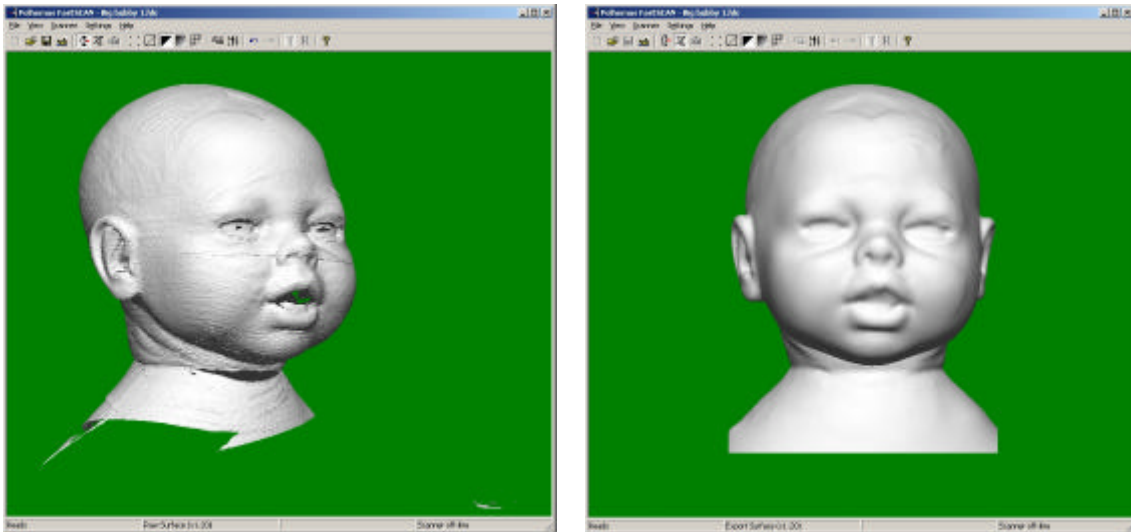
The head and shoulders of the two dolls were scanned using the Polhemus FastSCAN™ handheld 3D laser scanner. The construction of the foetal doll posed a potential problem for the scanner in that the doll was moulded out of a semi-opaque silicon rubber that gave a very poorly defined (noisy) surface as viewed by the laser scanner. The larger doll was of a ridged construction, with a painted surface that scanned very well.

### FastRBF Processing

It was initially proposed to paint the head of the smaller doll to improve the quality of the scan, but the FastRBF Extensions smoothing functionality ensured that the noisy data was modelled by a smooth surface, as shown in the figure below. It also automatically ensured that the surface was free from holes and water-tight. The FastRBF processed surface is guaranteed to be within a specified tolerance (in this case 0.1mm) from the original surface points.



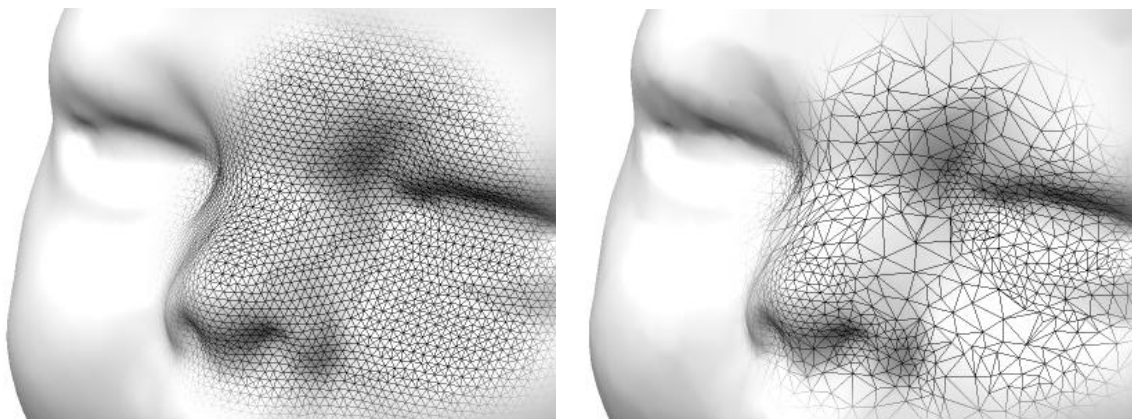
The foetal doll: raw data comprising approximately 141,000 facets (left) and the closed, FastRBF processed surface containing approximately 97,000 facets (right). The processed surface



The newborn doll: raw data comprising approximately 247,000 facets (left) and the closed, FastRBF processed surface containing approximately 169,000 facets (right).

## FastRBF Simplification

The FastRBF Extensions simplification technique exploits the underlying unique mathematical functions that are used to produce the FastRBF processed surface. Consequently, surfaces simplified with FastRBF are more faithful to the raw scan data than other traditional methods. Namely, an accuracy parameter is specified, and in these examples 0.05mm was used, so that the simplified surface will be no further than 0.05mm from the non-simplified surface. Despite such a tight constraint, the polygon count from the foetal doll was reduced from approximately 169,000 facets to 23,000 facets (a reduction of 86%), and for the newborn doll, from approximately 97,000 to 17,000 (a reduction of 82%).

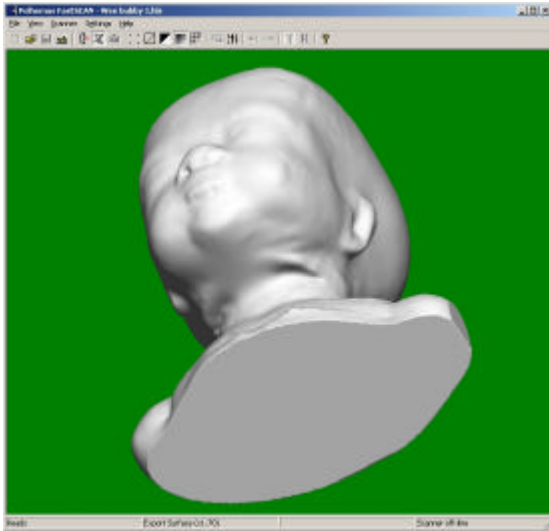


The newborn doll before and after FastRBF simplification: the fine mesh (left) and the simplified mesh (right).

## Exporting

The models were exported as IGES 128 (NURBs) entities, which is one of the many industry standard formats that FastSCAN supports. Using the above FastRBF Extensions simplification feature, the number of facets was kept to under 25,000, which was a operating system limitation on which the SolidWorks program was running.

In order to compare the ability of SolidWorks to import these surfaces, the foetal doll model was exported as a closed surface (ie planes added at the bounding box), and the newborn doll was exported as an open surface, ie the model was not closed at the shoulders and base.



The foetal doll exported as a closed, water-tight model, with closed planes at the bounding box, ie at the shoulders and base.

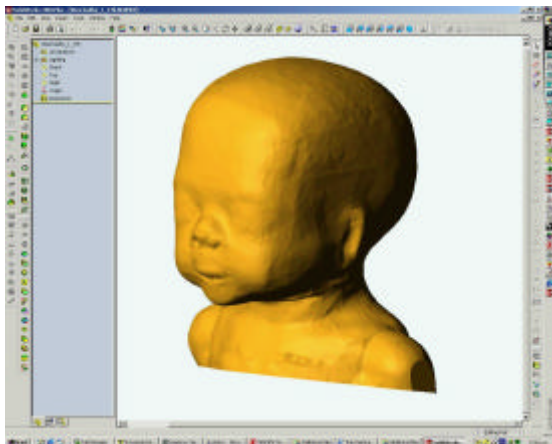
## **Importing into SolidWorks**

Jeremy Palman, Mechanical Draughtsman, was given the task of importing the objects into SolidWorks. For the (closed) foetal model, importing took approximately 3 minutes, resulting in an "imported solid" (as seen in the feature manager tree). Jeremy was able to start working on the model immediately.

With the open newborn model, the task of creating a solid model involved a few more steps before SolidWorks would recognise the model as a solid. Very briefly, these included:

- Lofting surfaces over the open boundaries using the 'create planar surface' command
- Saving the model as a ParaSolid file, and reloading the file
- Using 'import diagnosis' on all the surfaces, and choosing the 'close all gaps' option
- Again, saving the model as a ParaSolid file, and reloading the file - which was now a perfect SolidWorks imported solid model.

Jeremy's final comment: *"Very satisfying and very successful"*.



Screen Captures of the two Models in SolidWorks.

## Summary

The mathematical consistency of the post-processed data guaranteed by the FastSCAN FastRBF Extensions was critical in creating models that would within SolidWorks. And the solution was also rapid, eg for the foetal model:

Step	Time (minutes)	Advantages
1. Scanning	5	<ul style="list-style-type: none"><li>• Handheld, so able to scan entire surface</li><li>• Number of facets: 141,000</li></ul>
2. FastRBF processing	4	<ul style="list-style-type: none"><li>• Automatic hole filling</li><li>• Smoothing of noise</li><li>• Water-tight</li><li>• Closed surface (optional)</li><li>• Number of facets: 97,000</li></ul>
3. FastRBF simplification	26	<ul style="list-style-type: none"><li>• Decrease number of points ...</li><li>• ... while remaining faithful to the original model, in a way that's determined quantitatively</li><li>• Plus all the features of the above step</li><li>• Number of facets: 17,000</li></ul>
4. Export	0.01	<ul style="list-style-type: none"><li>• Export to industry standard formats</li></ul>
5. Importing, SolidWorks	3	<ul style="list-style-type: none"><li>• Parsing and solid model processing automatic for the closed surface</li></ul>

## Contacts:

Scanner: FastSCAN  
**Polhemus Incorporated**  
40 Hercules Drive  
Colchester, VT 05446  
Tel +1 802 655 3159  
Fax +1 802 655 1439  
[sales@polhemus.com](mailto:sales@polhemus.com)  
[www.polhemus.com](http://www.polhemus.com)