REAL REVERSE ENGINEERING

There is a growing disillusionment with scanning systems on the market place, as companies and hardware fail to deliver a resultant file that the customers are completely happy with, that they can use inside of their native CAD system and that meets their initial expectations.

POINT CLOUD

The reality tends to be a little different, the picture you see in most reverse engineering software is in fact thousands of points shaded or rendered on the screen to look like it is forming a real-time surface in front of your eyes. It is not; it is just points or in some cases a triangular surface mesh.

Try to export this point cloud into a traditional CAD package and more often that not it will be unable to handle data and will come to a grinding halt. A point cloud from a simple demonstration block is very rarely illustrative of real life components and very few CAD systems have been designed to meet this challenge.

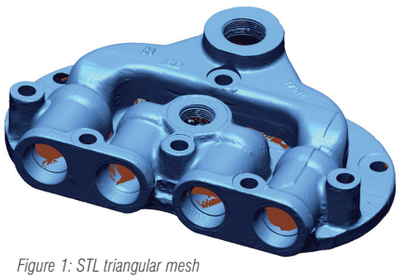

Figure 1: STL triangular mesh

STL MESH CREATION

From a point cloud typically the next stage is for the file to be converted into a triangular surface mesh or Stereolithography (STL) file (Fig.1). All the major reverse engineering software on the marketplace can achieve this with varying levels of success and speediness. With scanning hardware developing at a rate of knots, software companies have to be equally adept to keep up with the ever-increasing point cloud data collection rates.

The initial file size of the point cloud can be greatly reduced at this point, as larger triangles can be created to represent large flat surfaces and smaller triangles in the areas of high curvature.

If the aim of a scanning project is to use a 3D printer or similar to reproduce an object, then this type of file is typically a suitable end result. All major rapid prototyping systems tend to be tailored to accept these files and quickly produce a replica product. However, the problem comes again when the STL is attempted to be used from inside the customer's native CAD system. All too often there is an option that says 'Import STL', however the reality is a file that takes an age to import and then cannot be rotated or manipulated in any useful manner.

FULL CAD MODEL

The next stage is to produce an IGES file. Great — now we are getting to what the customer really wants well, not exactly.

An IGES file can be read into nearly all CAD systems, but what does it consist of? Well, the easiest and most common form of IGES file produced from scan data is some form of rapid surface. This, simply put, is a series of mostly four sided surface patches that wrap themselves to the underlying scan data. This means that imperfections, chips, worn areas etc. will be represented in the final file.

Geometric areas of components will also closely represent the actual real world part and therefore a cylinder that is egg-shaped would be reproduced in this irregular fashion in the resultant model.

The reality is that this file is not much use to anyone looking to re-manufacture a component. When re-manufacture is a requirement, the customer is actually looking for 'design intent' from the scan file in order that, for example, a bore that is measured at 19.998 mm can be adjusted to it's original nominal dimension of 20 mm. The customer also wants to be able to make sure, for example, that this bore is perpendicular to the top plane.

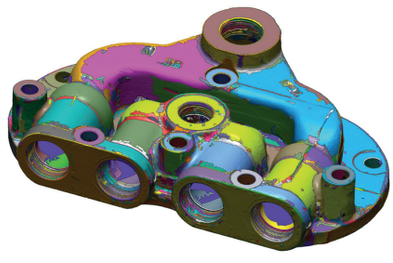

Figure 2: Region segmentation (planes, cylinders)

REVERSE ENGINEERING SOLUTION

The solution to this problem has been perfected by EuroPac3D — a scanning hardware and software supplier who also offers an extensive scanning bureau service.

The combination of the company's scanning expertise and the use of XOR reverse engineering software has produced a solution that works in the real world for customers who want a parametric CAD model that they can edit, manipulate and produce drawings from inside of their CAD system.

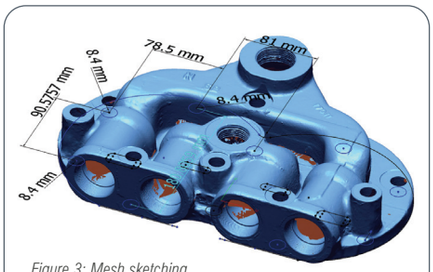

Figure 3: Mesh sketching

First of all, the XOR software can use a point cloud or STL file as starting point. Region segmentation of this raw data means that the file is automatically split into different colours representing different areas of geometry. For example, planes, cylinders, cones etc will be found automatically from the file and created with one simple push of a button (Fig. 2). Dimensions of these features can then be quickly and easily altered as the user looks for 'design intent' adjusting diameters into meaningful numbers.

More complex shapes can also be created with a couple of easy steps. A 'Mesh Sketch' (Fig. 3) can be easily created. This is a 'sketch' familiar to most CAD users, except it uses the profile of the underlying scan data as its reference. The sketch can be constructed with parametric constraints as would be done in a traditional CAD system and then 'snapped' to the scan reference data. Once a profile is created, the accuracy can be checked with a click of a button that shows a 'whisker' diagram which shows deviation of sketch to scan. Once the sketch is finished it can be utilised in a familiar fashion to extrude, revolve, sweep etc… into a solid model.

There is nothing new inside of XOR to a CAD user; it is just capable of using scan data extremely well and manipulating this data to create a file that is truly usable in the customer's CAD system.

The introduction of XOR3 in May is another leap forward into the parametric reverse engineering market with the introduction of a 'sweep wizard', a 'revolve wizard', 'extrude wizard' and 'pipe wizard'. This giant step means that automatic parametric solid modelling is getting ever closer.

Can this process be completely automatic? Probably not, there will always be some human intervention needed to decide what a dimension or fit between parts really is, however, the hours and hours of laborious modelling to reproduce something you already have are coming down drastically.

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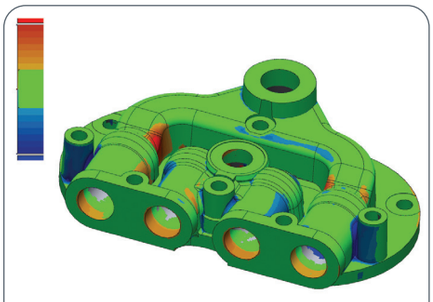

Figure 4: Accuracy of model creation

The final model produced from XOR software can be exported as an IGES, STEP or Parasolid file. In addition, the real power comes from the ability to 'live transfer' this file into Solidworks, Pro/Engineer, Siemens NX, Autocad and CATIA (Fig. 5). This means that the complete history tree is transferred into the customer's CAD system and the part can be quickly and easily edited, fitted into an assembly or part component drawings produced. This is the final loop of the reverse engineering process truly closed, with customers receiving exactly what they want.

SOLUTIONS IN THE REAL WORLD

Alsager Precision, based in Crewe, Cheshire, is one of many customers to have embraced this latest technology. Having already purchased a Cimcore measuring arm from EuroPac 3D as a quality control inspection tool, Alsager Precision decided to increase its reverse engineering capability.

It purchased a Perceptron V4 laser scanner and Rapidform XOR software. The Perceptron laser fits straight onto the Cimcore arm which can be easily switched between scanning and touch probing.

Alsager Precision produces and supplies high precision components and assemblies to the automotive, aerospace, energy and medical industries. This wide diversity of products served made it essential that the Perceptron laser could scan virtually any surface from shiny metal to dark carbon fibre. An average point resolution of 4.5 microns also made this product extremely attractive for high detail complex medical applications that previously would have been difficult to tackle.
The purchase of XOR software also means that many more projects can be tackled where no drawings or legacy CAD data is available. The software allows scanned parts to be rapidly interrogated and turned into parametric solid models from which components can be machined. The introduction of laser and scanning software to Alsager precision means that the measuring arm is utilised 100% of the time, which is now split between quality control inspection and reverse engineering projects.

The introduction of XOR and the Perceptron laser has reduced the reverse engineering process by weeks.

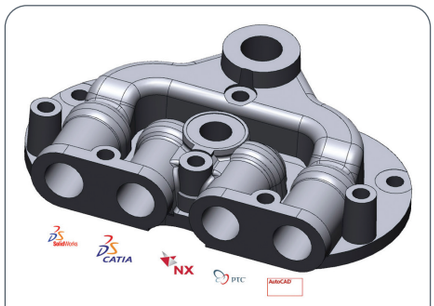

Figure 5: Final solid model

THE FUTURE

The advent of 64 bit computers and the revolution of XOR software complementing scanning hardware means that EuroPac 3D can produce CAD models exactly to the specification the user requires.

Native transfer into the major CAD systems is allowing a fully editable model that can be used in all areas of manufacturing, CFD, 2D drawings and not just an unusable dumb model.

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