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EXCELLENCE IN 3D MEASURMENT

Application Example: 3D Scanning, Reverse Engineering, Titanium 3D Printing

Specialized Medical Instrument Reproduction using Advanced Manufacturing Processes

Measuring Systems: ATOS Core 80
Manufacturing Systems: ARCAM Q20
Keywords: Medical equipment, 3D scanning, 3D printing, additive manufacturing

Specialized and highly sought after medical components can now be reproduce using non-contact optical 3D scanning and titanium 3D printing. In this case we explore the capturing, reverse engineering and additive manufacturing of a pair of forceps used in complex eye operations. An ocular surgeon approached Scan-Xpress with this one-off hand modified instrument that was being shipped across the country from one hospital to another to perform vital procedures and was in such high demand that the scanning took place overnight.

Photos of original forceps

Due to the reflective nature of the nickel plating the forceps were first treated using an opacifying spray, applied at high precision using a modeler's spray gun. Past quantitative tests have indicated that this process adds approximately 3 - 4 microns to the surface of the part which was deemed acceptable for this application.

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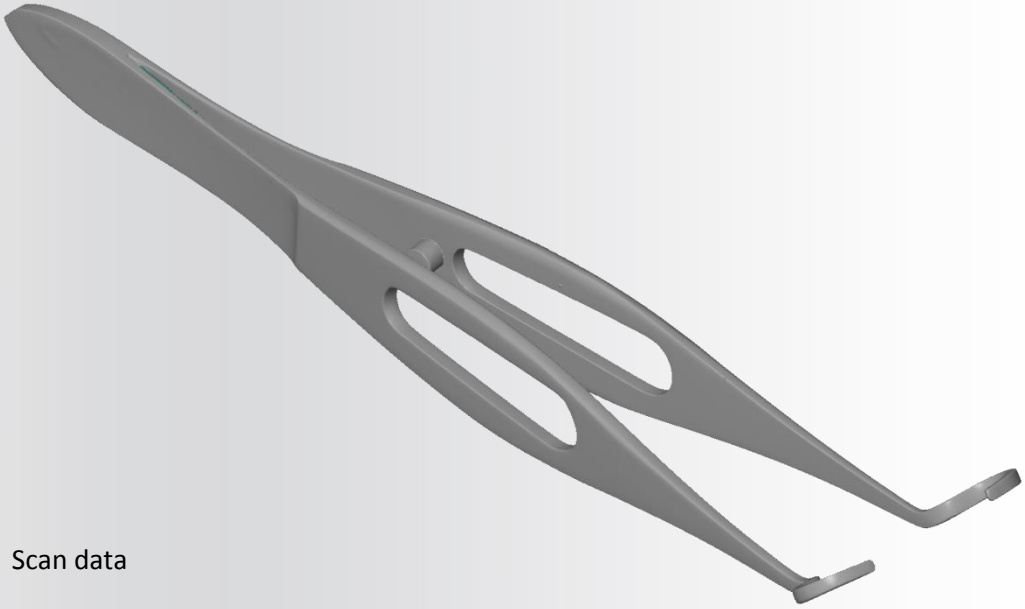
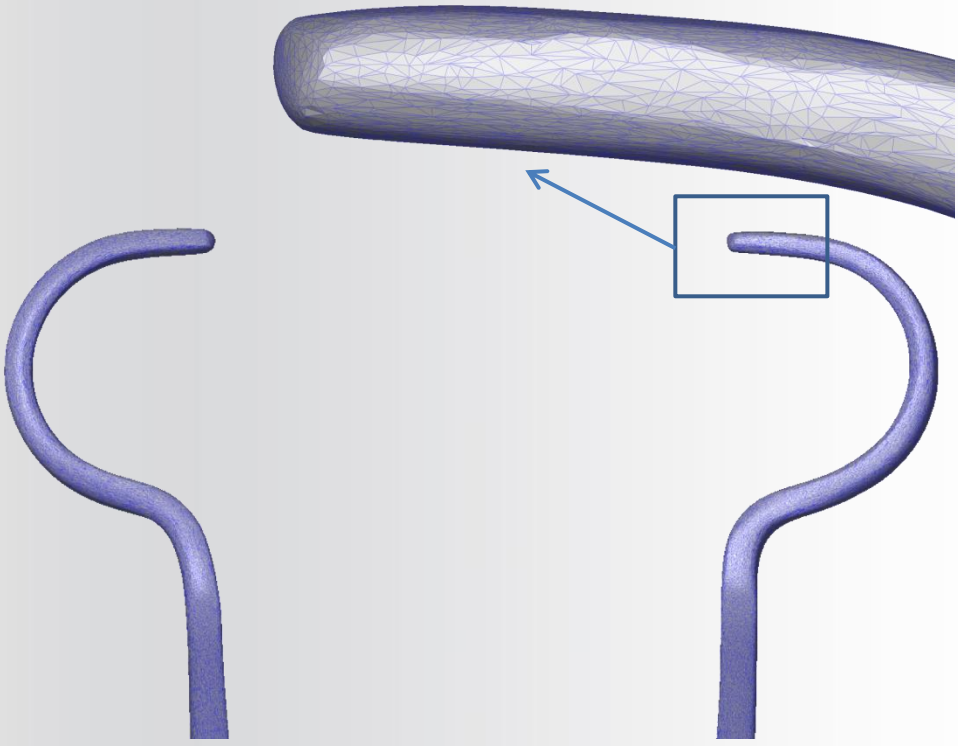
The output of the ATOS scanning system is an STL file format, also known as a 'mesh'. Under the measurement conditions used for this operation the resolution of the mesh was around 0.01 mm. The density of the mesh was reduced to around 80 000 measurement points for optimum downstream workflow efficiency.



Scan data



Scan data with mesh structure

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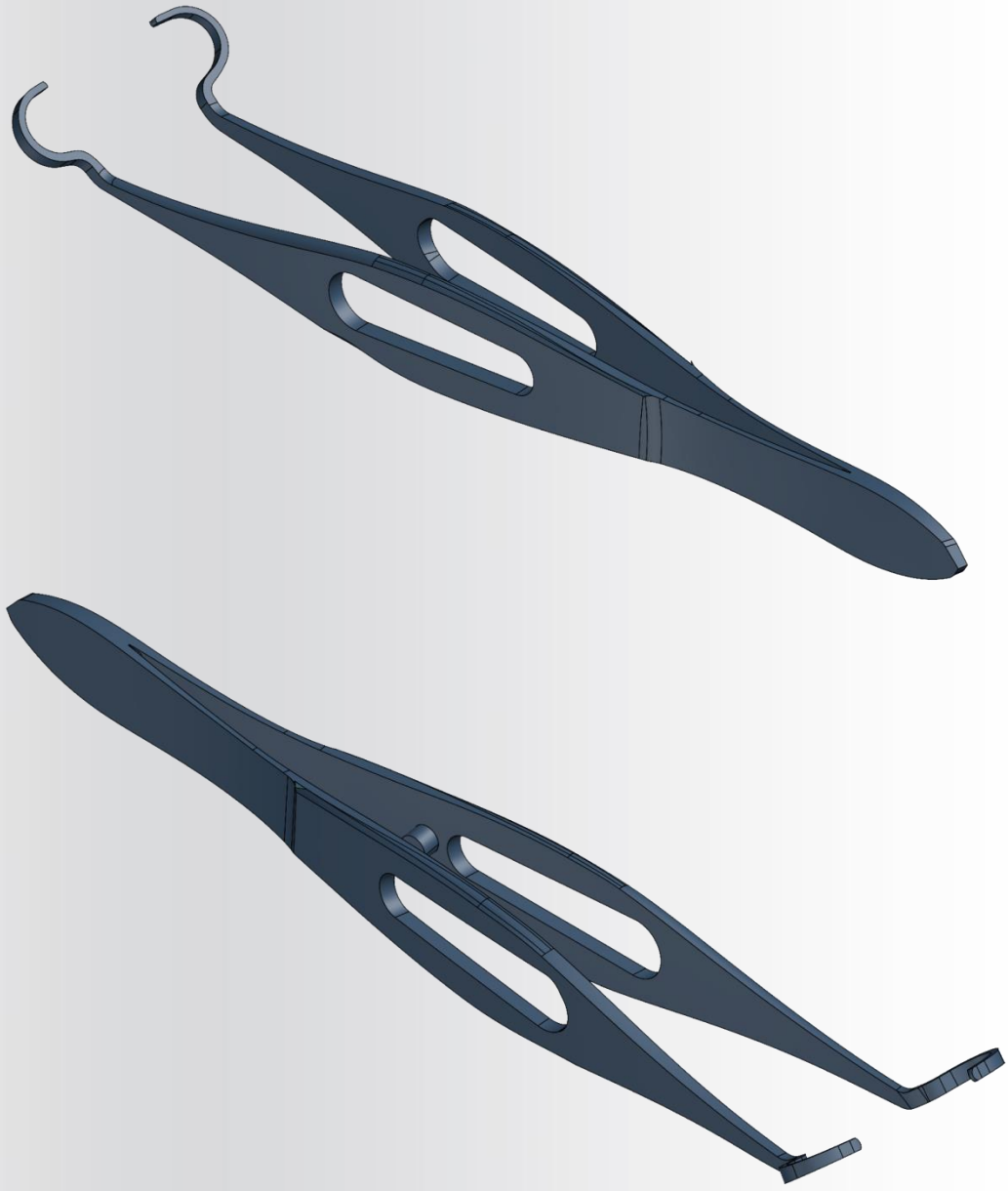
Whilst printing directly from the output of the scanning system is possible, this approach would duplicate any manufacturing defects or wear and tear present in this well used piece of equipment. As a result the scan data was used to reverse engineer a mathematical surface that best described the ideal geometry of the tool. Other than a small feature used to prevent the forceps from closing too tightly, the part was treated as a perfectly symmetrical body.



CAD model isometric views

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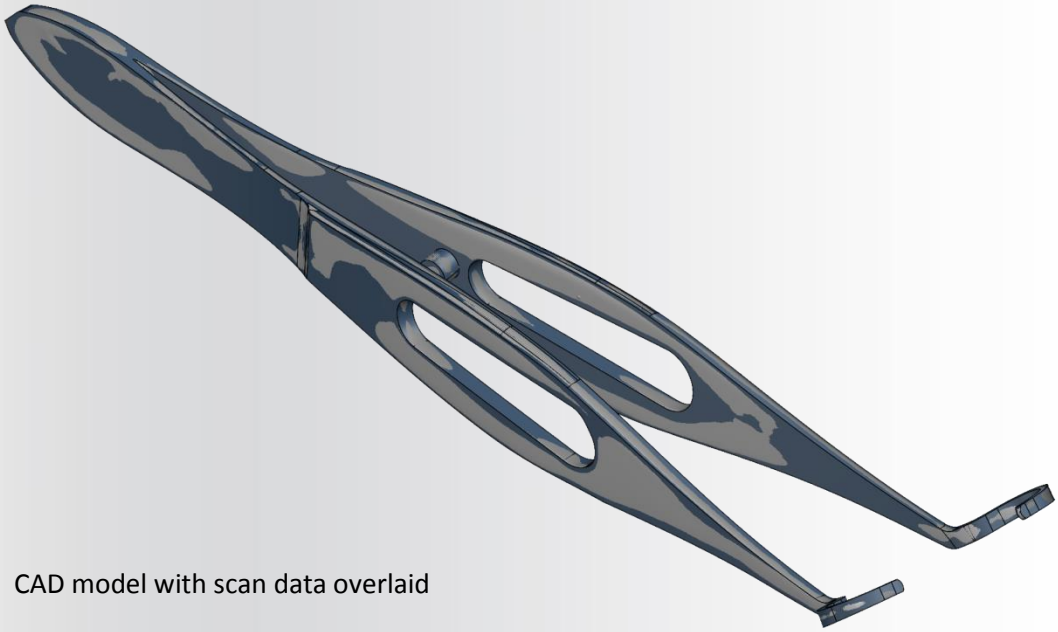
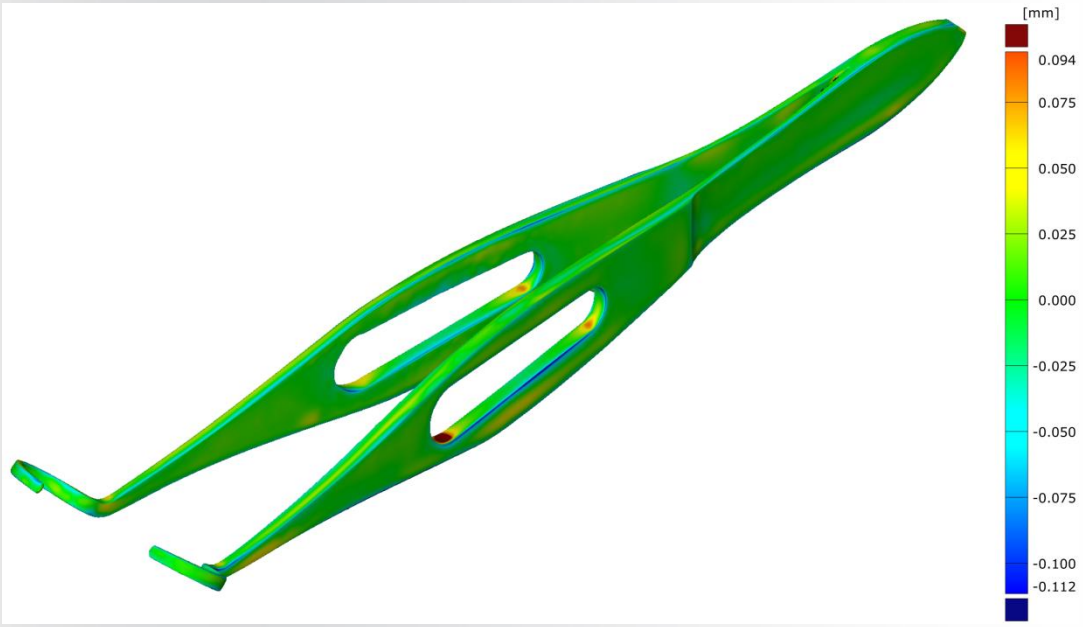
In order to validate the accuracy of the reverse engineering process the scan data was overlaid on the CAD model using a Gaussian best fit approach. In the image below the scan data is shown in grey and can be seen to undulate through the CAD model which is depicted in dark blue.



CAD model with scan data overlaid

A geometry deviation analysis was performed to verify that the accuracy of the model was within +/- 0.025 mm of the scan data. The color map illustrating this is shown below.



Geometry deviation colour map

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The approved CAD model was then sent to our additive manufacturing partner in New Zealand, **Zenith Tecnica,** who produced the forceps using electron beam melting (EBM) additive manufacturing technology on their Arcam Q20 machine.

Arcam Q20

The finished print was Nickel coated and autoclaved before being packaged and sent to the client. It is now being used in surgery.

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