



 **CS MACHINE**

 **Geomagic® Design X™**

REVERSE ENGINEERING MODELLING PROCESS SAMPLE PIECE 1

The point cloud of the upper part of the sample piece which was scanned via GEOMAGIC DESIGN X and laser scanner measuring arm is as in Figure-1. In this scan, 1,490,626 points were measured.

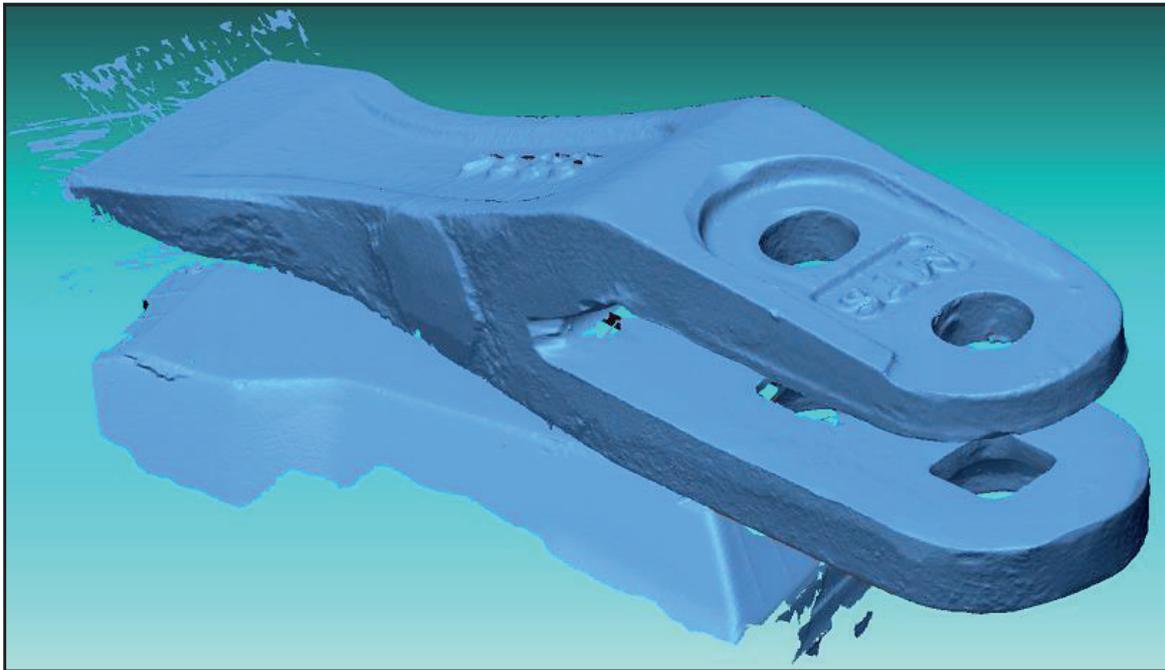


Figure 1

The point cloud of the lower part of the piece is as in Figure-2 and the number of points taken was 1,295,544.

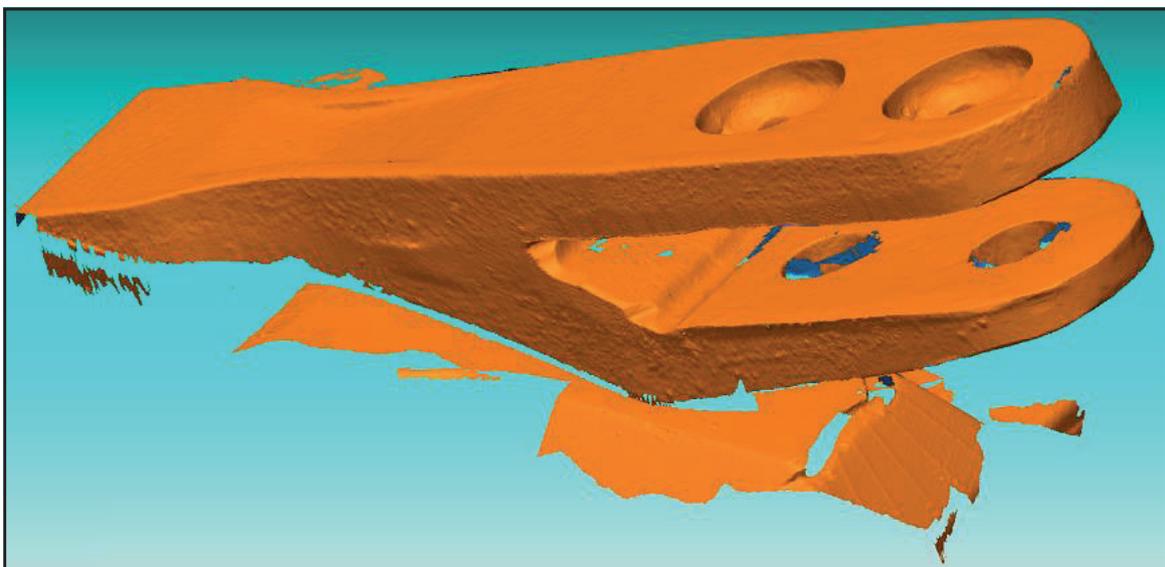


Figure 2

Non-particle points in these point clouds were cleaned and aligned by GEOMAGIC DESIGN X automatically. See Figure-3

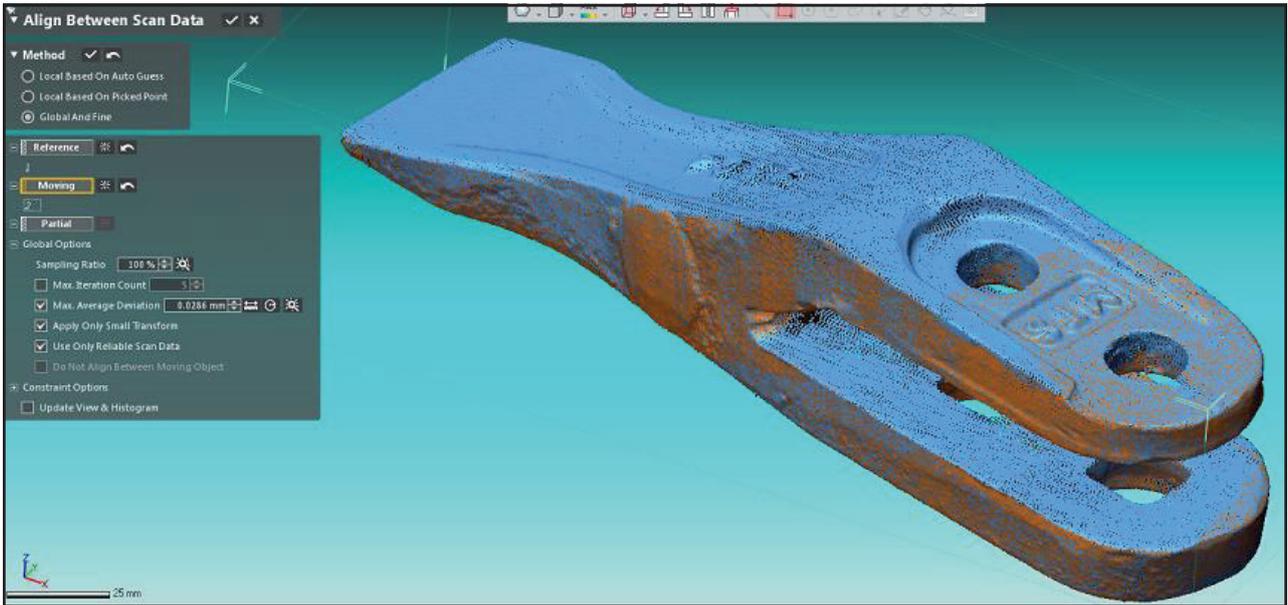
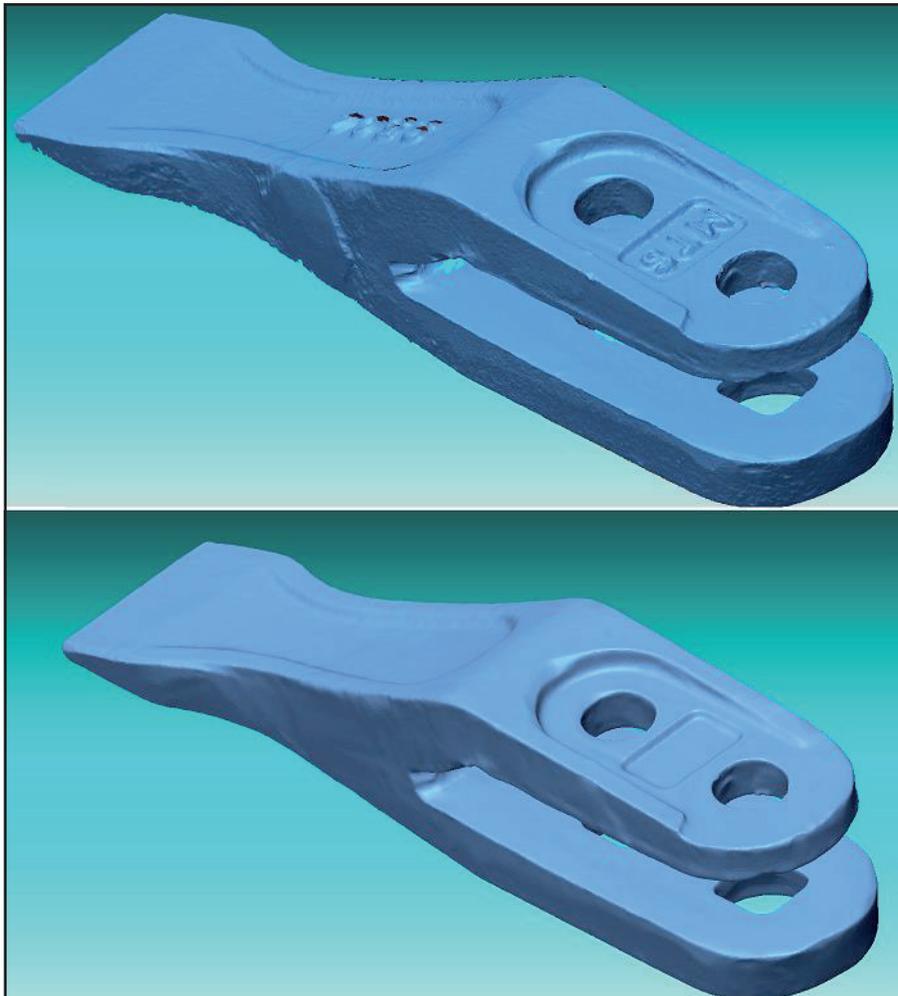


Figure 3



After the scan data were aligned, the mesh (net structure) was knitted, the necessary corrections (deleting the letters, smoothing the surface, etc.) were made on the mesh, and the number of points was simplified to 75,582. The differences between before and after the arrangement can be seen in Figure-4.

Figure 4

By the help of GEOMAGIC DESIGN X, which has the most powerful commands among existing reverse engineering software, the geometric elements on the mesh were automatically detected as in Figure-5.

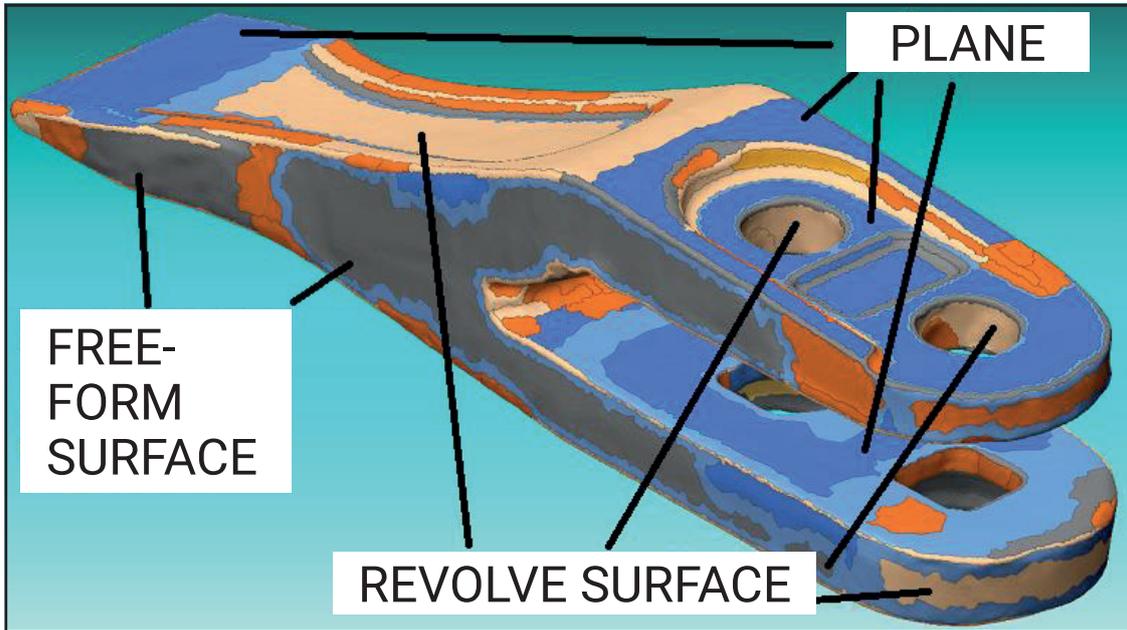


Figure 5

By using the found geometries, the alignment of the mesh structure on the 3D coordinate system was made.

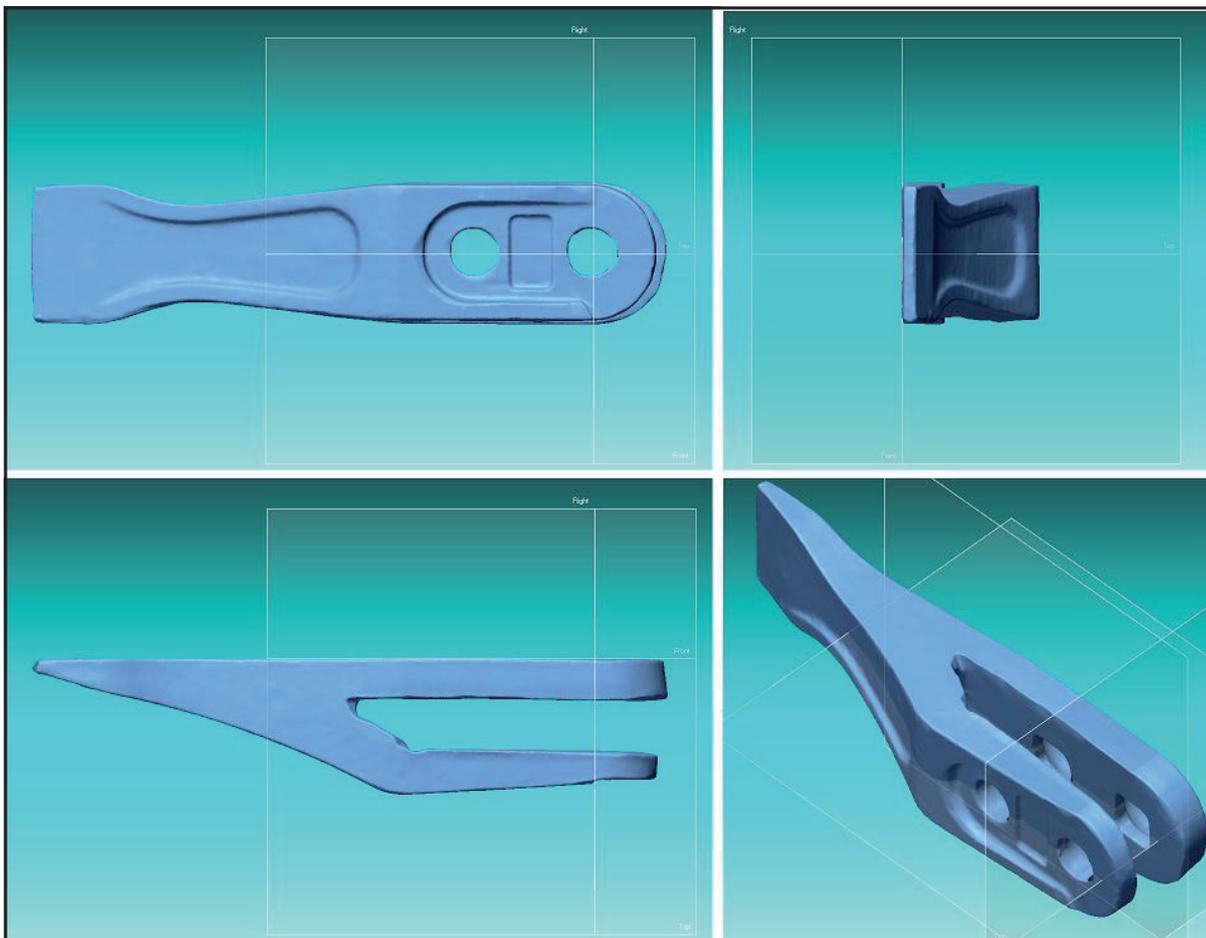


Figure 6

In GEOMAGIC DESIGN X software; there are commands to create more accurate and faster geometries over mesh (auto-surface, mesh fit, etc.) as well as all the drawing commands (line, arc, circle, trim, fillet, mirror, linear pattern, etc.) and surface or solid creation commands (extrude, revolve, loft, sweep, draft, shelf, etc.) found in CAD programs. During the modeling of this piece, the parametric modeling path was followed with the solid modeling logic of a CAD software, with the help of the Mesh Sketch command, which takes a section through the mesh. See Figure 7-10.

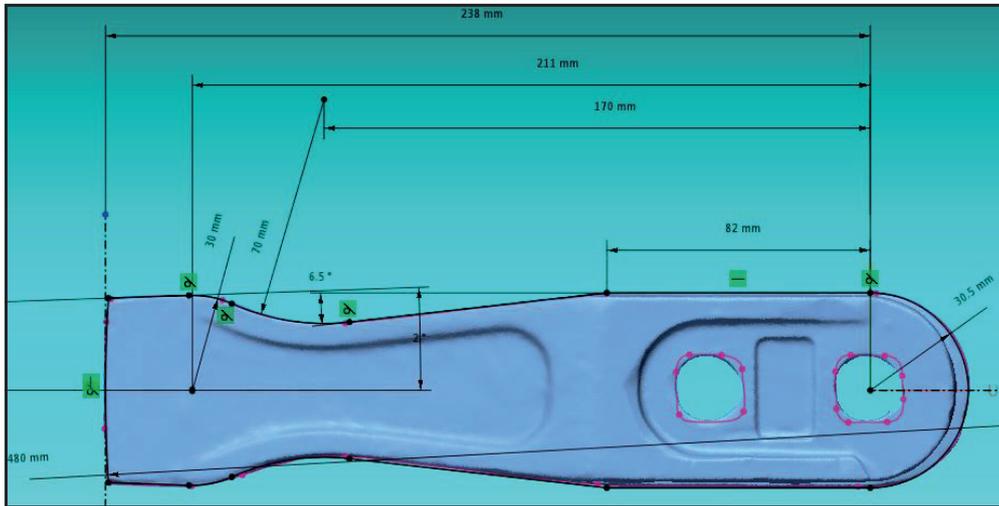


Figure 7

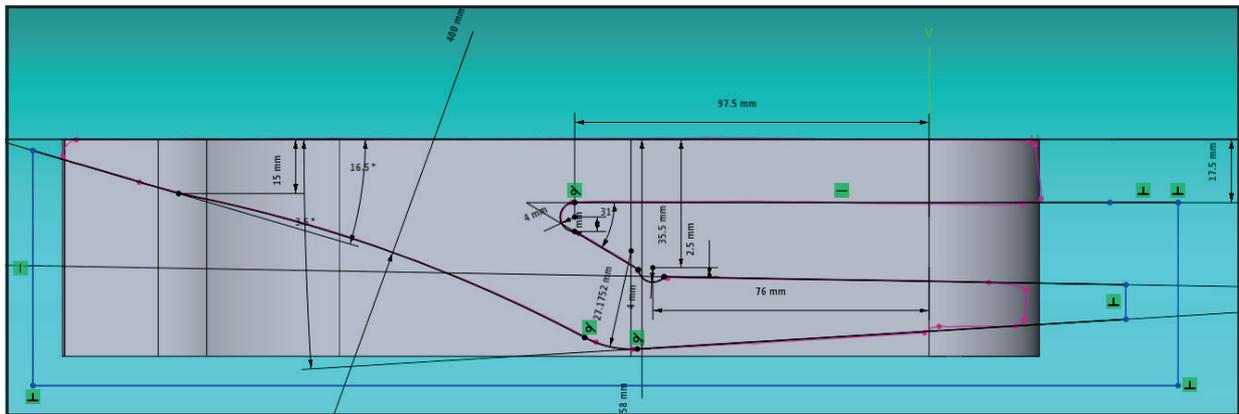


Figure 8

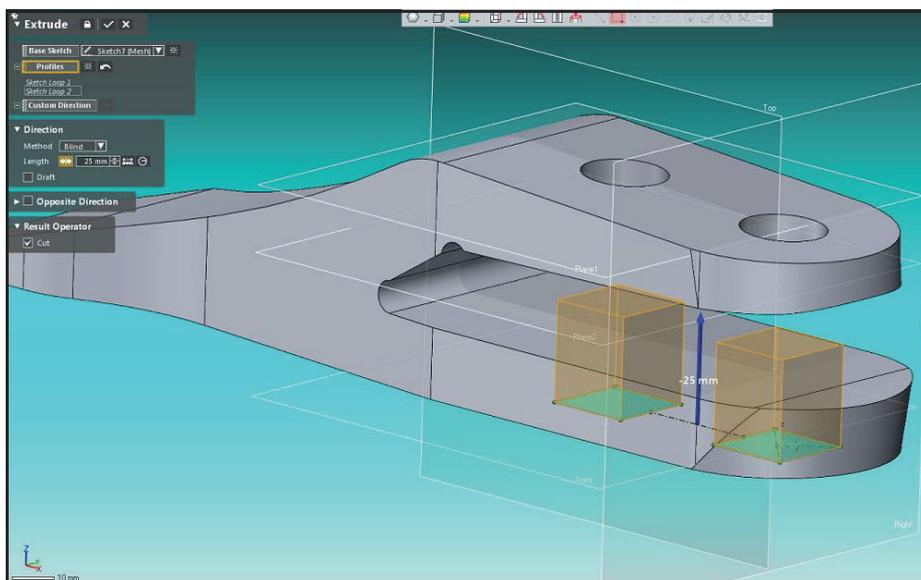


Figure 9

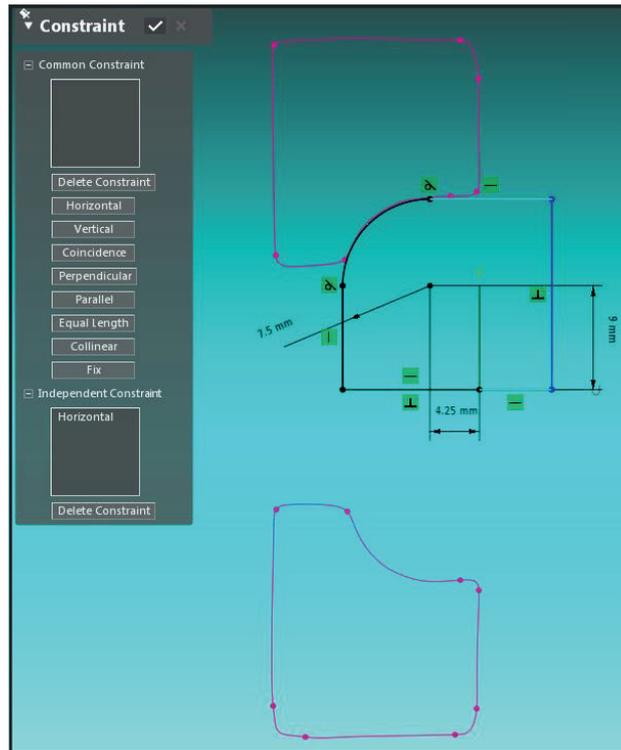


Figure 10

The final model taken after all these steps can be seen in Figure 11.

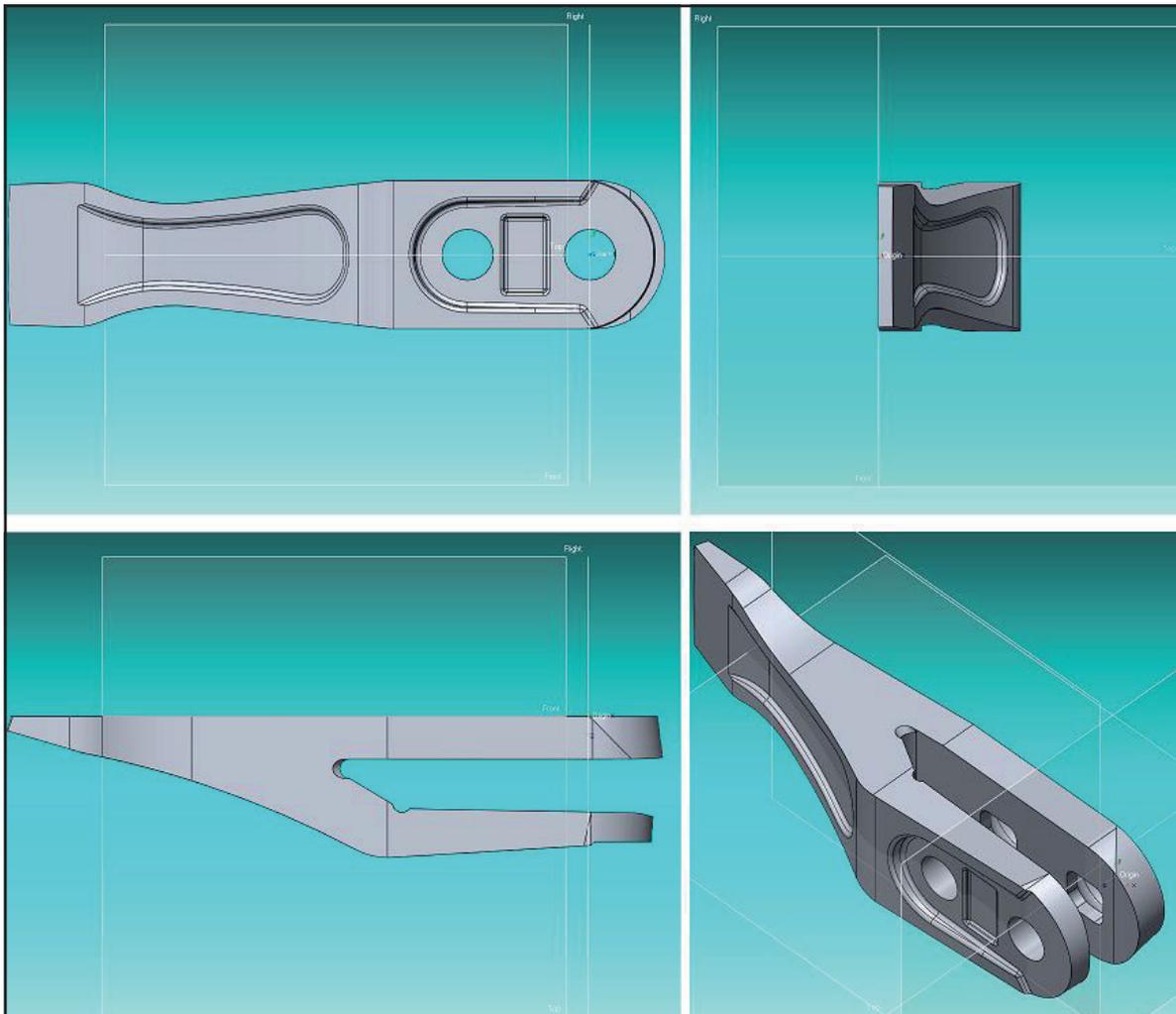


Figure 11

Finally; the solid model and mesh created were compared with the control module of GEOMAGIC DESIGN X, and the color maps seen in Figure-12 were created within tolerance values entered ($\pm 0.25\text{mm}$, $\pm 0.50\text{mm}$, $\pm 0.75\text{mm}$, $\pm 1\text{mm}$).

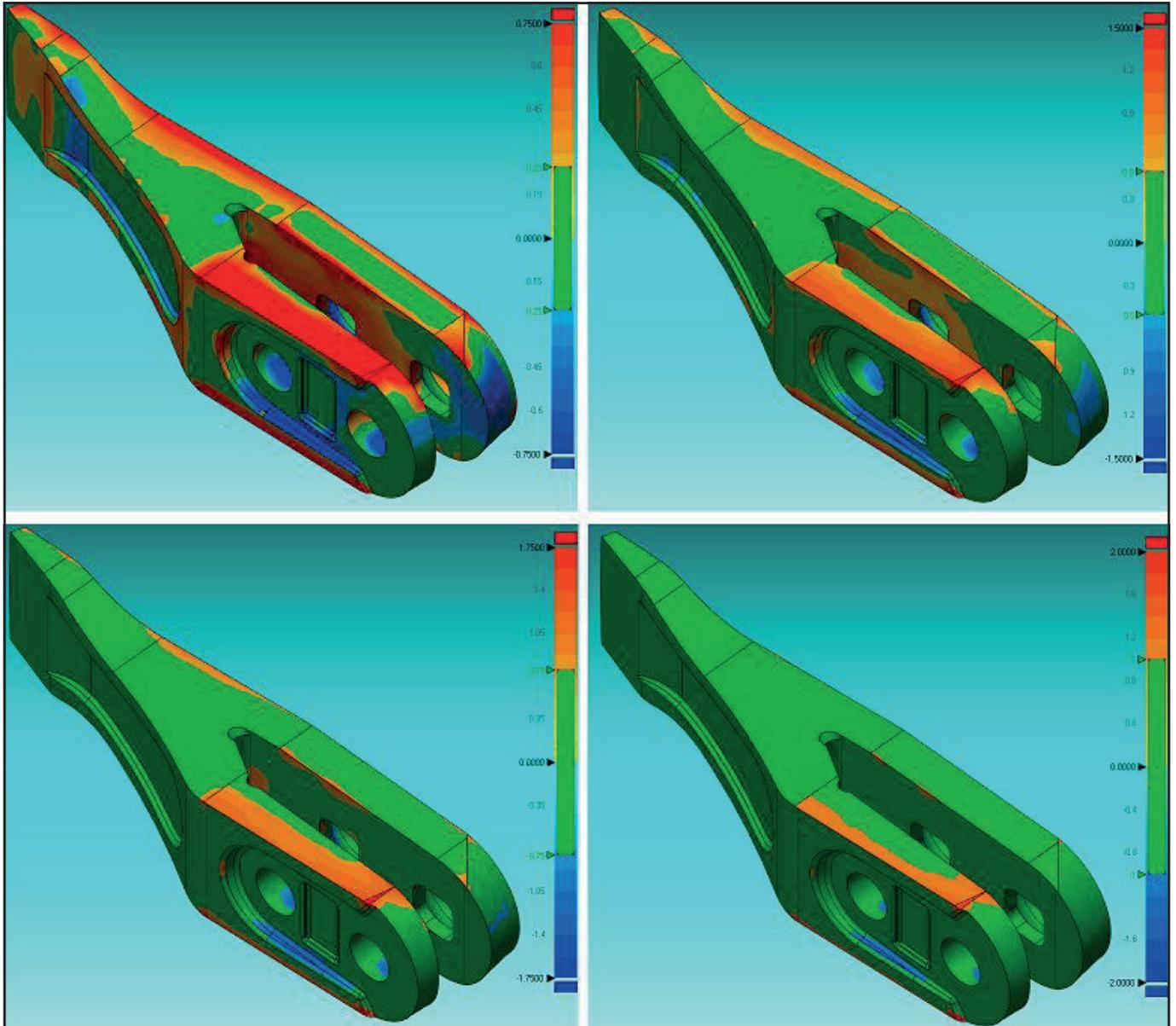


Figure 12

As can be seen from the processes made; all the tools needed during a reverse engineering work from scanning to modeling can be found in GEOMAGIC DESIGN X. No other CAD software is needed to convert the obtained raster data to solid model or surface.

The created model can be exported in to several formats such as IGES, STEP, Parasolid. Moreover, by the help of LiveTransfer command in GEOMAGIC DESIGN X, the entire model, in addition to the product tree, can be transferred to a CAD program (Solidworks, NX, Creo, Inventor, Autocad, Solid Edge) which are used parametrically. Following this stage, the model obtained in the CAD software environment has no difference from a model designed from scratch in that software.

REVERSE ENGINEERING MODELLING PROCESS SAMPLE PIECE 2

The point cloud of the upper part of the sample piece which was scanned via GEOMAGIC DESIGN X and laser scanner measuring arm is as in Figure-13. In this scan, 1,366,498 points were measured.

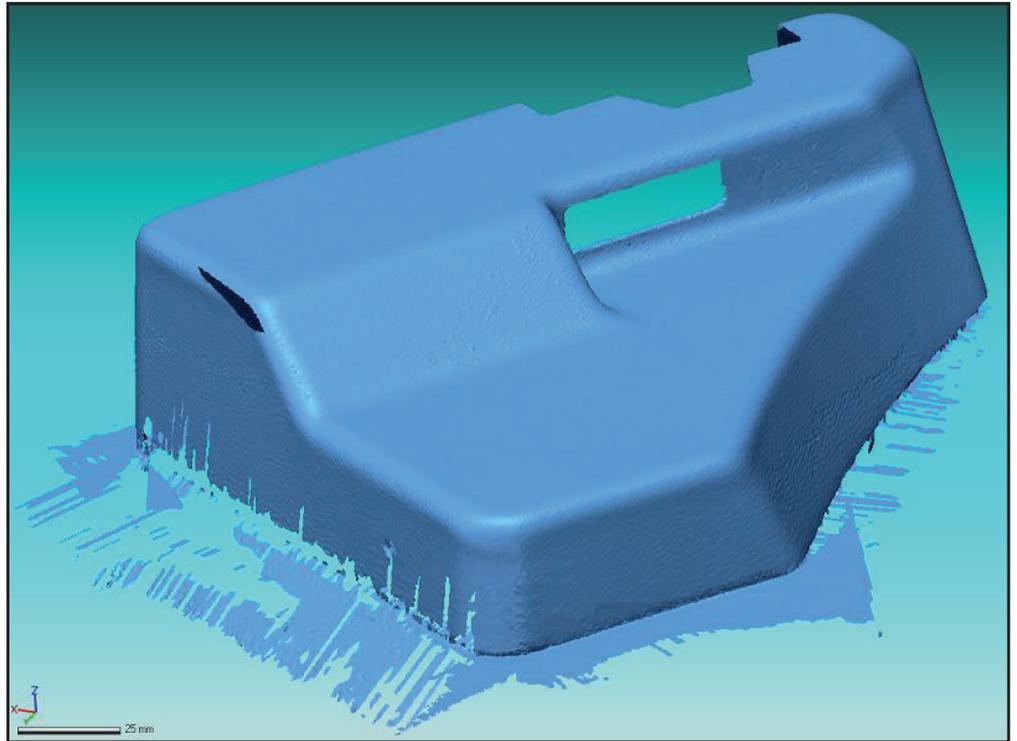


Figure 13

The point cloud of the lower part of the piece is as in Figure-14 and the number of points taken was 2,141,606.

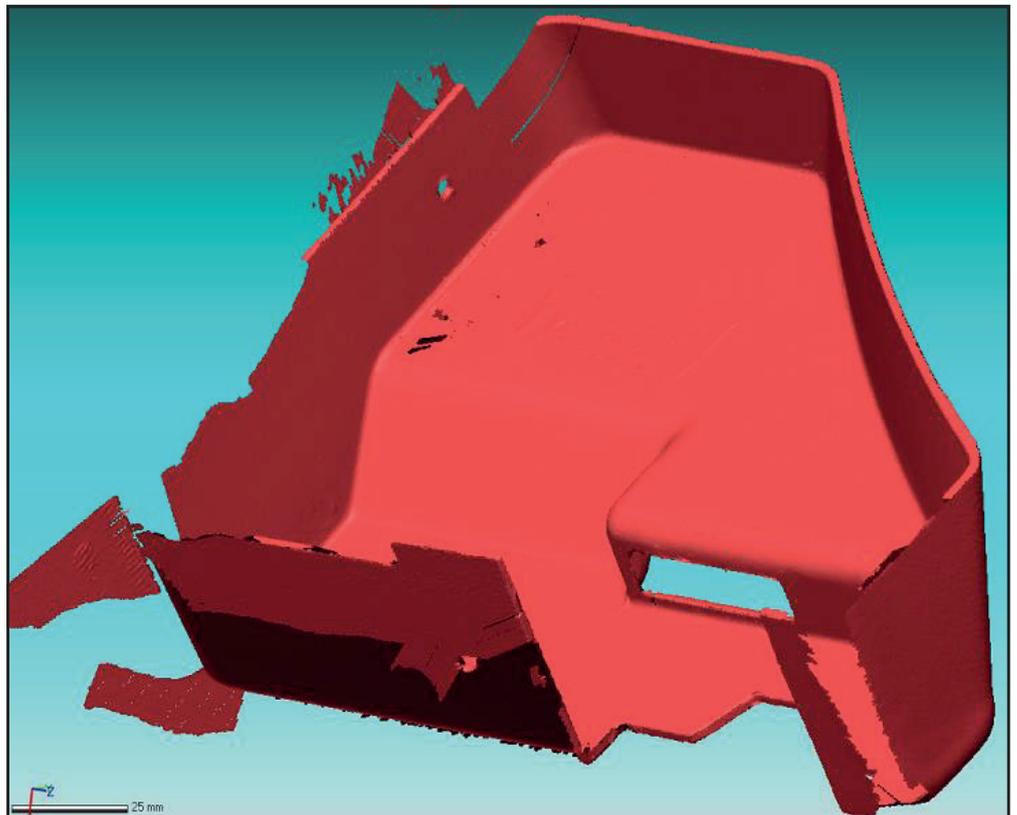


Figure 14

Non-particle points in these point clouds were cleaned and aligned by GEOMAGIC DESIGN X automatically. See Figure-15

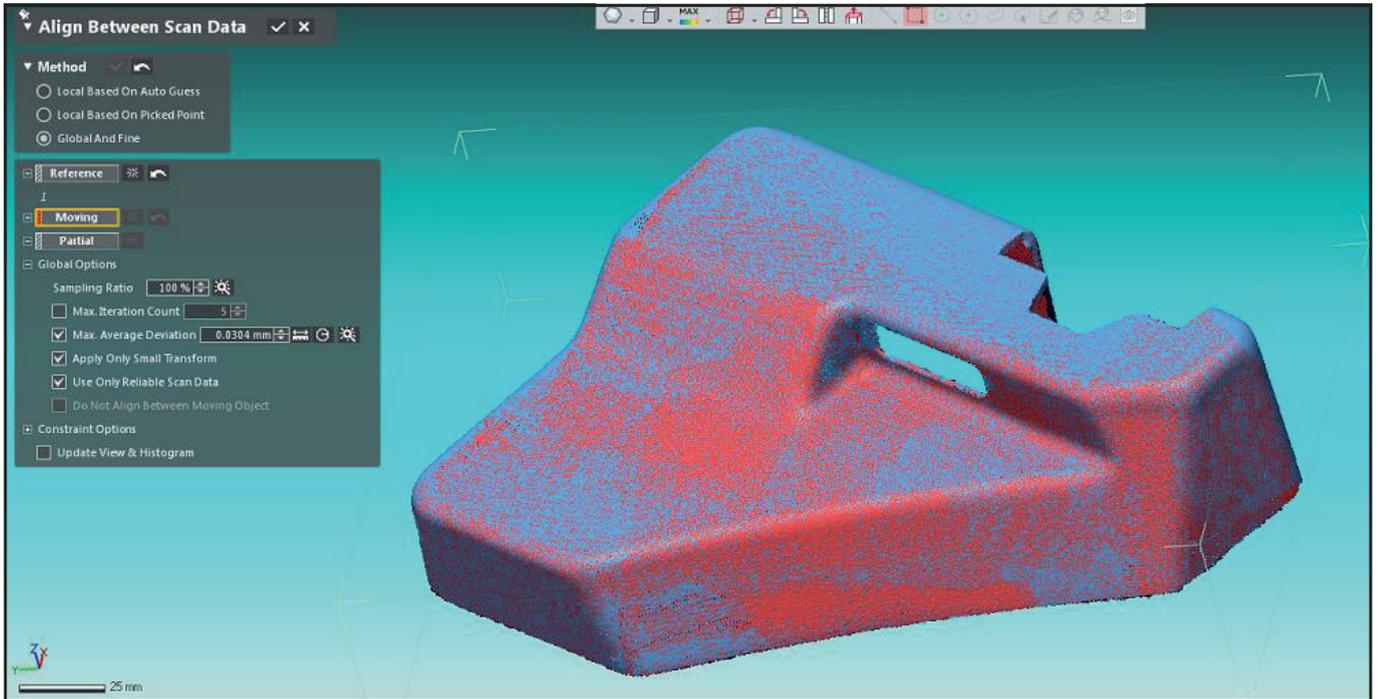
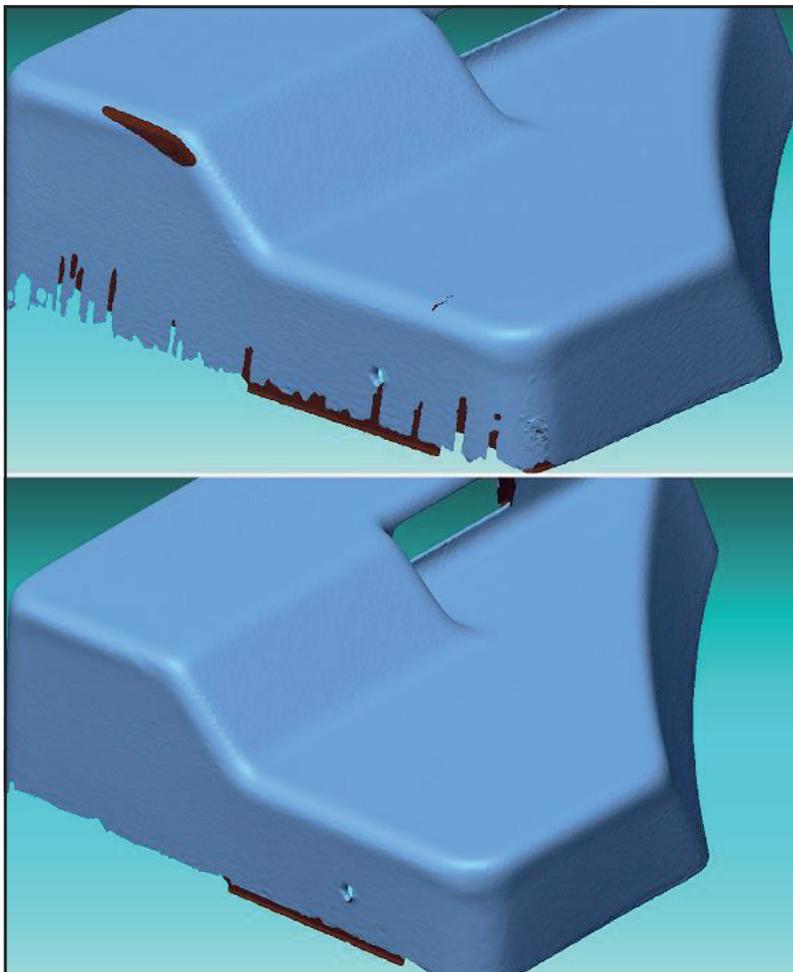
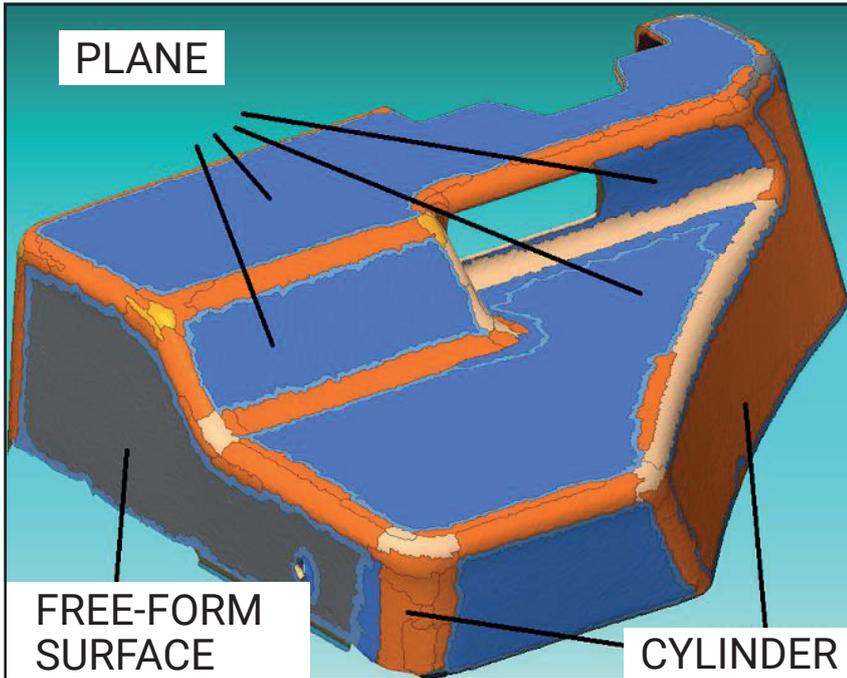


Figure 15



After the scan data were aligned, the mesh (net structure) was knitted, the necessary corrections (deleting the letters, smoothing the surface, etc.) were made on the mesh, and the number of points was simplified to 265,119. The differences between before and after the arrangement can be seen in Figure-16.

Figure 16



By the help of GEOMAGIC DESIGN X, which has the most powerful commands among existing reverse engineering software, the geometric elements on the mesh were automatically detected as in Figure-17.

Figure 17

By using the found geometries, the alignment of the mesh structure on the 3D coordinate system was made.

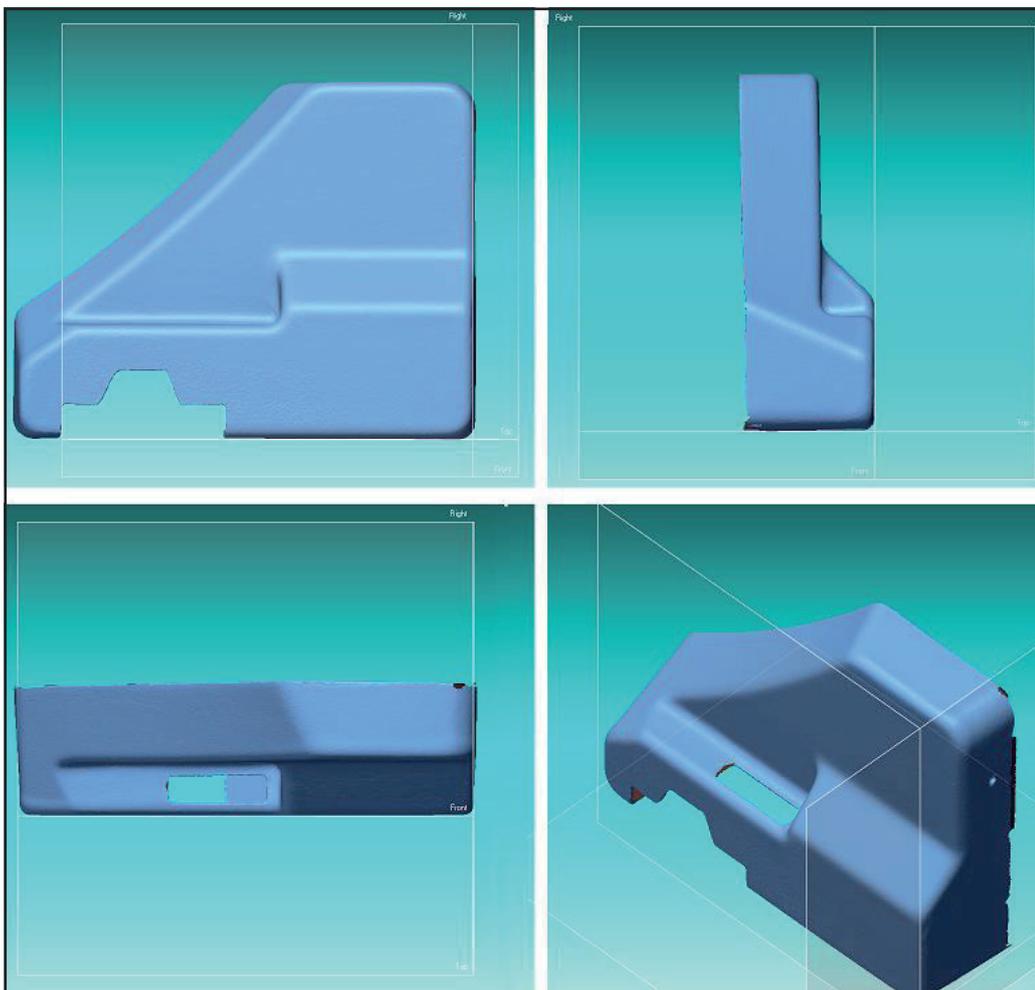


Figure 18

In GEOMAGIC DESIGN X software; there are commands to create more accurate and faster geometries over mesh (auto-surface, mesh fit, etc.) as well as all the drawing commands (line, arc, circle, trim, fillet, mirror, linear pattern, etc.) and surface or solid creation commands (extrude, revolve, loft, sweep, draft, shelf, etc.) found in CAD programs. During the modeling of this piece, with the help of the Mesh Fit command, the surfaces of the piece were created separately and combined by shearing according to each other. See Figure-19.

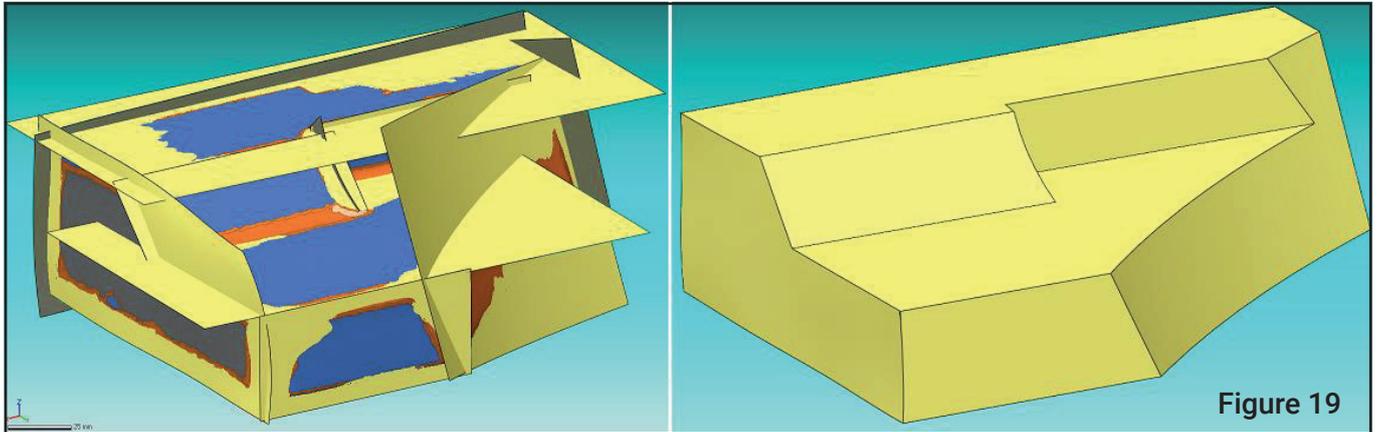


Figure 19

Necessary radius were entered to the junction edges of the surfaces by taking measurements over the mesh, The surface thickness was given as t:2mm; so the solid model seen in Figure-20 was obtained.

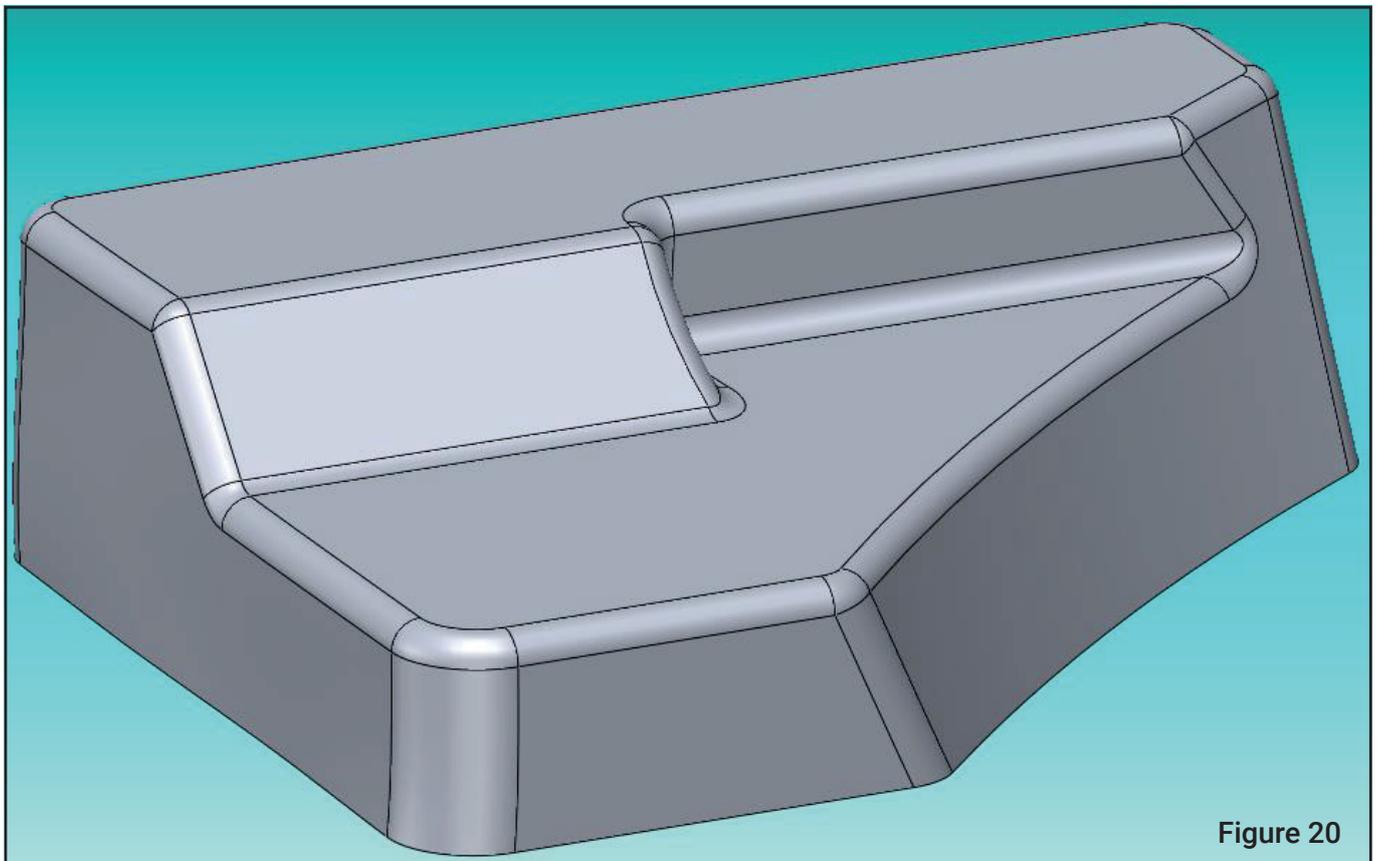


Figure 20

Afterwards, the discharges on the piece were parametrically processed into the model by determining their nominal dimensions. See: Figure-21.

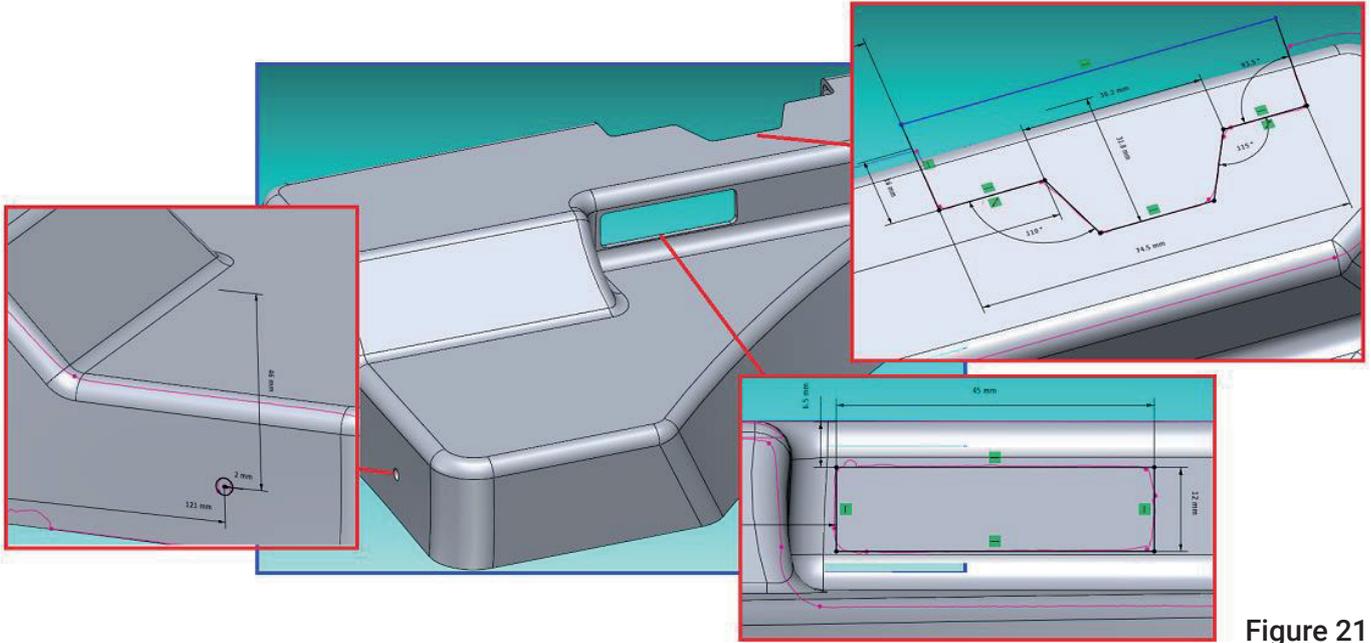


Figure 21

The final model taken after all these steps can be seen in Figure-22.

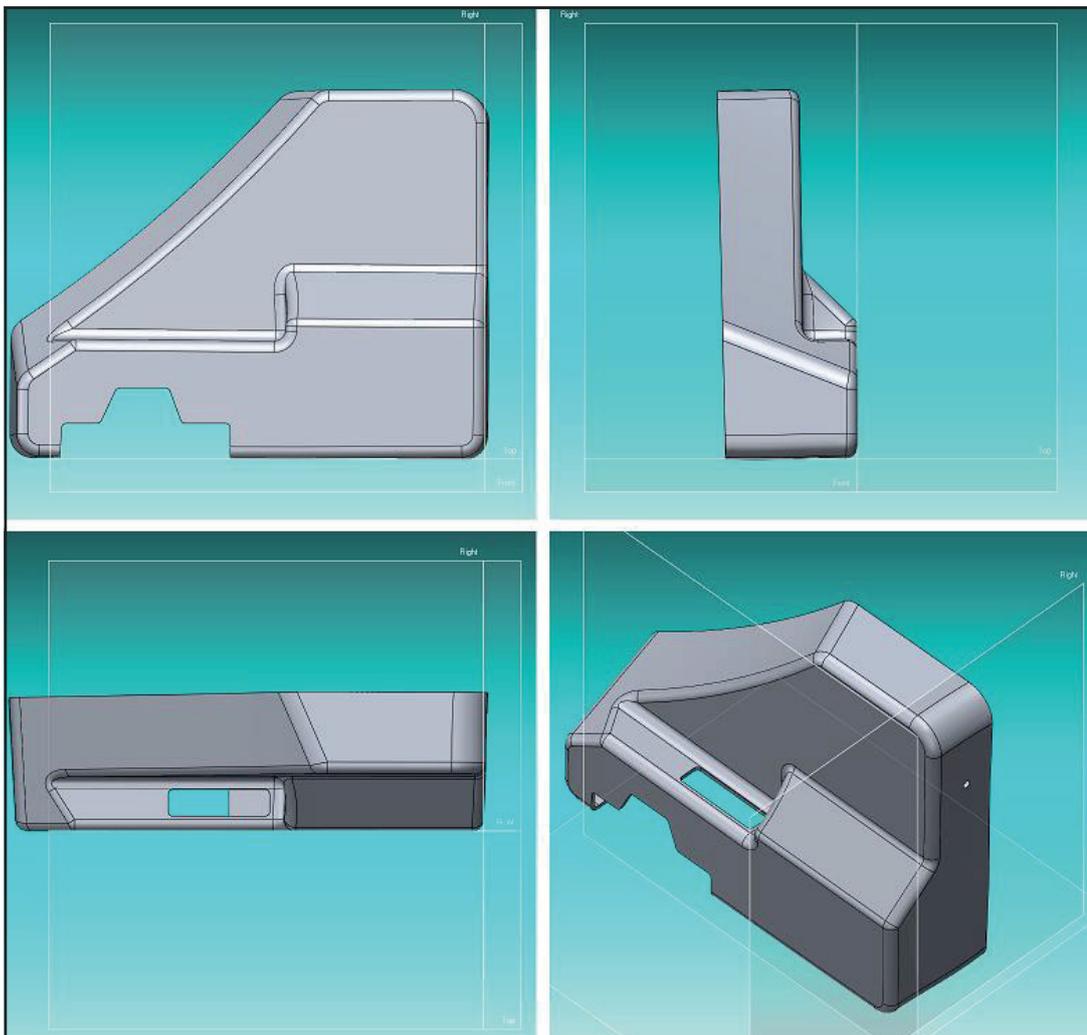


Figure 22

Finally; the solid model and mesh created were compared with the control module of GEOMAGIC DESIGN X, and the color maps seen in Figure-23 were created within tolerance values entered ($\pm 0.2\text{mm}$).

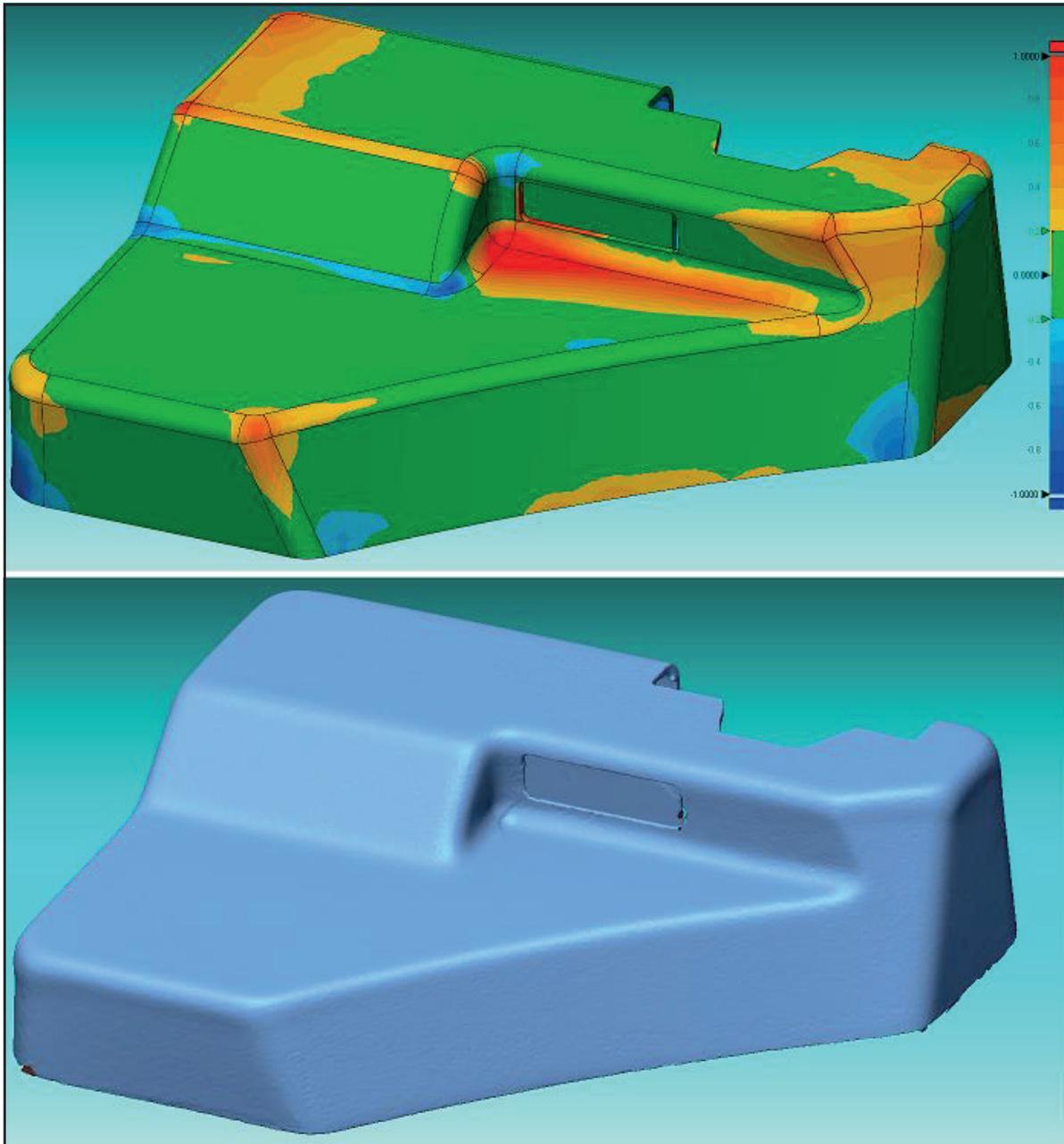


Figure 23

As can be seen from the processes made; all the tools needed during a reverse engineering work from scanning to modeling can be found in GEOMAGIC DESIGN X. No other CAD software is needed to convert the obtained raster data to solid model or surface.

The created model can be exported in to several formats such as IGES, STEP, Parasolid. Moreover, by the help of LiveTransfer command in GEOMAGIC DESIGN X, the entire model, in addition to the product tree, can be transferred to a CAD program (Solidworks, NX, Creo, Inventor, Autocad, Solid Edge) which are used parametrically. Following this stage, the model obtained in the CAD software environment has no difference from a model designed from scratch in that software.



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