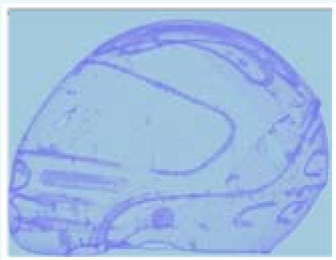
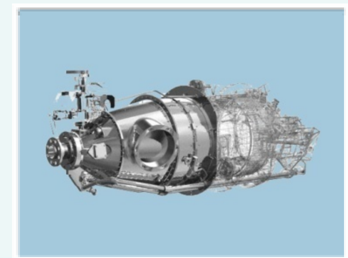
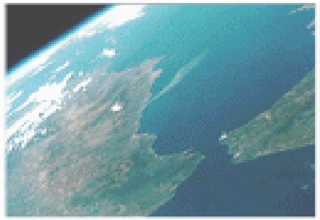
Reverse Engineering



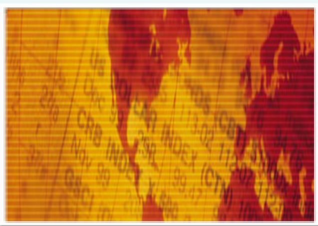





About us:

MAX Design

- Is based in Pondicherry in India.
- Has an international management team.
- Has more than 30 years’ experience in the development and management of trans-national IT related projects.
- Places Professionalism and Transperancy first and foremost.
- Is deeply and personally interested in yachting and flying.



Your Requirements:

If you wish to:

- Become more effective and competitive,
- Utilize and optimize your internal resources on your core competences,
- Increase your flexibility and timeliness with the response to your clients,
- Manage working peaks in a more efficient way,
- Gain the cost advantage of emerging economies without investments and risks,
- Take active part in the processes of globalization, and at the same time
- Lower your fixed costs, save on the expenses currently incurred and improve your profitability...

Our Services

MAX Design offers You a multitude of CAD support services that include:

3D CAD & Modeling:

- Digitization of paper drawings,
- Creation of detailed engineering drawings,
- Creation of 3D Simulations,
- Translation and migration of CAD Models
- Reverse Engineering,
- 3D Model Analysis,
- Design Automation, etc.

Rendering and Animations:

- Creation of photo-realistic images,
- Detailed visualization of products,
- Animations, etc.

Working together:

We offer You the possibility to work in a flexible way and to choose the solution that better suits you. For example we can work for you:

• On an hourly basis,

• On given projects,

• By setting up and running your own Off-shore Design Center (ODC):

- This is offered to those who require an ODC but don't have either the time, the resources or the experience to set up an ODC of their own.
- This solution drastically removes the risk and annuls the necessary initial investments for the setting up an ODC.

Or, suggest an arrangement that suits you best.

Reverse Engineering

Topics Covered

- What is Reverse Engineering?
- Why Reverse Engineering?
- Point cloud data conversion
- How CAD software helps in cloud data to surface
- Class-A surface Definition
- Reverse Engineering process flow
- Case study with examples

What Is Reverse Engineering?

Engineering is the profession involved in designing, manufacturing, constructing, and maintaining of products, systems, and structures. At a higher level, there are two types of engineering: forward engineering and reverse engineering.

Forward engineering is the traditional process of moving from high-level abstractions and logical designs to the physical implementation of a system. In some situations, there may be a physical part without any technical details, such as drawings, bills-of-material, or without engineering data, such as thermal and electrical properties.

The process of duplicating an existing component, subassembly, or product, without the aid of drawings, documentation, or computer model is known as reverse engineering.

Why Reverse Engineering?

Reverse engineering is very common in such diverse fields as software engineering For example, when a new machine comes to market, competing manufacturers may buy one machine and disassemble it to learn how it was built and how it works. In some situations, designers give a shape to their ideas by using clay, plaster, wood, or foam rubber, but a CAD model is needed to enable the manufacturing of the part.

As products become more organic in shape, designing in CAD may be challenging or impossible. There is no guarantee that the CAD model will be acceptably close to the sculpted model. Reverse engineering provides a solution to this problem because the physical model is the source of information for the CAD model. This is also referred to as the part-to-CAD process.

Another reason for reverse engineering is to compress product development times. In the intensely competitive global market, manufacturers are constantly seeking new ways to shorten lead-times to market a new product. Rapid product development (RPD) refers to recently developed technologies and techniques that assist manufacturers and designers in meeting the demands of reduced product development time.

For example, injection-molding companies must drastically reduce the tool and die development times. By using reverse engineering, a three-dimensional product or model can be quickly captured in digital form, re-modeled, and exported for rapid prototyping/tooling or rapid manufacturing.

Point cloud data conversion

In recent days, rapid machining through digital prototyping has been popular for its applicability in a wide range of complex and useful parts. Rapid construction of prototypes from point cloud data based on section plane method is available, which is an approximate method. Discusses some suitable methodology for conversion of point cloud data to a physical prototype where data acquisition is through a mechanical touch trigger probing process using CNC milling machine.

The process is quite useful for reverse engineering of complex sculptured parts. A concept called tangent plane method is adopted for the generation of 3D geometry on point cloud data of sculptured parts with due emphasis on probe radius compensation after data capture and tool radius compensation during tool-path generation. Computer simulated results are presented, based on real-world point cloud data.

How CAD software helps in cloud data to surface

Reverse engineering software package that, when used in conjunction with a 3D scanning device, provides a quick way of creating digital surface models of existing physical objects and making them available on a computer for further processing or for archiving.

Reverse engineering software enables users to efficiently handle 3D digitized data imported as individual points from tactile measuring devices, as point clouds or facet data from laser scanners, or from photogrammetry systems. In addition to standard ASCII-based and STL formats, Reverse engineering software supports proprietary data formats from individual scanner manufacturers.

Once imported, scan data can be displayed as rendered images and then converted to a surface model for further development and refinement. Scan data and surface data can also be used simultaneously real-time rendering technology, to create photo-realistic visualizations for early design review and packaging needs.

The surface model data generated with Reverse engineering software can be exported to other vendors' engineering CAD systems either via an industry-standard IGES or VDA interface, one of which, at the customer's choice, is included as standard, or via optional (at additional cost) direct interfaces to the leading CAD/CAM systems.

Class-A surface Definition

Class-A surfaces and their requirements have a close relationship with the aesthetics of a product. The reflection of light plays a major role in surface appearance. If a surface does not posses certain described characteristics, Visual appearance of the product will get affected.

Characteristics of Class-A surface can be classified into three major categories

Aesthetic requirements

- Reflection, smoothness
- Style features as intended by Designer/Stylist

Mathematical Requirements

- 0 order continuity (Positional Continuity / G0 Continuity)
- 1 order continuity (Tangent Continuity / G1 Continuity)
- 2 order continuity (Curvature Continuity/ G2 Continuity)
- 3 order continuity (Constant rate of change of curvature/ G3 Continuity)

Manufacturing requirements

- Panels should retain their shape - proper stretching requirement should be taken care,
- Styled features should retain intended shapes,
- Feature lines like shoulder line or waist line on body side panel, feature lines on hood panel should retain their place (skidding),
- Bulge effect on flange lines should be avoided,
- Manufacturability of shapes (Forming of sheet metal, Moulded components) etc.

Reverse Engineering process flow

Step 1:
A cloud of points taken from scanned data using a digitizer such as a laser scanner, computed tomography, or faro arms.

Step 2:
Convert the point cloud to a polygonal model. The resultant mesh is cleaned up, smoothed, and sculpted to the required shape and accuracy.

Step 3:
Draw or create curves on the mesh using automated tools such as feature detection tools or dynamic templates.

Step 4:
Create patches using surface fitting and editing tools.

Step 5:
Export the resulting final surface that satisfies accuracy and smoothness requirements to a CAD package for generating tool paths for machining.

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Step 7:
Manufacture and analyze the part for physical, thermal, and electrical properties.

Case study with Examples

Case 1: Helmet

Project scope: Reverse engineering

Product: Helmet

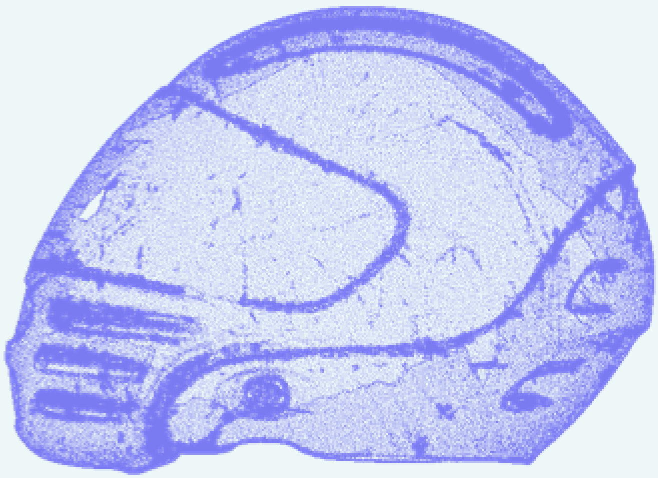
Input: Cloud data

Deliverable: IGES

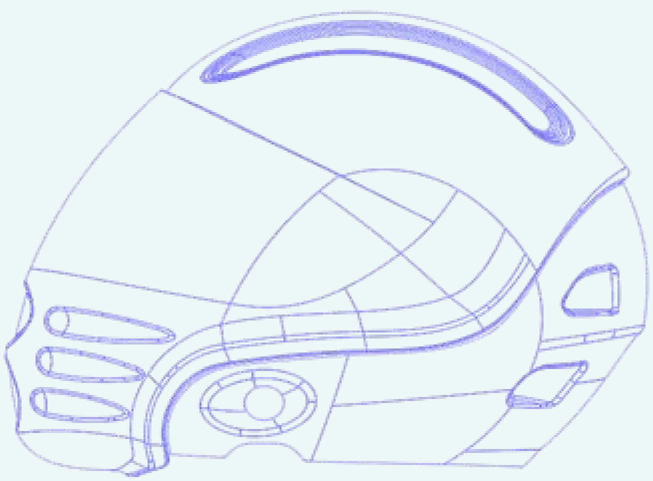
Process flow:

- Cleaning the cloud data
- Creating symmetry plane
- Creating curves on the mesh
- Creating patches with 0.2mm deviation maintained position continuity- 0.05mm and Tangent continuity-0.1°
- Mirroring opposite side surfaces
- Performed surface and surface continuity analysis

Case 1: Helmet



Cloud data



Wireframe

Case 2: Rotor

Project scope: Reverse engineering

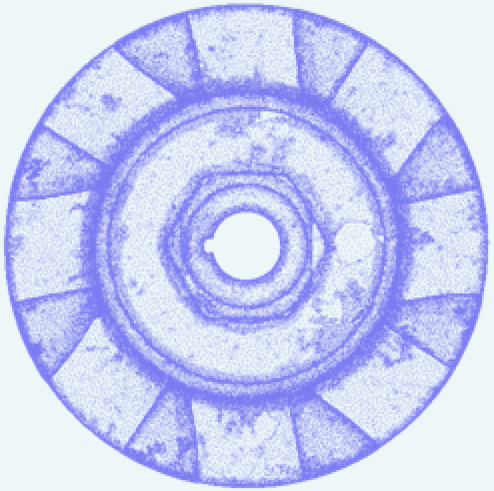
Product: Rotor

Input: STL

Deliverable: IGES

Process flow:

- Cleaning the cloud data
- Creating centre axis of the cylinder
- Creating curves on the mesh
- Creating patches in one blade with 0.2mm deviation maintained position continuity- 0.05mm and Tangent continuity-0.1°
- Arrayed all other blade surfaces
- Performed surface and surface continuity analysis



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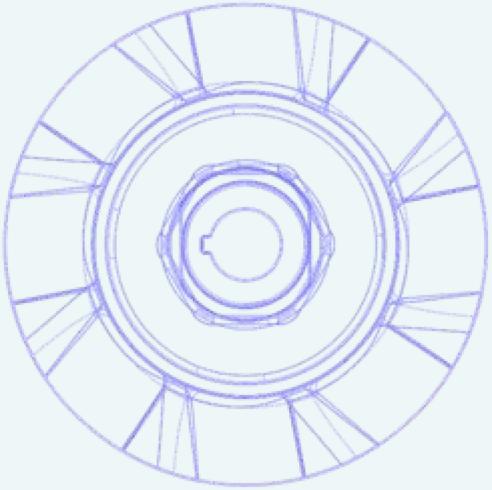


Wireframe

Case 3: Car door

Project scope: Class A

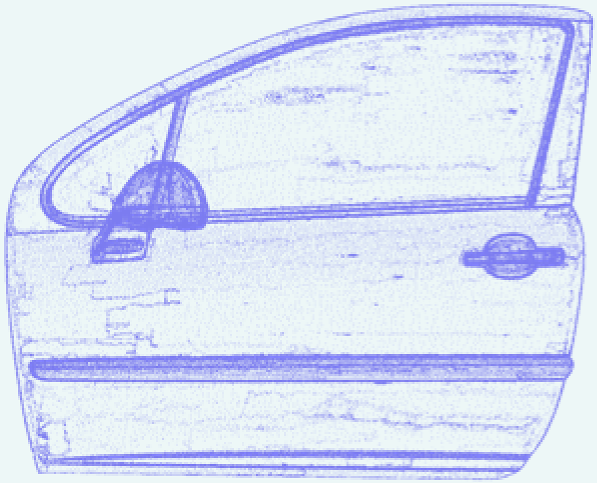
Product: Car door

Input: STL

Deliverable: IGES

Process flow:

- Cleaning the cloud data
- Creating curves on the mesh
- Creating patches with 0.1mm deviation maintained position continuity- 0.02mm and Tangent continuity- 0.1°
- Performed surface and surface continuity analysis



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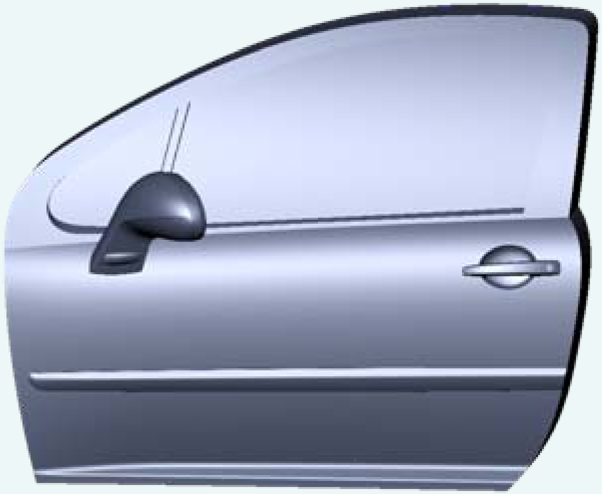
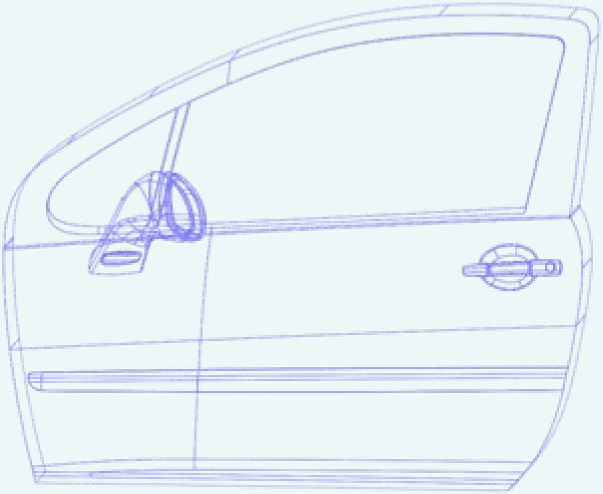




Wireframe

Case 4: Front Bumper

Project scope: Class A

Product: Front Bumper

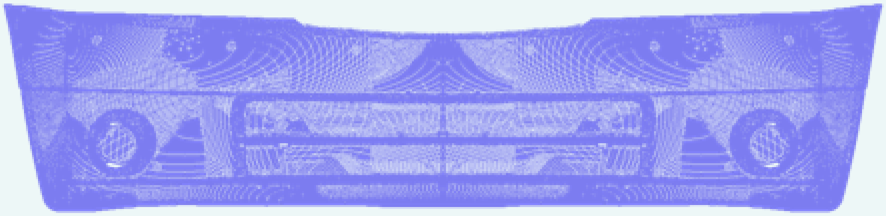
Input: Cloud data

Deliverable: IGES

Process flow:

- Cleaning the cloud data
- Creating symmetry plane
- Creating curves on the mesh
- Creating patches with 0.2mm deviation maintained position continuity- 0.05mm and Tangent continuity-0.1°
- Mirroring opposite side surfaces
- Performed surface and surface continuity analysis

Case 4: Front Bumper



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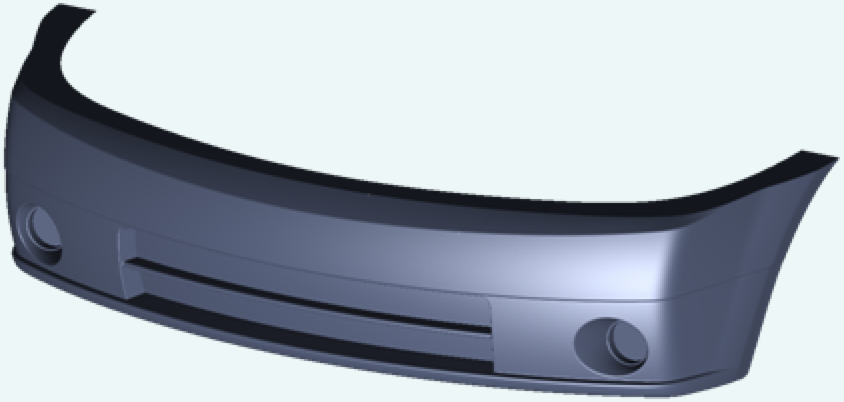
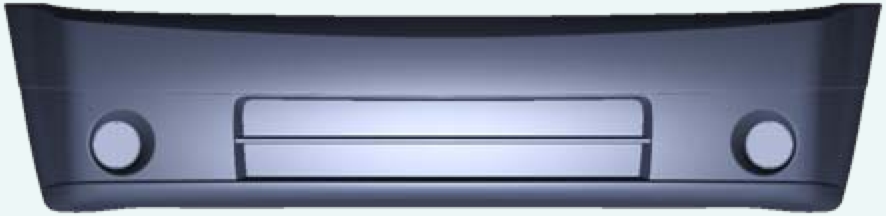




Wireframe

Project scope: Class A

Product: Engine Block

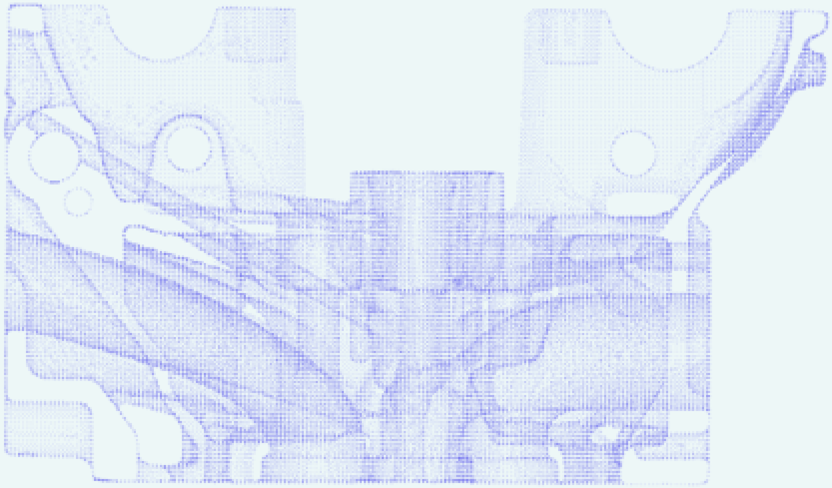
Input: Cloud data

Deliverable: IGES

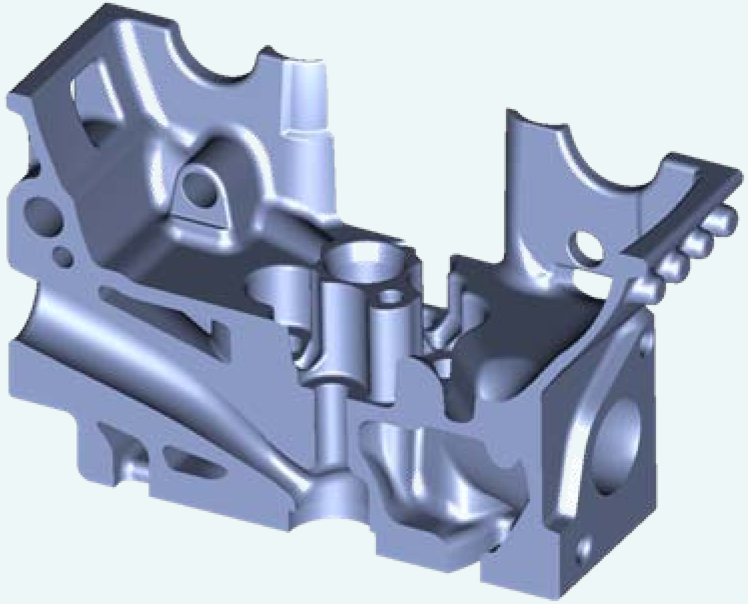
Process flow:

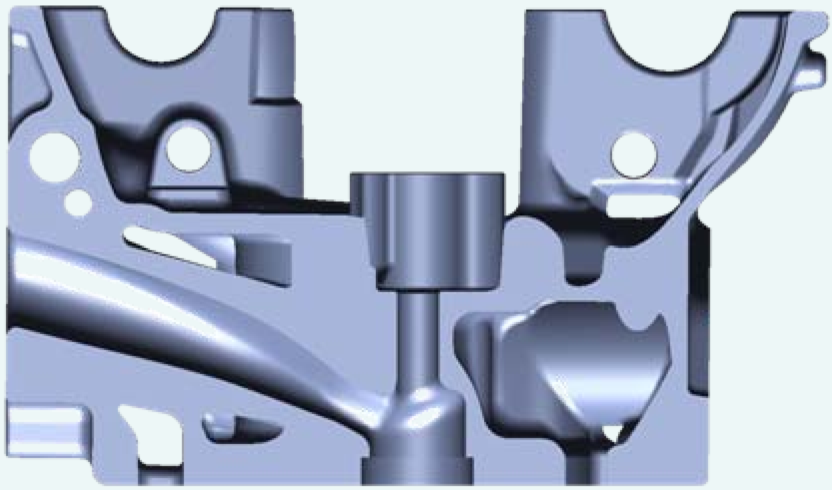
- Cleaning the cloud data
- Creating curves on the mesh
- Creating patches with 0.3mm deviation maintained position continuity- 0.05mm and Tangent continuity-0.1°
- Performed surface and surface continuity analysis

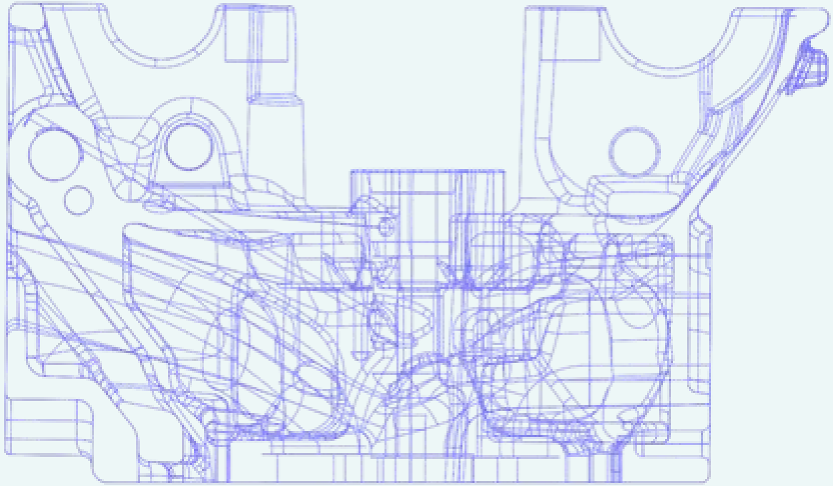
Case 5: Engine Block



Cloud data







Wireframe

Project scope: Reverse Engineering

Product: Tray

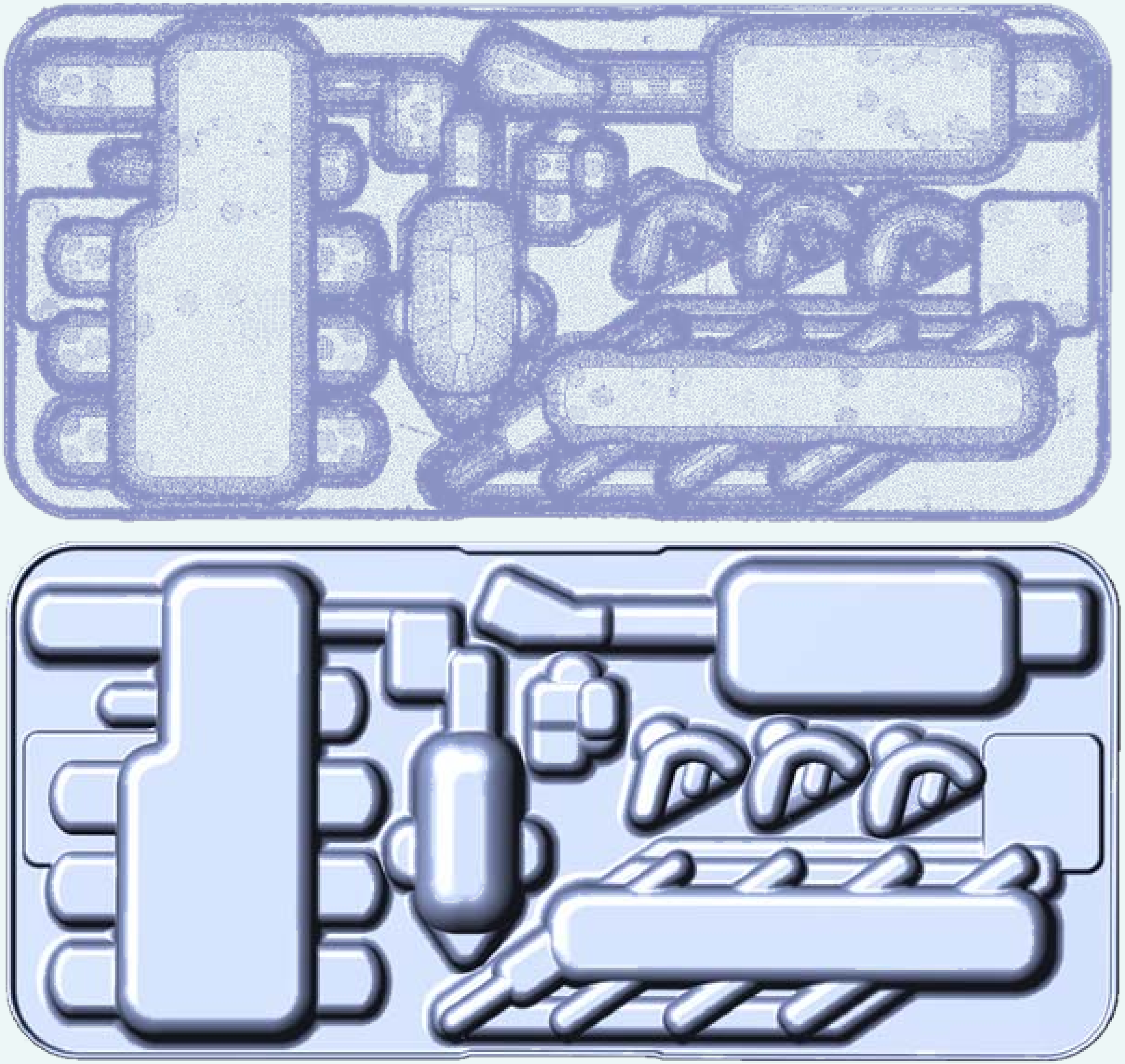
Input: Cloud data

Deliverable: IGES

Process flow:

- Cleaning the cloud data
- Creating curves on the mesh
- Creating the one side patches with 0.3mm deviation maintained position continuity- 0.05mm and Tangent continuity-0.1°
- Performed surface and surface continuity analysis

Case 6: Tray



THANK YOU!