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One Stop Solution for Mechanical Engineering

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'Reverse engineering (RE) ' *is the process of taking something (a device, an electrical component, a software program, etc.) apart and analyzing its workings in detail, usually with the intention to construct a new device or program that does the same thing without actually copying anything from the original.*

Ducati Motorcycle Sprocket → 3D Scan Data from Breuckmann Structured Light Scanner → CAD Data in STEP or SolidWorks format

Ducati - 3D Scanning & 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.

1) *Forward Engineering : It* 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.

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

Reverse engineering can be viewed as the process of analyzing a system to:

  a) Identify the system's components and their interrelationships
  b) Create representations of the system in another form or a higher level of abstraction
  c) Create the physical representation of that system

REVERSE ENGINEERING

➤ Reverse engineering is very common in such diverse fields as software engineering, entertainment, automotive, consumer products, microchips, chemicals, electronics, and mechanical designs.

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.

A chemical company may use reverse engineering to defeat a patent on a competitor's manufacturing process.

In civil engineering, bridge and building designs are copied from past successes so there will be less chance of catastrophic failure. In software engineering, good source code is often a variation of other good source code.

Photograph   CAD model   FE model
Reverse engineering

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REVERSE ENGINEERING USING CAD:

➢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.

Reason for Reverse Engineering:

• The 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.

SCAN DATA   CAD MODEL
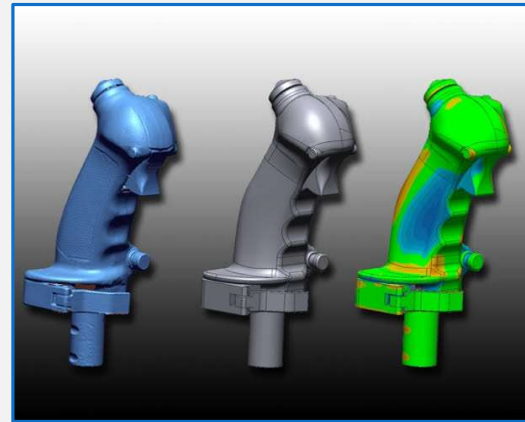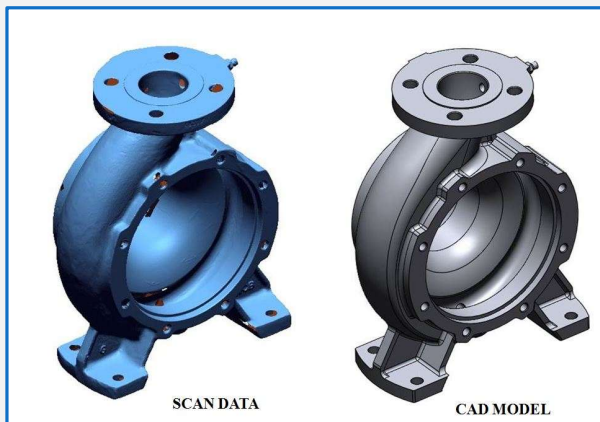
Reason for Reverse Engineering a part or product:

Following are reasons for reverse engineering a part or product:

✓The original manufacturer of a product no longer produces a product
✓There is inadequate documentation of the original design
✓The original manufacturer no longer exists, but a customer needs the product
✓The original design documentation has been lost or never existed
✓Some bad features of a product need to be designed out.
  For example, excessive wear might indicate where a product should be improved
✓To strengthen the good features of a product based on long-term usage of the product
✓To gain competitive benchmarking methods to understand competitor's products and develop
  better products
✓The original supplier is unable or unwilling to provide additional parts
✓The original equipment manufacturers are either unwilling or unable to supply replacement parts,
  or demand inflated costs for sole-source parts
✓To update obsolete materials or antiquated manufacturing processes with more current,
  less-expensive technologies

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- Reverse engineering enables the duplication of an existing part by capturing the component's physical dimensions, features, and material properties.
- Before attempting reverse engineering, a well-planned life-cycle analysis and cost/benefit analysis should be conducted to justify the reverse engineering projects.
- Reverse engineering is typically cost effective only if the items to be reverse engineered reflect a high investment or will be reproduced in large quantities. Reverse engineering of a part may be attempted even if it is not cost effective, if the part is absolutely required and is mission-critical to a system.
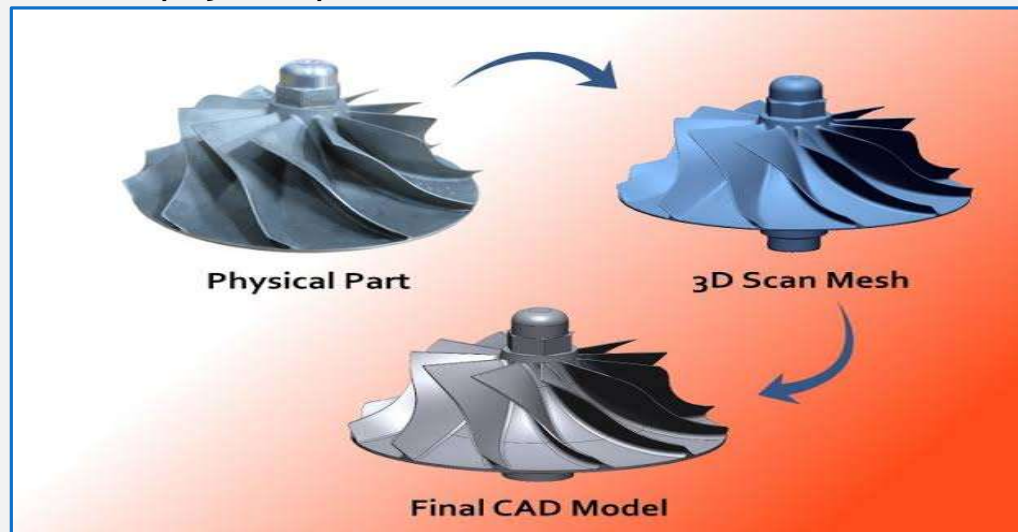
Reverse engineering of mechanical parts

- Reverse engineering of mechanical parts involves acquiring three-dimensional position data in the point cloud using laser scanners or computed tomography (CT).
- Representing geometry of the part in terms of surface points is the first step in creating parametric surface patches. A good polymesh is created from the point cloud using reverse engineering software.
- The cleaned-up polymesh, NURBS (Non-uniform rational B-spline) curves, or NURBS surfaces are exported to CAD packages for further refinement, analysis, and generation of cutter tool paths for CAM.
- Finally, the CAM produces the physical part.

Physical Part

3D Scan Mesh

Final CAD Model

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