

A decorative graphic on the left side of the slide consisting of two overlapping parallelograms. The front one is blue and the back one is a light green. They are positioned diagonally, with the blue one partially covering the green one.

3D Printing Optimization

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The history of 3D printing?

- In 1981, **Hideo Kodama** was trying to find a way to develop a rapid prototyping system. He came up with a layer-by-layer approach for manufacturing, using a photosensitive resin that was polymerized by UV light.
- In 2006, the **first commercially available SLS printer** was released, changing the game in terms of creating on-demand manufacturing of industrial parts.
- In the **2010s**, the prices of 3D printers started to decline, making them available to the general public. Along with the lowering prices, the quality and ease of printing also increased.
- In **2019**, the world's largest functional 3D printed building was completed. 3D printing is now consistently used in developing hearing aids and other healthcare applications, and many industries and sectors have adopted the technology into their everyday workflow.

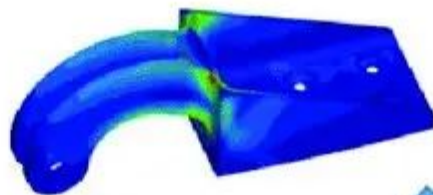
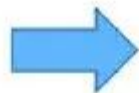


Topology optimization for 3D. How does it work?

- Conventional numerical design processes involve applying loads to a part that has already been manufactured and evaluating where it weakens. Engineers must then alter the design until the part meets the given mechanical constraints.
- With topology optimization, the logic is different: the mechanical loads represent input data that will allow the software to propose a new geometry for the part.
- Structural topology optimization first determines the minimum allowable design space necessary for shape optimization of the product. Then, virtually, the topology optimization software applies pressure on the design from different angles, tests its structural integrity, and identifies unnecessary material.



Original design



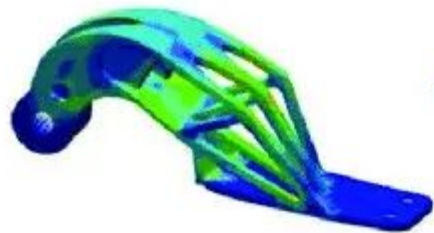
Original part FEA result



As topology optimized shape



Final optimized design



Final design validation FEA result

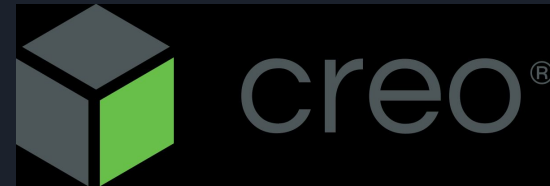
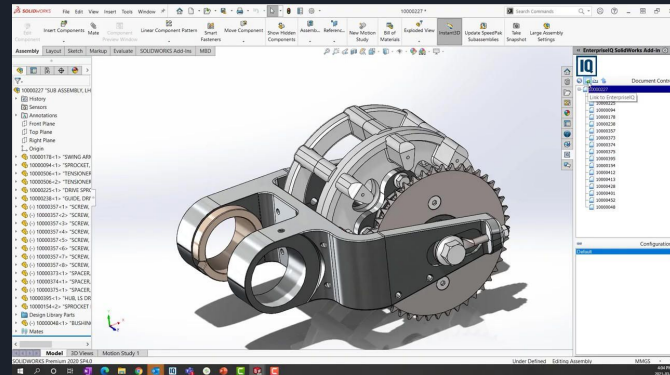


Topology Optimization vs. Generative Design

- Generative design and topology optimization have become buzzwords in the CAD design space, but it's a common misconception that they're synonymous.
- In a way, topology optimization serves as the foundation for generative design. Generative design takes the process a step further and eliminates the need for the initial human-designed model, taking on the role of the designer based on the predefined set of constraints.
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What softwares are used?

- Not all CAD softwares are build to work with topology 3D printing. However, some of the softwares that are capable to work with topology 3D printing include the following:
 - Dassault Systèmes.
 - Autodesk and nTopology
 - Solidworks
 - Creo and Fusion 360





Who use topology optimization?

- The aerospace industry:
 - A lighter aircraft consumes less fuel, which in the long term generates significant savings for an airline company.
- The automotive industry:
 - To lower production and maintenance cost.
- The medical profession:
 - for the manufacture of custom-made implants: topology optimization enables to imitate bone density and rigidity, while reducing total weight.



Resources

- <https://www.3dnatives.com/en/topology-optimisation140820184/#!>
- <https://www.bcn3d.com/the-history-of-3d-printing-when-was-3d-printing-invented/>
- <https://formlabs.com/blog/topology-optimization/>
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