

Semester Thesis / Master's Thesis

Computational Geometry for Topology-Optimized Assemblies and Mechanical Connections

Keywords: Topology Optimization, Connection Design, Computational Mechanics



Background:

Generative design offers significant potential for lightweight structures while accounting for complex requirements. However, integrating practical assembly constraints, particularly the accessibility of mechanical connections, remains a challenge. A key difficulty lies in mathematically representing assembly tools and their geometric characteristics in a form suitable for numerical optimization, while also considering additional factors such as human ergonomics and handling requirements.

This thesis focuses on computational methods for representing assembly tools within a topology optimization framework, using approaches such as implicit functions. Based on a predefined dataset of tools, the aim is to enable the algorithm to automatically select and potentially optimize suitable tool geometries while ensuring accessibility to mechanical connections (nuts, screw, etc.). The developed methods will ultimately enable the simultaneous optimization of lightweight components and the tools required for their assembly.

Task Description:

- Development of methods and algorithms for mathematical optimization in MATLAB and Python.
- Benchmarking and comparison to state-of-the-art approaches.
- Proof-of-concept via detailed FEM analysis or testing.

Required skills:

We are looking for highly motivated individuals who are keen to work on industry-relevant problems.

- Computational Mechanics, Mechanical Engineering or similar master's program
- Interest in topology optimization
- Previous experience with MATLAB or Python
- Independent and reliable work

We offer:

- Insights into research on relevant future technologies
- Freedom to follow new ideas and directions
- Industry insights and networking

Contact:

Sergi Pagès

Phone: +49 (89) 289-15157

Room: 5506.02.640

sergi.pages@tum.de