Institut für Konstruktionstechnik
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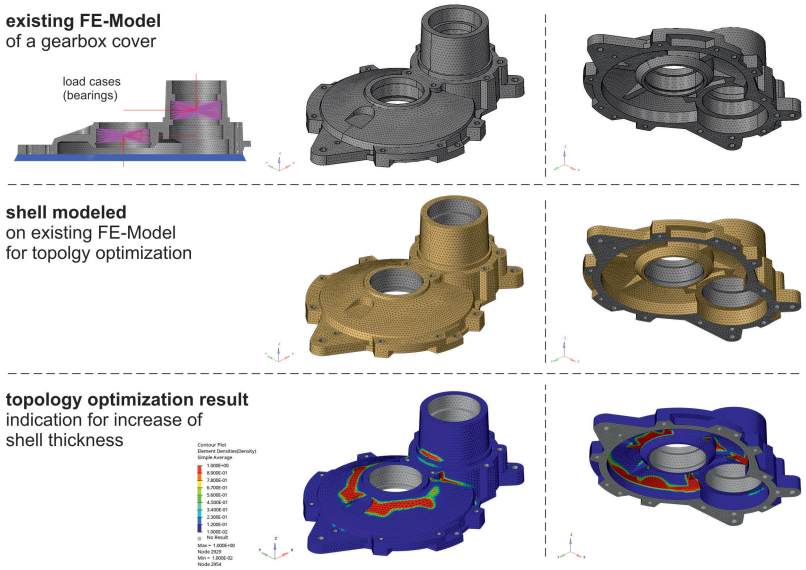
01.07.2025 / Be / Zi

Thema:

Leichtbau durch einen neuartigen FE-Ansatz: Implementierung und Test eines Schalenelements mit negativer Dicke

Lightweight design by a novel FE-Approach: Implementation and testing of a shell element with a negative thickness



Lightweight design plays a vital role in engineering, especially for mobile systems such as vehicles. Regarding sustainability lightweight design is most effective when weight reduction in existing parts is conducted without the change of material. Today's surface-based topology optimization adds mass to reinforce structures, offering numerical robustness, computational efficiency, and compatibility with complex FE models (in comparison to form optimization), yet it cannot remove material. This thesis shall explore a subtractive topology optimization method that carves away mass from an existing body. Its analytical validity has been demonstrated by extracting a small beam from a thicker one under classical mechanics principles. The next step is to embed this method into a finite-element model and evaluate its feasibility in simulation. Implementing and assessing this novel subtractive approach forms the central objective of your master's thesis.

Tasks

- Literature review of topology optimization and subtractive strategies
- Comparison of linear versus quadrilateral FE elements in the subtractive context
- Review and evaluation of preliminary studies on element formulations and optimization tools
- Development of a base FE model integrating subtractive topology optimization
- Parameter studies varying volume and thickness (optional: varying FE element type)
- Desirable: Assessment of convergence behavior, numerical stability, and implementation challenges
- Optional: Formulation of guidelines for ideal shell-element design

Starting points Literature:

1) K.-J. Bathe – Finite-Elemente-Methoden – Mit Anwendungen in der Festkörpermechanik
2) Peter Wriggers – Nichtlineare Finite-Element-Methoden