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# Future challenges for topology optimization for the usage in automotive lightweight design technologies

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## Abstract

Nowadays the development of mechanical components is driven by ambitious targets. Engineers have to fulfill technical requirements simultaneously under the restrictions of minimized costs and reduced weight for mechanical components. Accordingly in the last years newly developed and tested optimization methods have been integrated in the development processes of industrial companies. Today, especially topology optimization methods are gaining in importance and are often used for the first design proposal of casting parts.

However, these design proposals must be interpreted and transferred to CAD-models by design engineers and in later development phases manufacturing aspects must be considered. Both steps need more development time and normally material must be added to the design ideas. Beside castings parts, topology optimization is only a little help for the design of sheet structures, because framework structures are the result. Also crash and acoustic requirements cannot be completely supported by optimization methods.

Beginning with the current situation four challenges for further work can be formulated. First the technical aspects like crashworthiness and acoustic requirements should be implemented into the topology optimization. The second future path focus on sheet structures and hybrid parts. With new manufacturing rules, the result of the topology optimization should only consist of thin and plane orientated material. As an extension, structures with more than one sheet should be possible in the future. The costs of needed welding seams must be considered. The third challenge is the integration of manufacturing simulation. By including a casting simulation for example, each iteration of a topology optimization can be analyzed to the castability. By modifications of the design, beside the mechanical needs also casting aspects will be recognized.

The last future path treats a continuous and integrated development process. For this target, the CAE description of the topology results must be smoothed and automatically transferred to CAD models, which fulfills the design methodology in order to allow easy modifications.

**Keywords:** topology optimization; integrated casting simulation; multimaterial optimization;

sheet structures; CAE2CAD process.