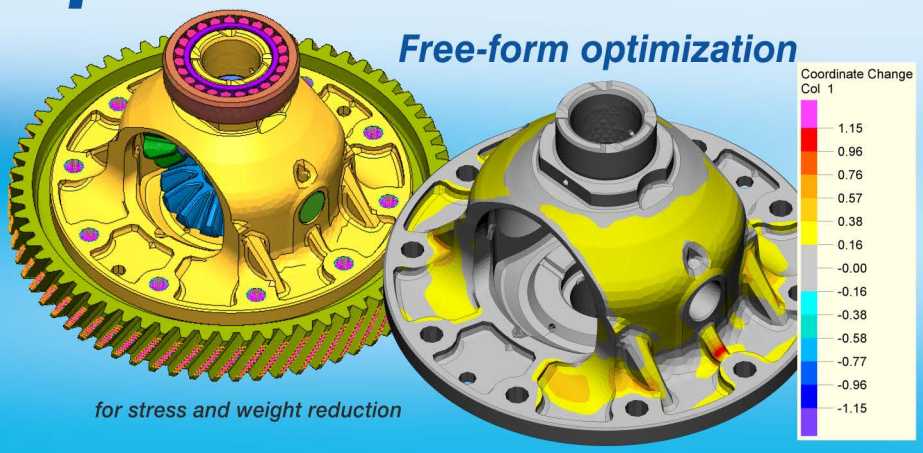
PERMAS

Optimization - Multimodal

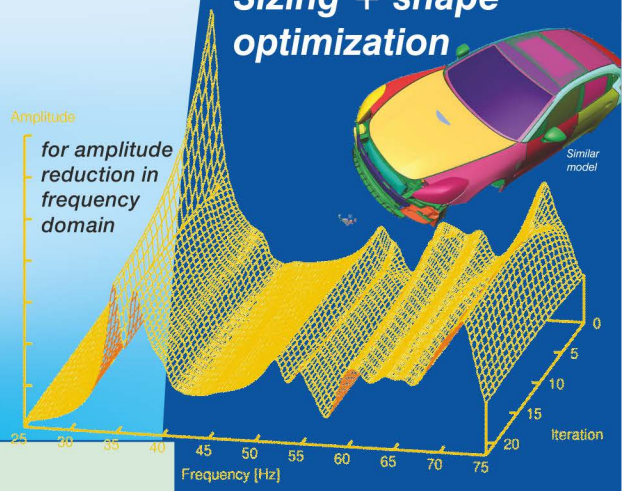
Concurrent optimization

Free-form optimization

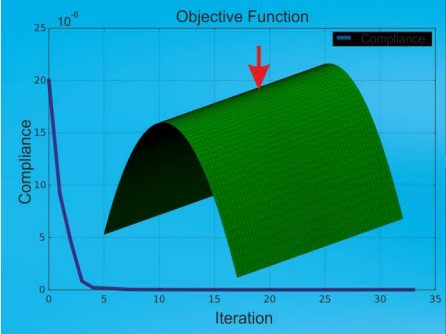


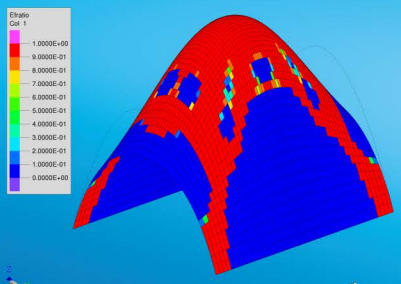
for stress and weight reduction

Sizing + shape optimization



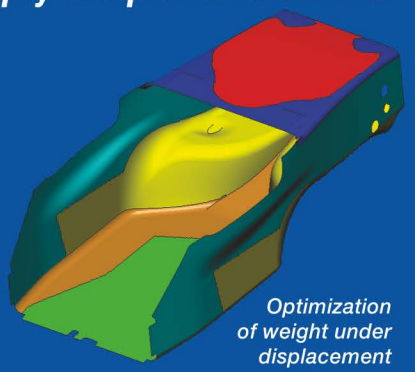
Shape + topology optimization



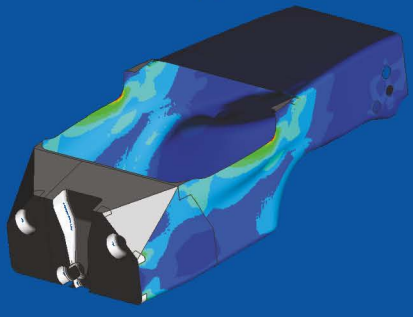


Optimization	Solvers
Conceptual Design	*Topology optimization* *Position change* *Bead design*
Design Optimization	*Sizing optimization (with free sizing)* *Shape optimization (free-form or with shape basis vectors)*
Robust Design	*Sampling* *Reliability analysis* *Robust optimization*
Multimodal	*Simultaneous execution of solvers*

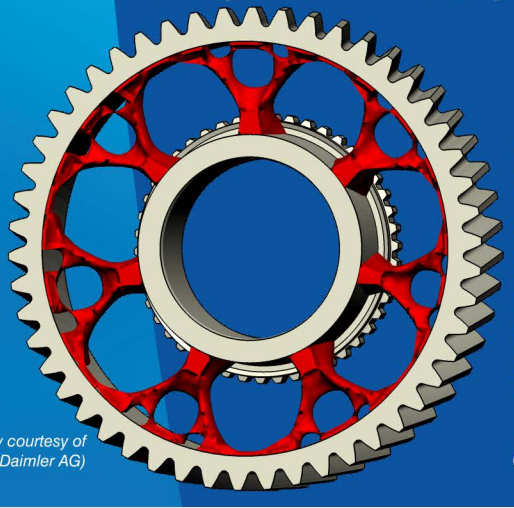
Optimization of ply shapes and stacks



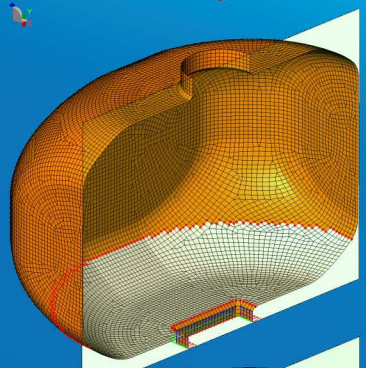
Optimization of weight under displacement constraints and ply failure criterion

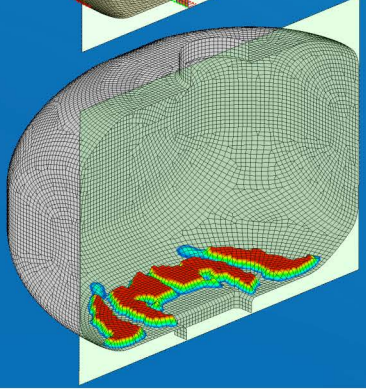


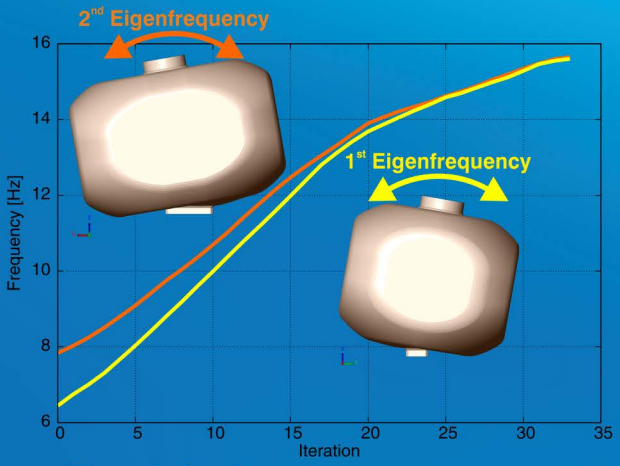
Topology optimization of a gear wheel body



(by courtesy of Daimler AG)

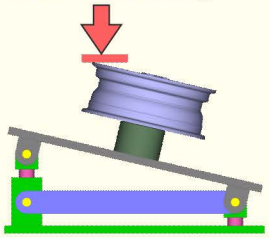


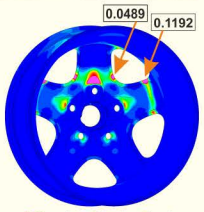




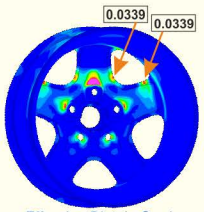
Bead design for maximum eigenfrequency

Shape Optimization of Wheel Spokes with Plasticity

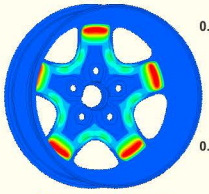




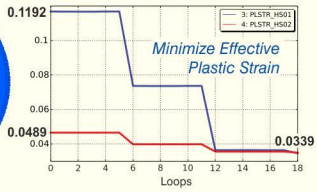
Effective Plastic Strain before Optimization



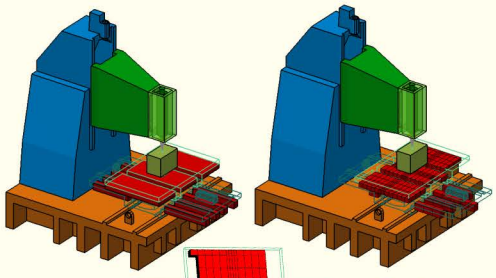
Effective Plastic Strain after Optimization

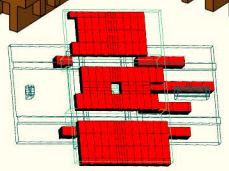


Coordinate Change

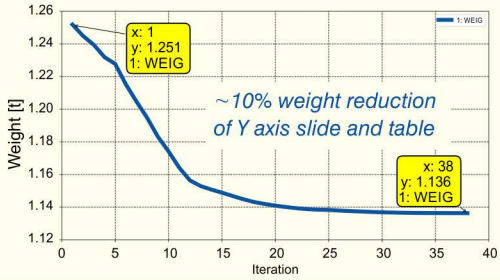


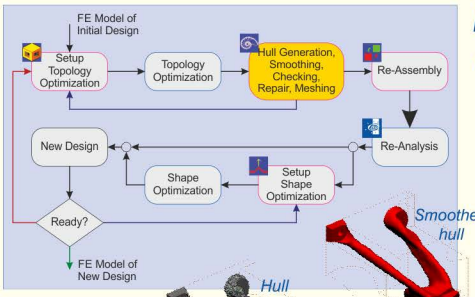
Topology Optimization of Machine Tool in Frequency Domain



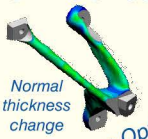


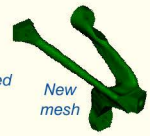
Design of a milling machine with controllers

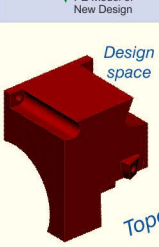




Design by Simulation of an Engine Bracket







Minimized stresses

Normal thickness change

New mesh

Smoothed hull

Freeform Optimization

Design time < 8h

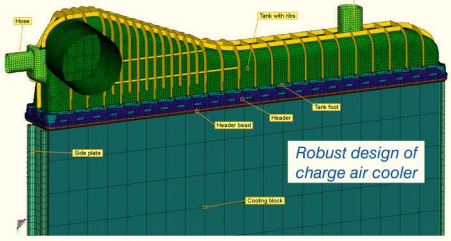
Hull

Design space

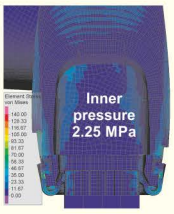
Topology Optimization

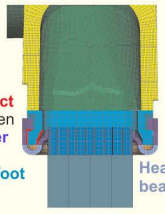
Process Steps					Total time
Analysis Results	TOPO	Wizards	Re-analysis	FREEFORM	
Total Compliance [Nmm]	2489.		2388.	2341.	
Weight [kg]	0.915		0.917	0.916	
Max. Displacement [mm]	1.020		0.975	0.951	
Max. vonMises Stress [MPa]	---		262.	174.	
Calculation time *)	5h 31m 22s		28s	8m 9s	< 6h
Preparation time using wizards	< 20m	< 30m	< 20m	< 20m	< 2h

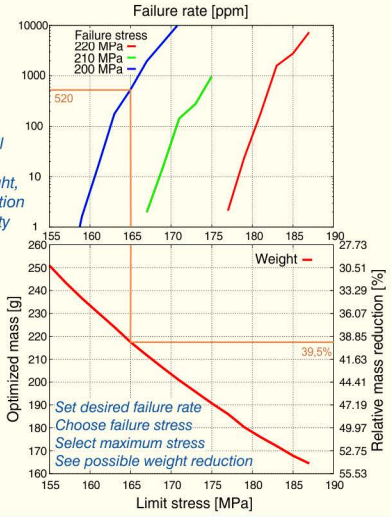
Shaping, Sizing, and Robustness



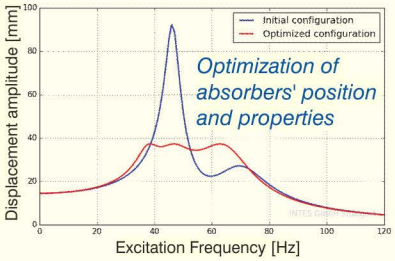
Rib and wall thickness, and rib height, for optimization and reliability

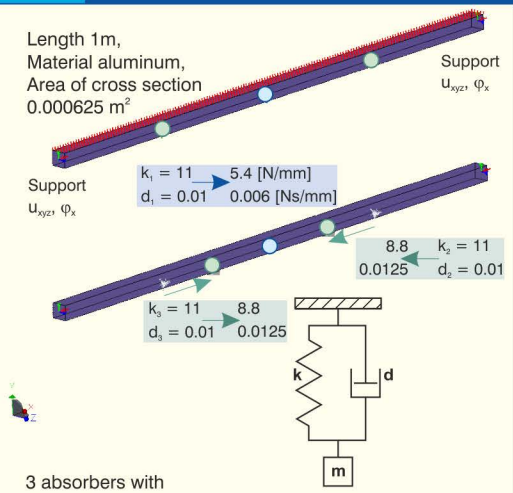






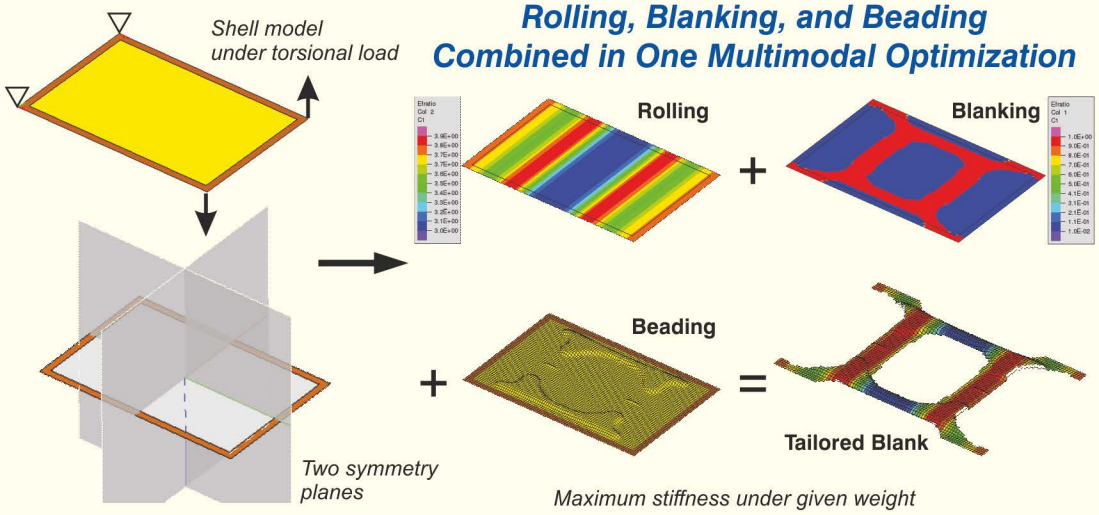
Positioning and Sizing of Absorbers on Beam under Pressure Load





3 absorbers with stiffness k, viscous damping d, and mass m = 0.085kg

Rolling, Blanking, and Beading Combined in One Multimodal Optimization



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