

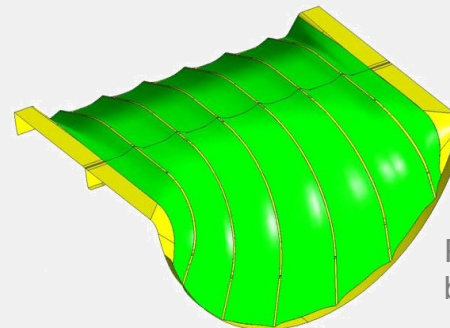
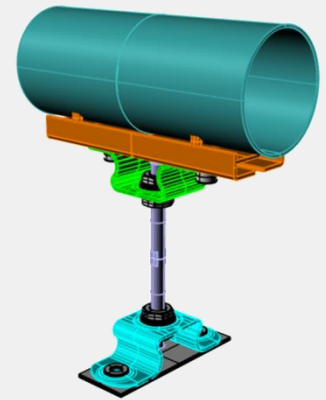
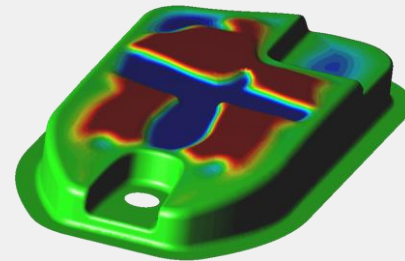
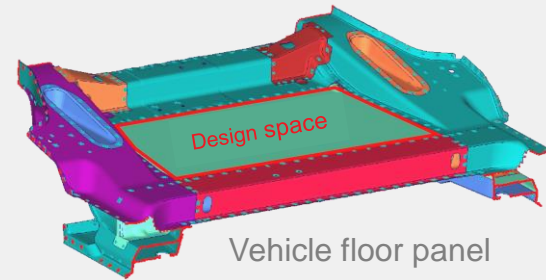


Rücktransformation von optimierten Sickendesigns in CATIA Regelflächen

23. Bayreuther 3D-Konstrukteurstag, 14.09.2022



- FEMopt Studios GmbH
- XCARAT Software
- Bead Designer Add-on
- Door Carrier from Brose Fahrzeugteile



- Spin-Off from the Chair of Structural Analysis, Prof. Bletzinger, TU Munich
- Founded in May 2011
- Operation sites
 - Munich
 - Ruhland (close to Dresden)
 - Cottbus (close to Berlin)
- Business activities in the field of structural optimization
- Customers
 - Aerospace industry
 - Automotive industry
 - Mechanical engineering
 - Civil engineering



- Consulting
 - Structural analysis of mechanical components
 - Structural optimization projects
 - Development of CAE software components (e.g. plug-ins)
- Software package XCARAT
 - Our own developed analysis and optimization software
 - Flexible and modular tool for structural optimization
 - Based of provided finite element models

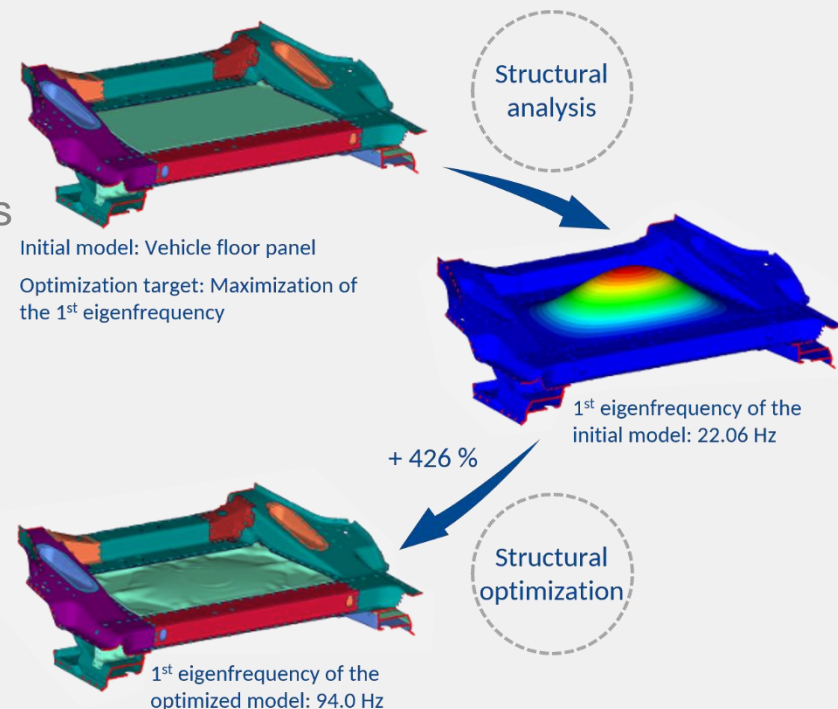
- Customers



Wir leben Autos.



- Platform independent, Windows, Linux
- SMP parallel solution strategies
- Complete structural element library
 - Solids, shells, membranes, beams, trusses
 - Composite elements
 - Linear and non-linear formulation
 - Spot weld models, rigid bodies, ...
- Analysis methods
 - Linear and non-linear statics and dynamics
 - Eigenfrequency and buckling analysis
- Optimization strategies
 - Constrained and unconstrained problems, gradient methods
 - Topology, Shape, Topography, Sizing Optimization



XCARAT Software

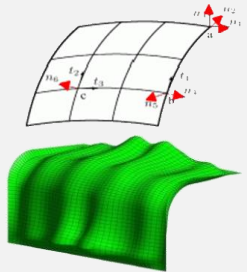
Overview Structural Optimization

- Flexible formulation of the specific optimization problem
- Fast gradient based optimization strategy
- FE-based parametrization →
- Efficient sensitivity analysis
- Powerful FE-mesh regularization

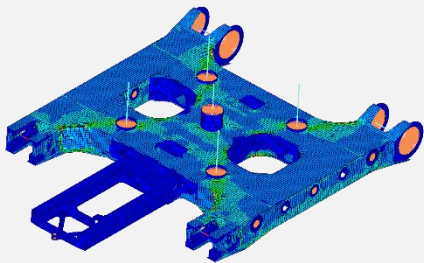
CAGD free (= FE-based)

- Optimization variables
 - Based on FE-model (e.g. nodal coordinates, thickness, ...)

High flexibility, minimal modeling effort!

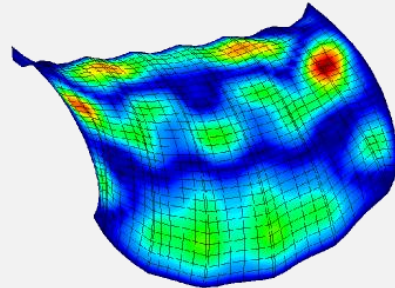


Sizing Optimization



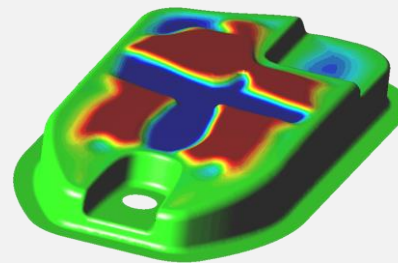
Welding structure
“Dozer chassis”

Shape Optimization



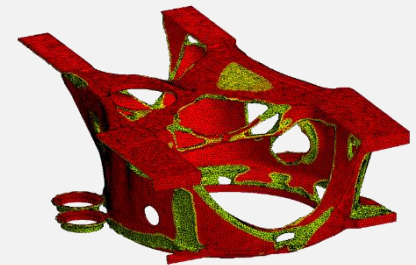
Pressure bulkhead
“A350”

Topography Optimization



Oil pan

Topology Optimization

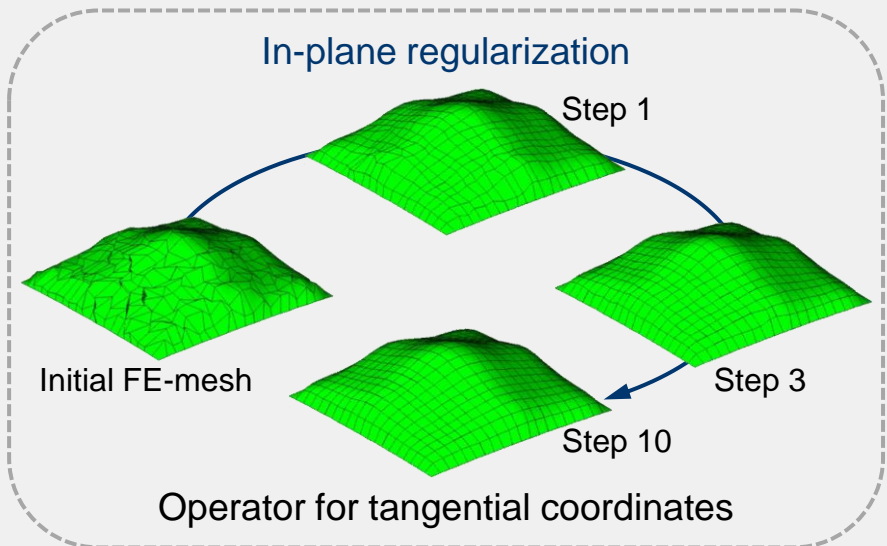
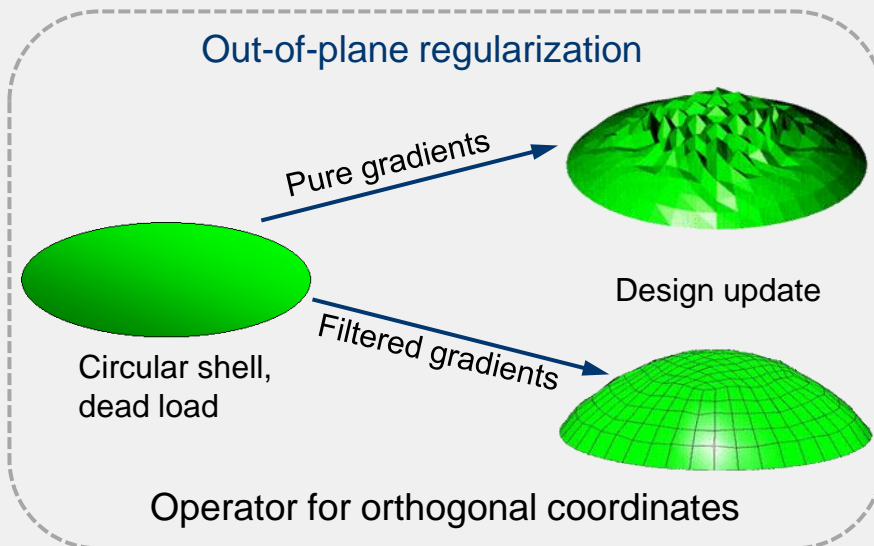


Machine carrier
“Wind turbine”

- Parameter free shape optimization (Engineering example: brake caliper)



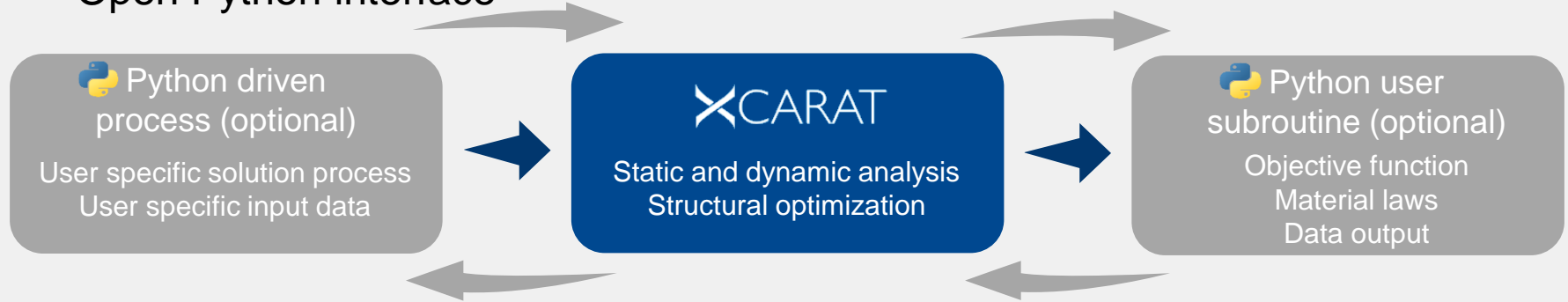
- Effective mesh regularization



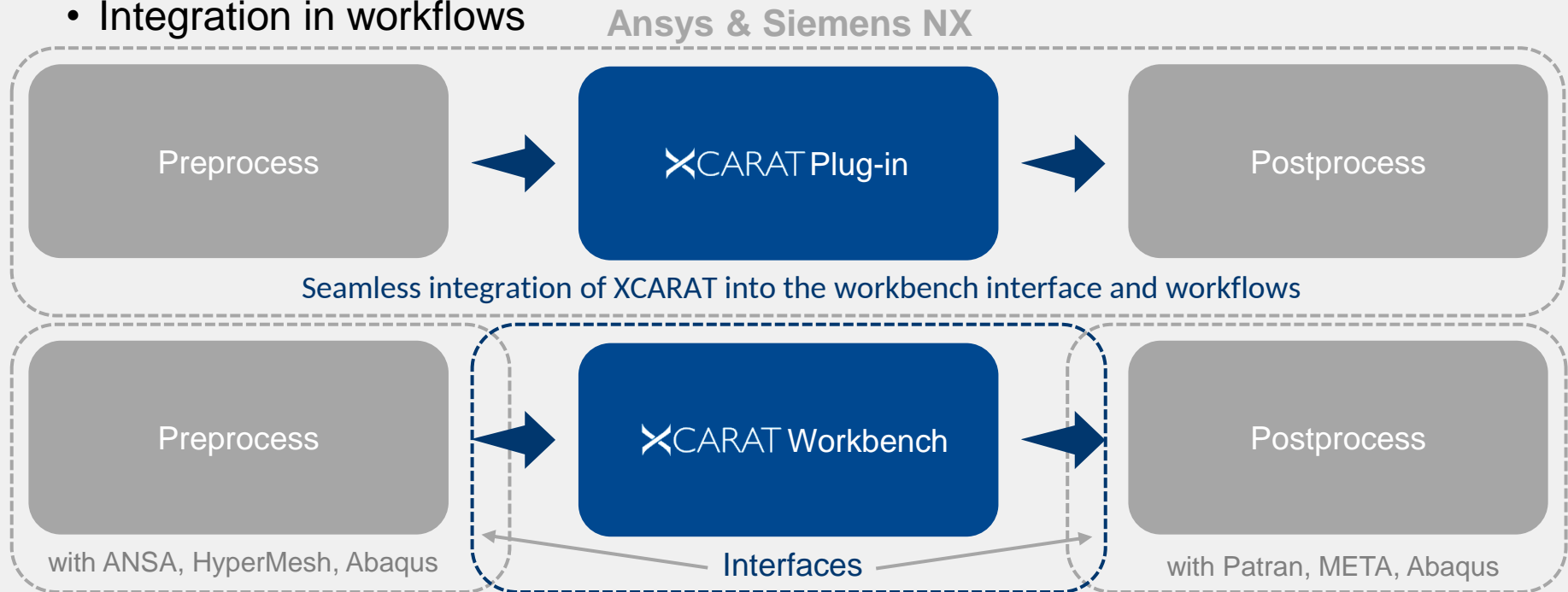
XCARAT Software

Key-Features

- Open Python interface



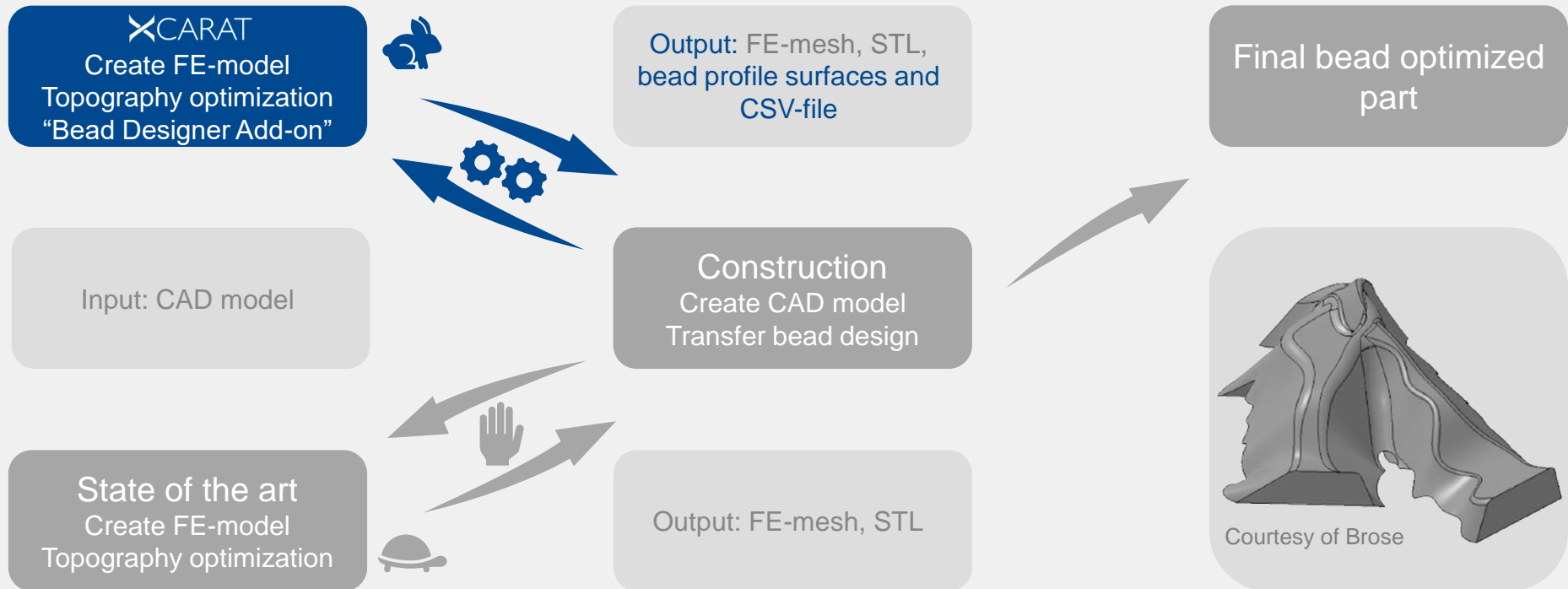
- Integration in workflows



Bead Designer Add-on

Goal

Support and acceleration of bead construction in CAD based on the design updates of a shape optimization

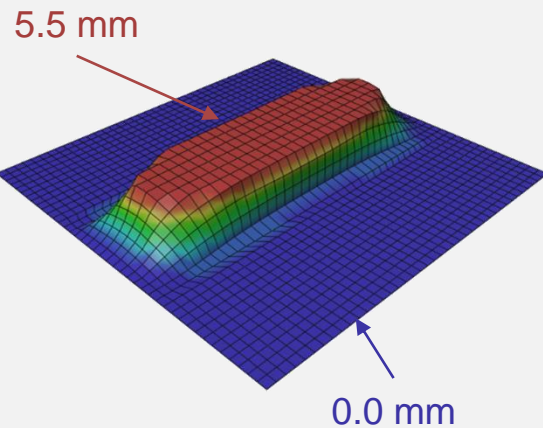


Bead Designer Add-on

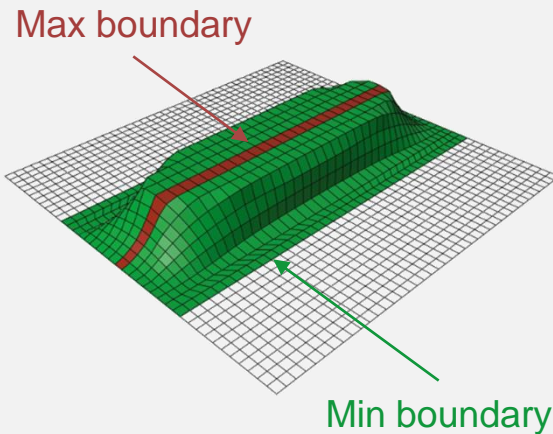
Basic Principle “Bead Finding”

Numerical method based on the design update

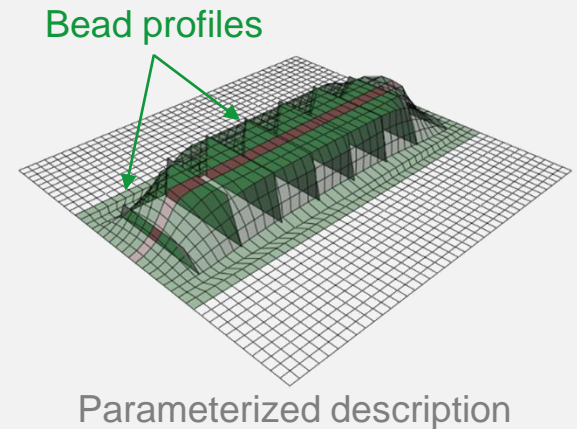
Chosen Design Update



Determination of Course Curves



Fitting of Beading Profiles



Initial design



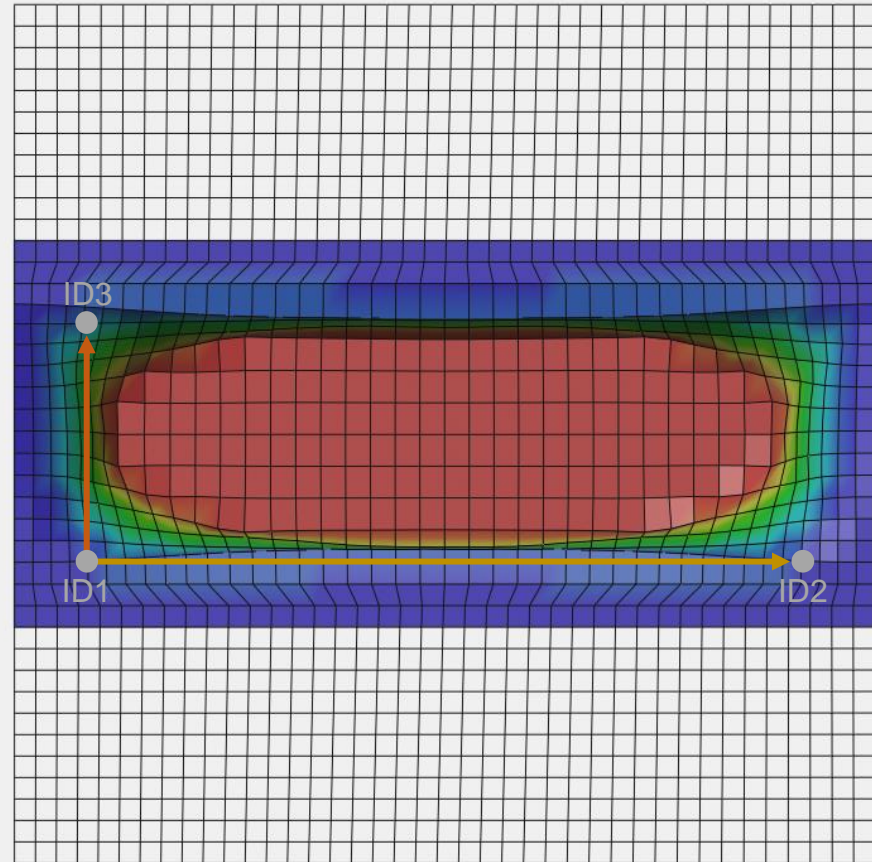
Definition input
parameter



Optimization

Definition input parameter which necessary for the fitting optimization

- **Longitudinal** direction with node ID1 and ID2
- **Cross** direction with node ID1 and ID3
- Spacing between the bead profiles
- Length of the bead
- Width of the bead
- Height of the bead

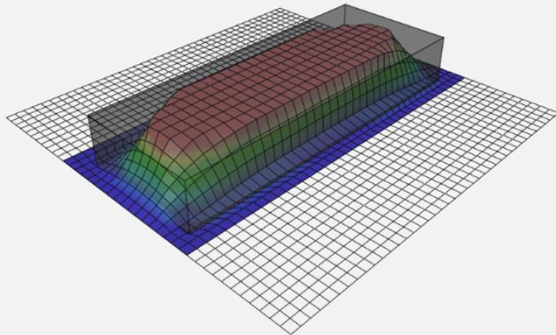


Bead Designer Add-on

Resulting Optimized Bead Profiles

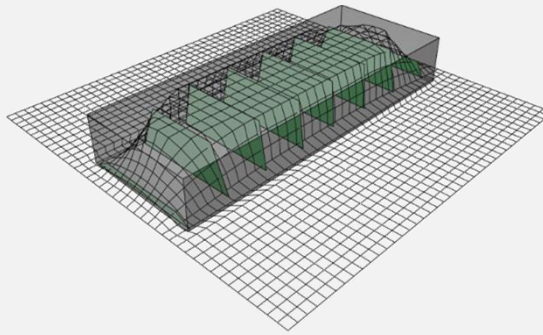
Due to the optimization, the rectangular initial profiles are adjusted to optimal trapezoidal profiles

Chosen Design Update



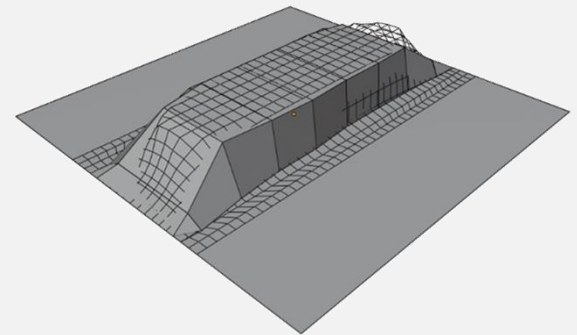
Initial defined rectangle

Optimization Result



Optimized bead profiles

Transferred CAD Model



Bead interpretation

Determination
rectangular profile



Fitting the profiles
into the FE mesh

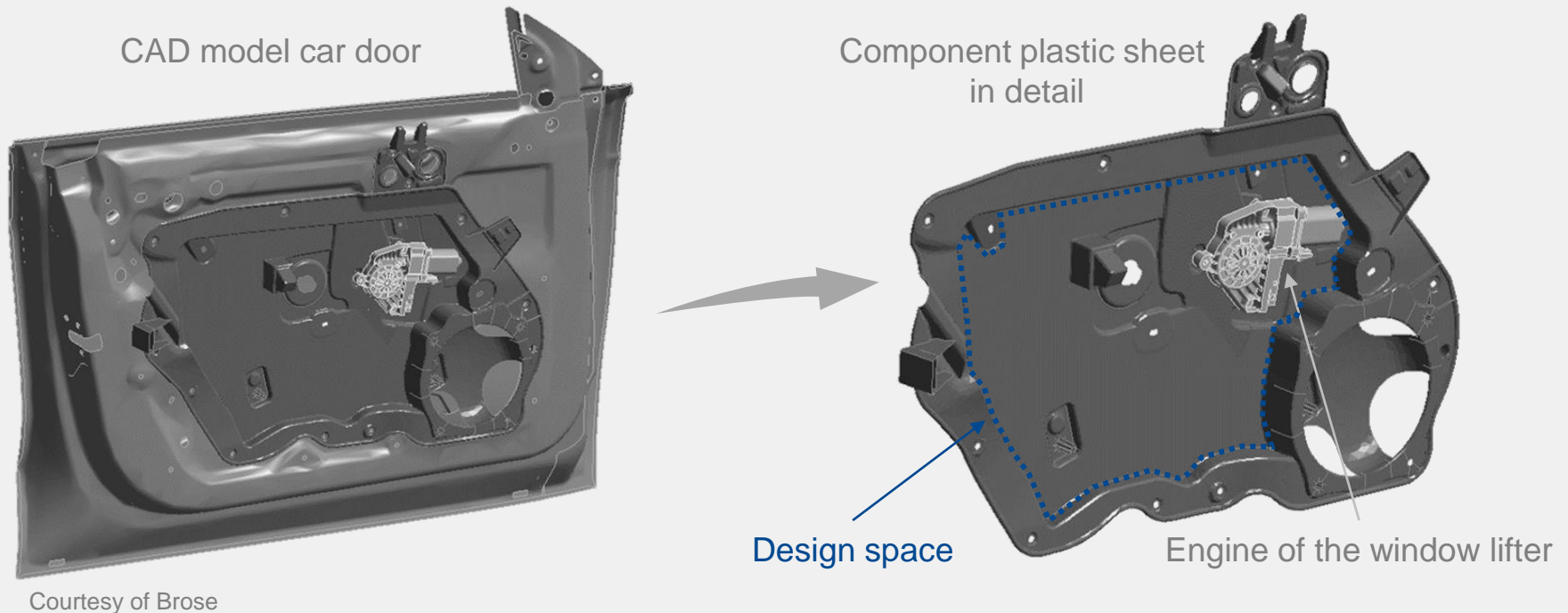


Fast bead
conversion

Door Carrier from Brose Fahrzeugteile

Initial CAD Model and Optimization Target

Problem: The engine of the window lifter causes a too high sound emission at the initial model as a result of the harmonic excitation this structure

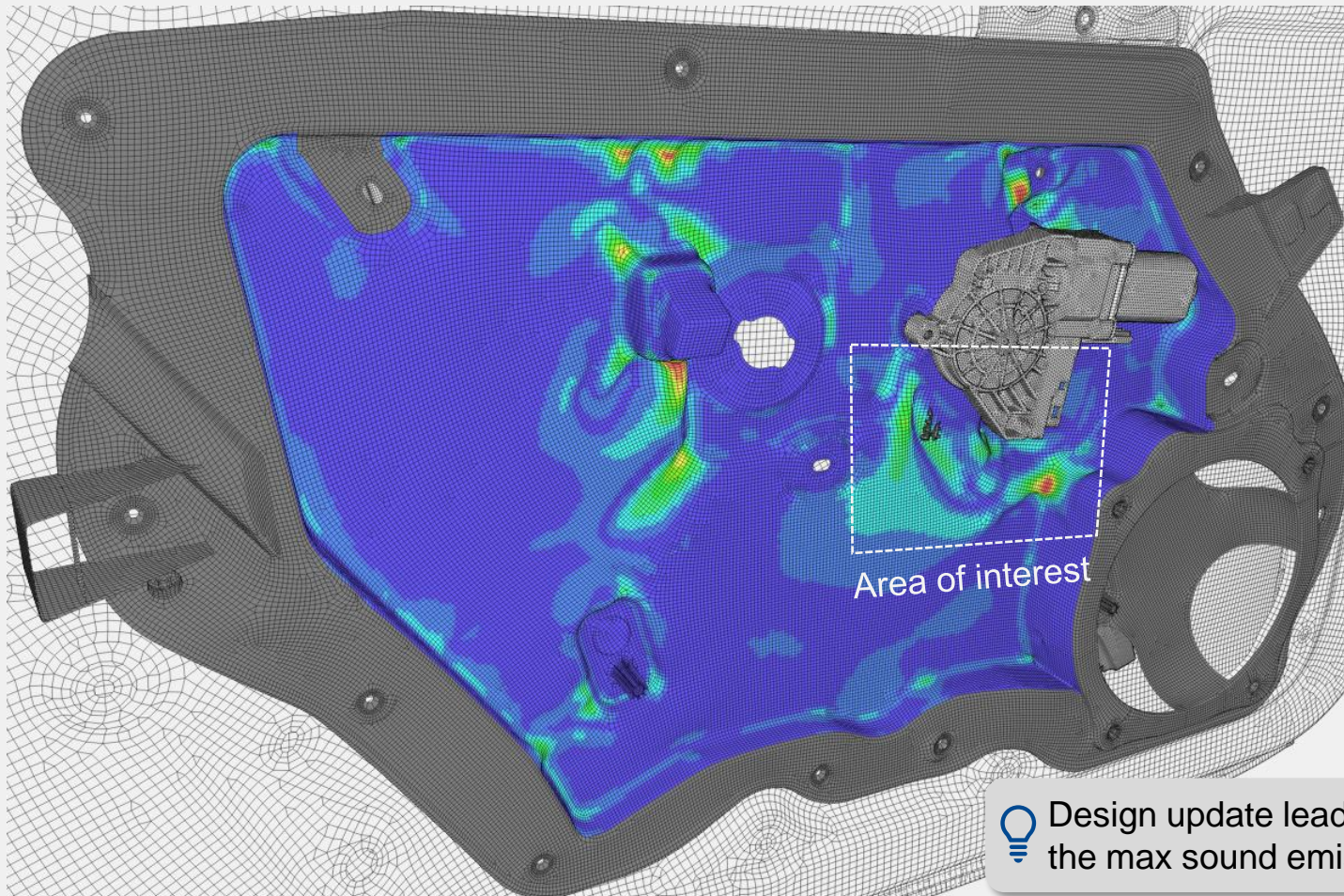


Target: Minimize the caused sound emission due to the introduction of beads into the optimization model

Door Carrier from Brose Fahrzeugteile

Optimized Bead Design

Resulting bead structure significantly improves the sound emission problem caused by the engine of the window lifter



Design update
(absolute)

- Max
- Middle
- Min

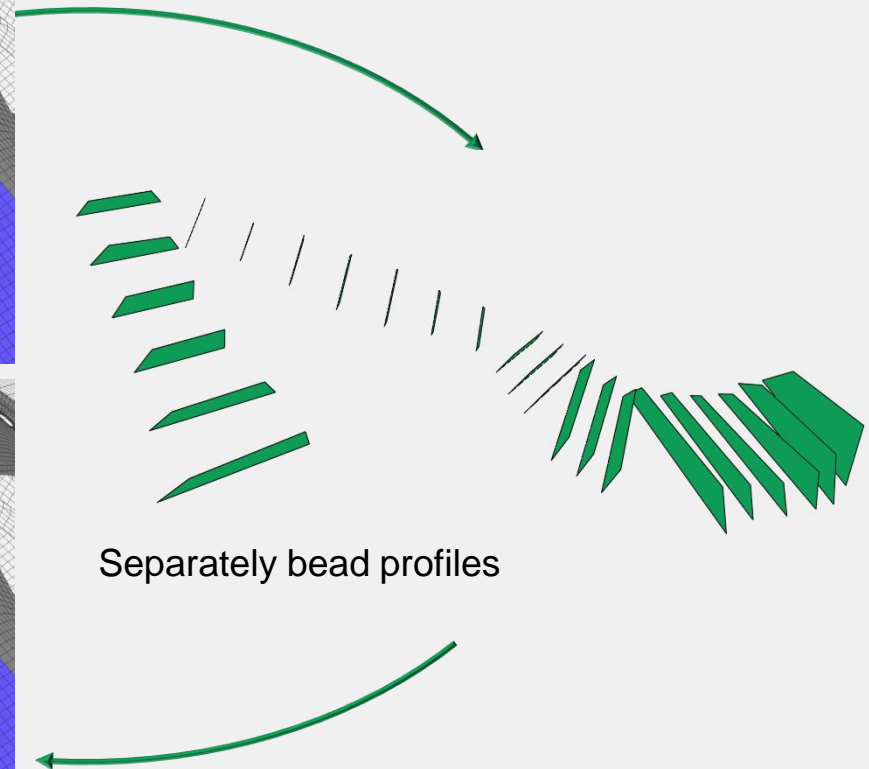
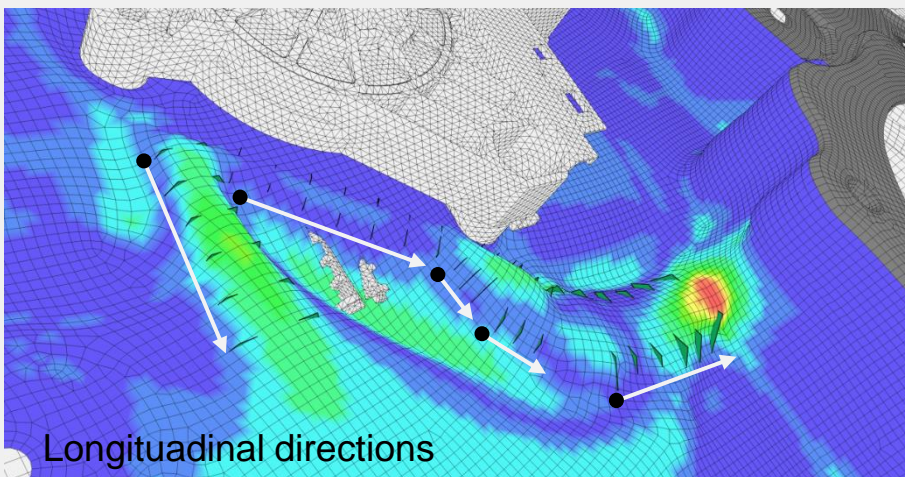
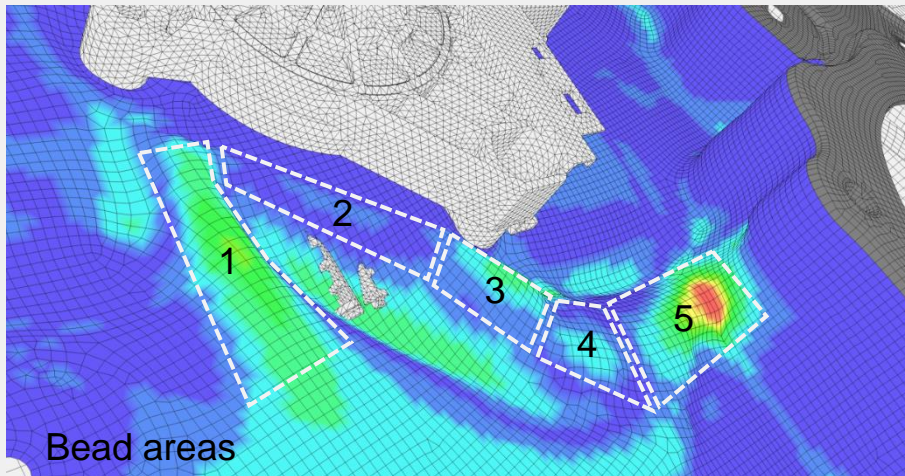


Design update leads to a reduction of the max sound emission by 16 dB

Door Carrier from Brose Fahrzeugteile

Create Bead Profiles with Bead Designer Add-on

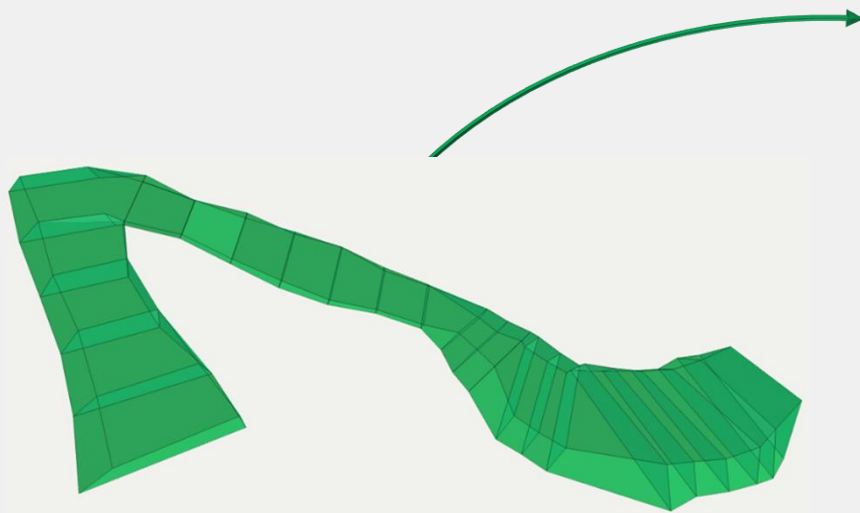
The whole bead structure consists of 5 separate beads with different longitudinal directions



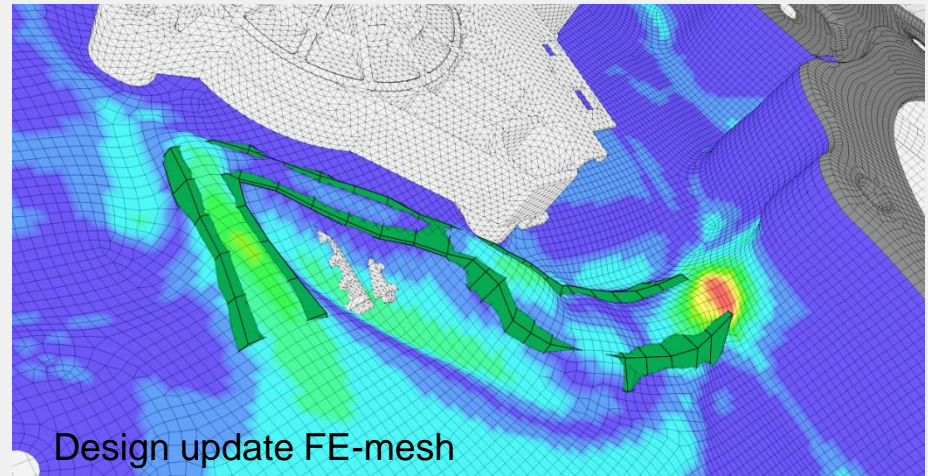
Door Carrier from Brose Fahrzeugteile

Bead Profiles as a Basis for Modeling

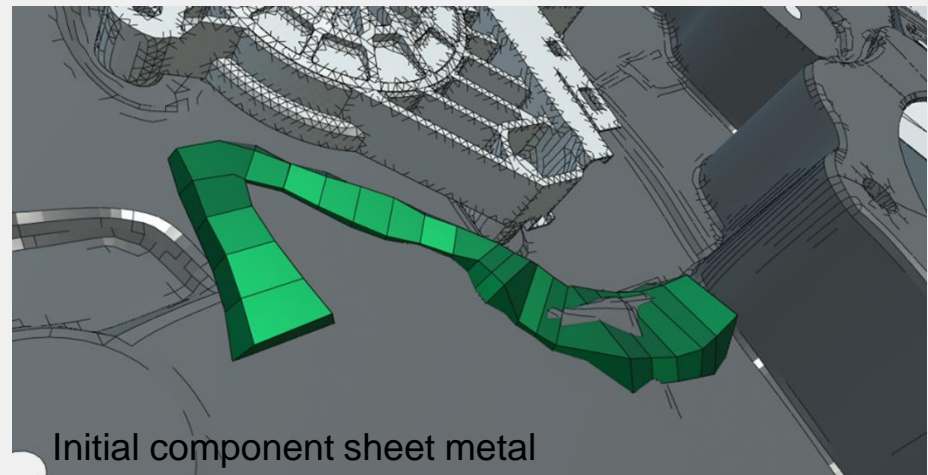
Assembling the separate bead profiles to create a closed structure, which significantly simplifies and accelerates the adaptation of the CAD model



Closed bead structure



Design update FE-mesh

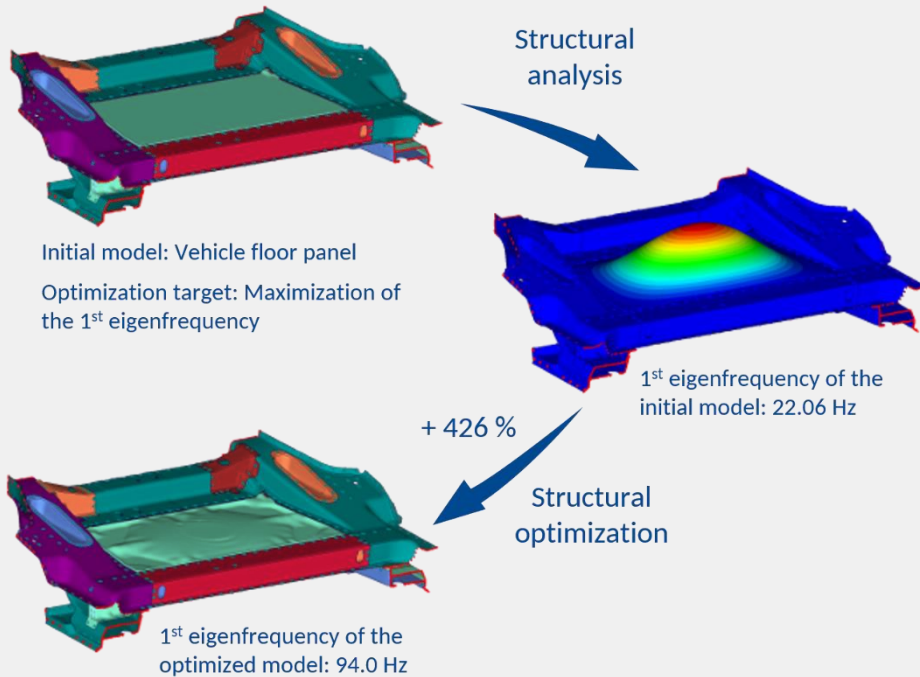


Initial component sheet metal

Feel Free to Contact Us

Any Questions?

“Any component has the potential to be optimized!”



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