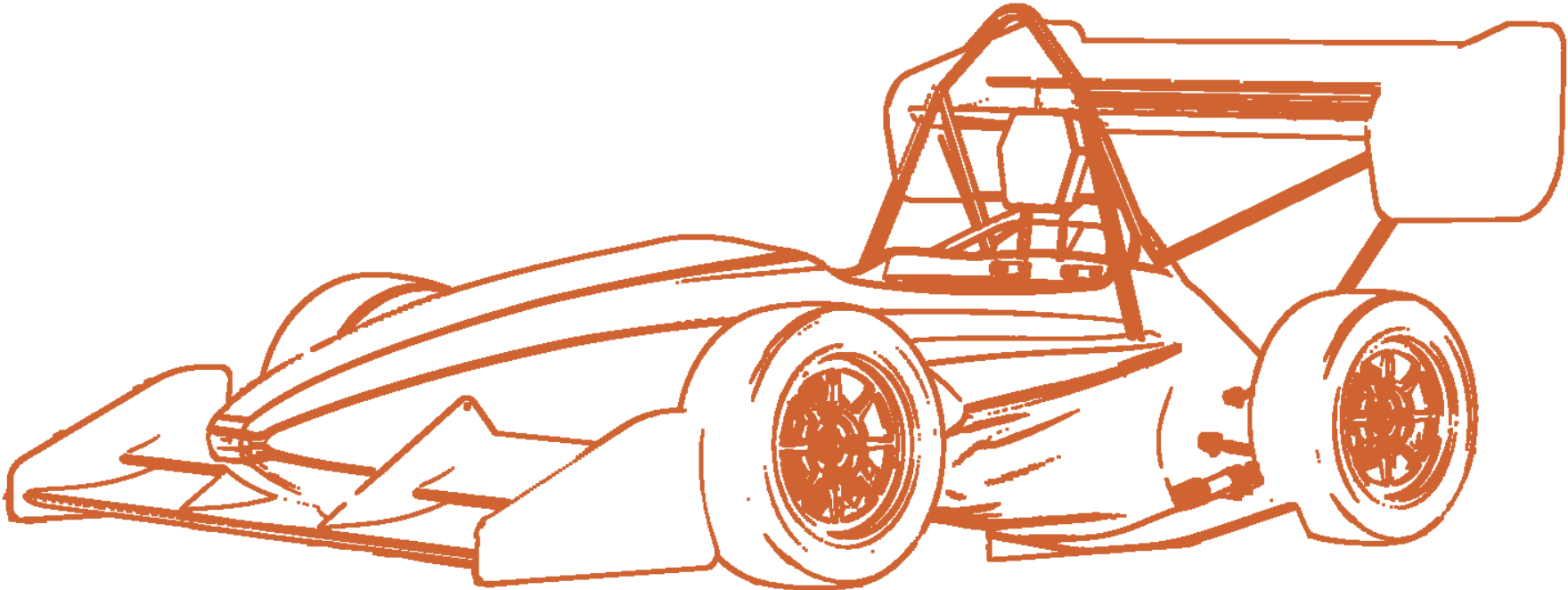


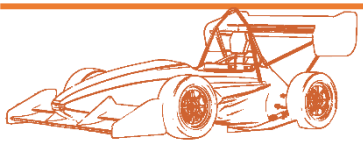
Ply Stack Up Optimization of a Formula Student CFRP-Rim

Alexander Grassl



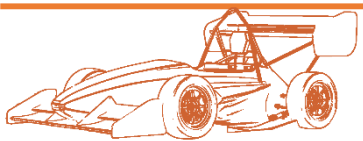
Agenda

- Formula Student
- Starkstrom Augsburg e.V.
- Current Status
- CFRP-Hybrid Rim
- Optimization
- Weight Comparison



F Formula Student

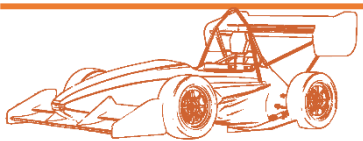
- 152 FSE Teams from 37 Countries
- 419 FSC Teams from 52 Countries



Starkstrom Augsburg e.V.

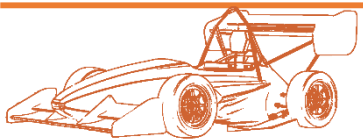
UASA1504 – Cedur

Weight	252 kg
Power	80 kW
Torque	1200 Nm
Acceleration	0-100 km/h – 3,2 sec



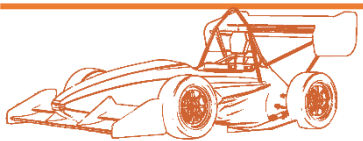
C Current Status

- 13" Aluminum Rim
- 3500g Weight

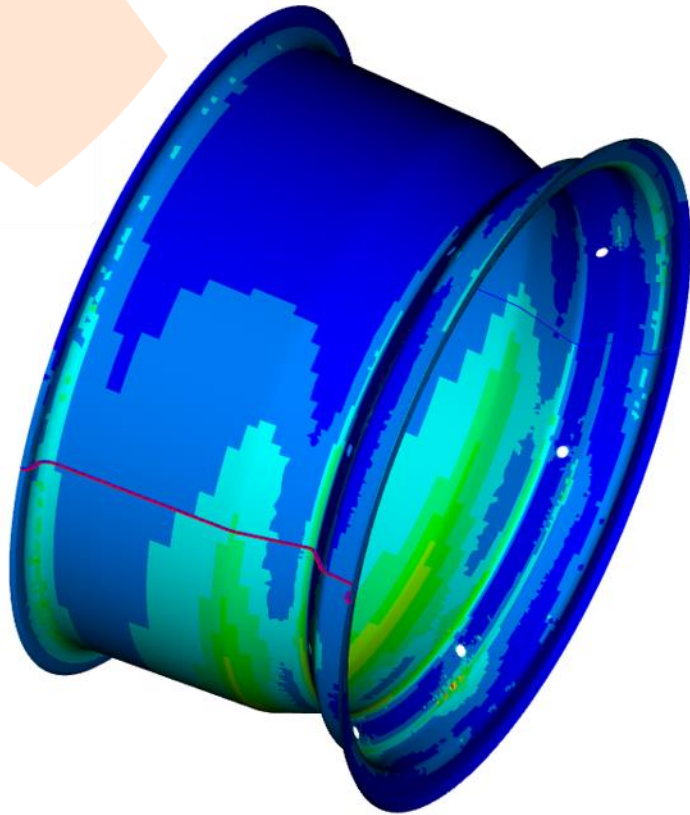


CFK-Hybrid Rim

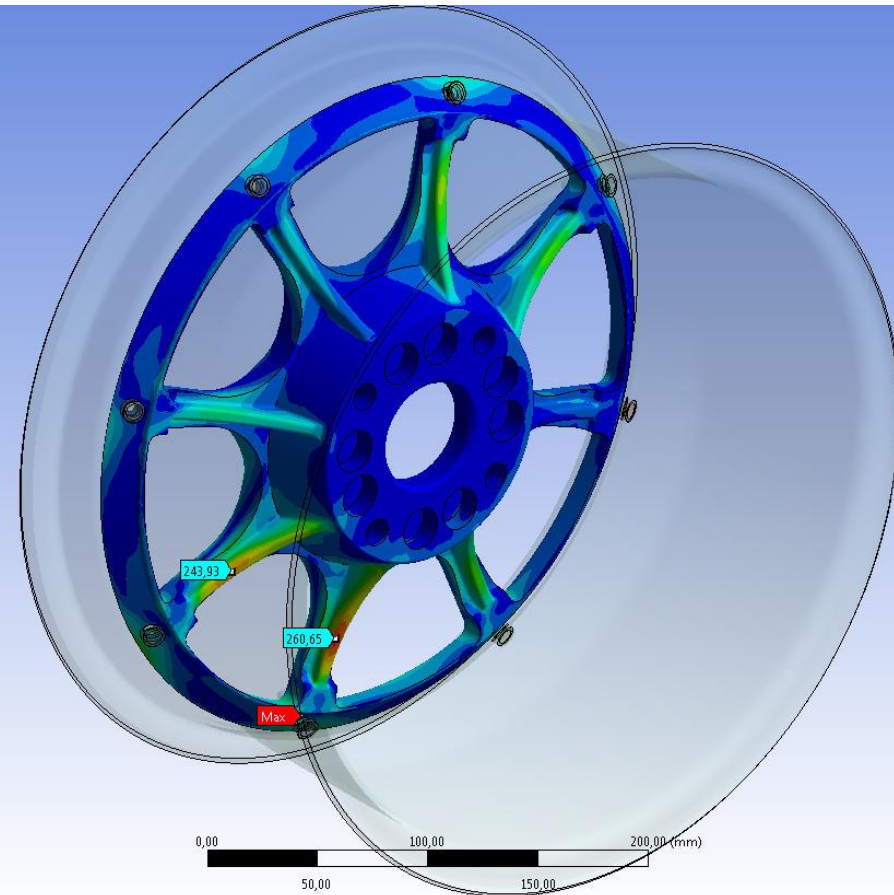
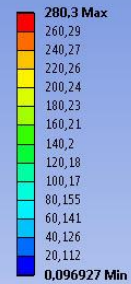
- Wheel Star made out of high strength Aluminum
- External laminated Rim Base from CFRP Prepreg Fabric
- 2 Component Epoxy bonding on large surface area
- Additional Bolting



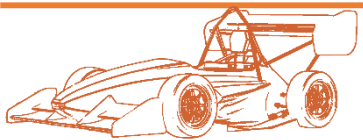
CFK-Hybrid Rim



C: Statisch-mechanische Analyse
Vergleichsspannung Felgenstern (gemittelt)
Typ: Vergleichsspannung (von Mises) - Schicht (Beta) 0
Einheit: MPa
Zeit: 1
05.03.2015 13:21

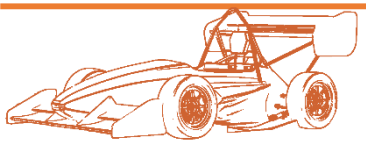
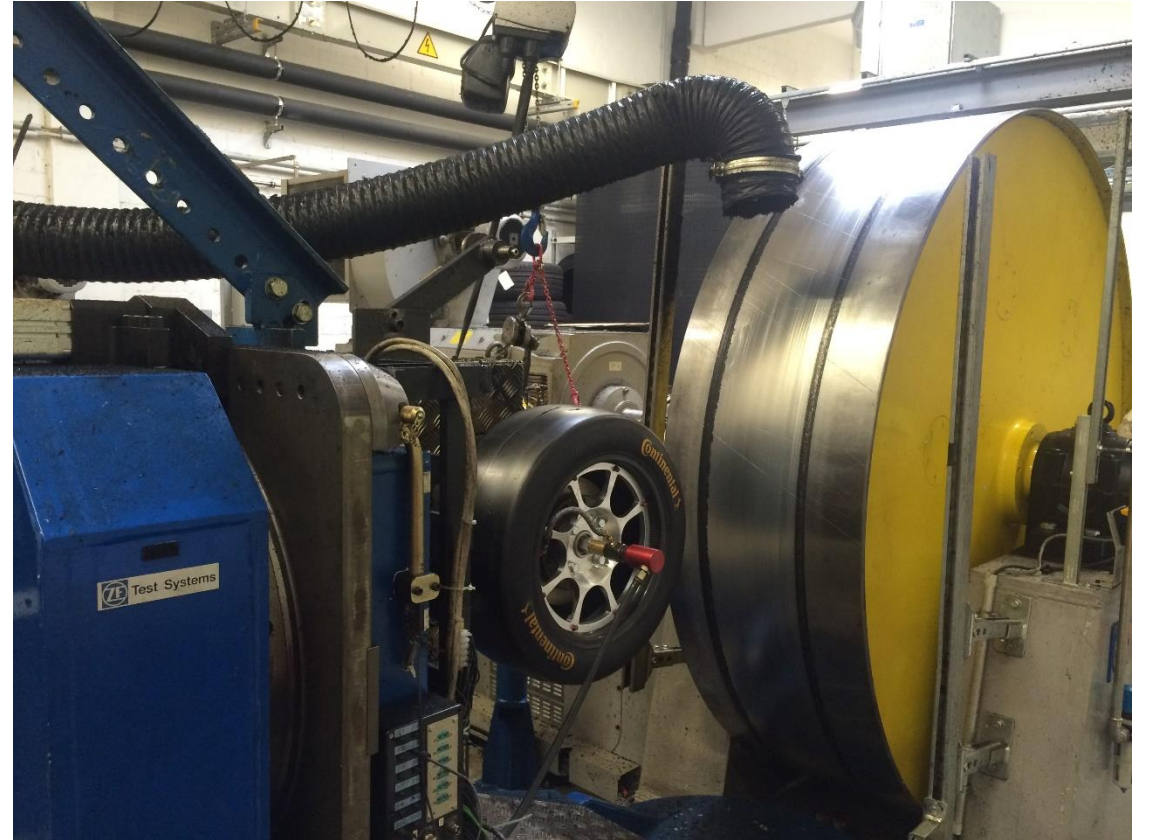


Point Labels: 7183

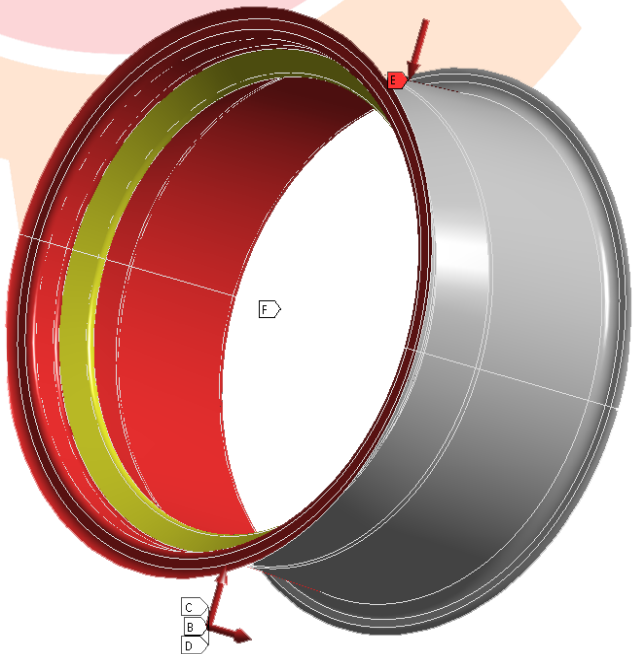


CFK-Hybrid Rim

- Biaxial Chassis Dynamometer
- Realistic Load Condition

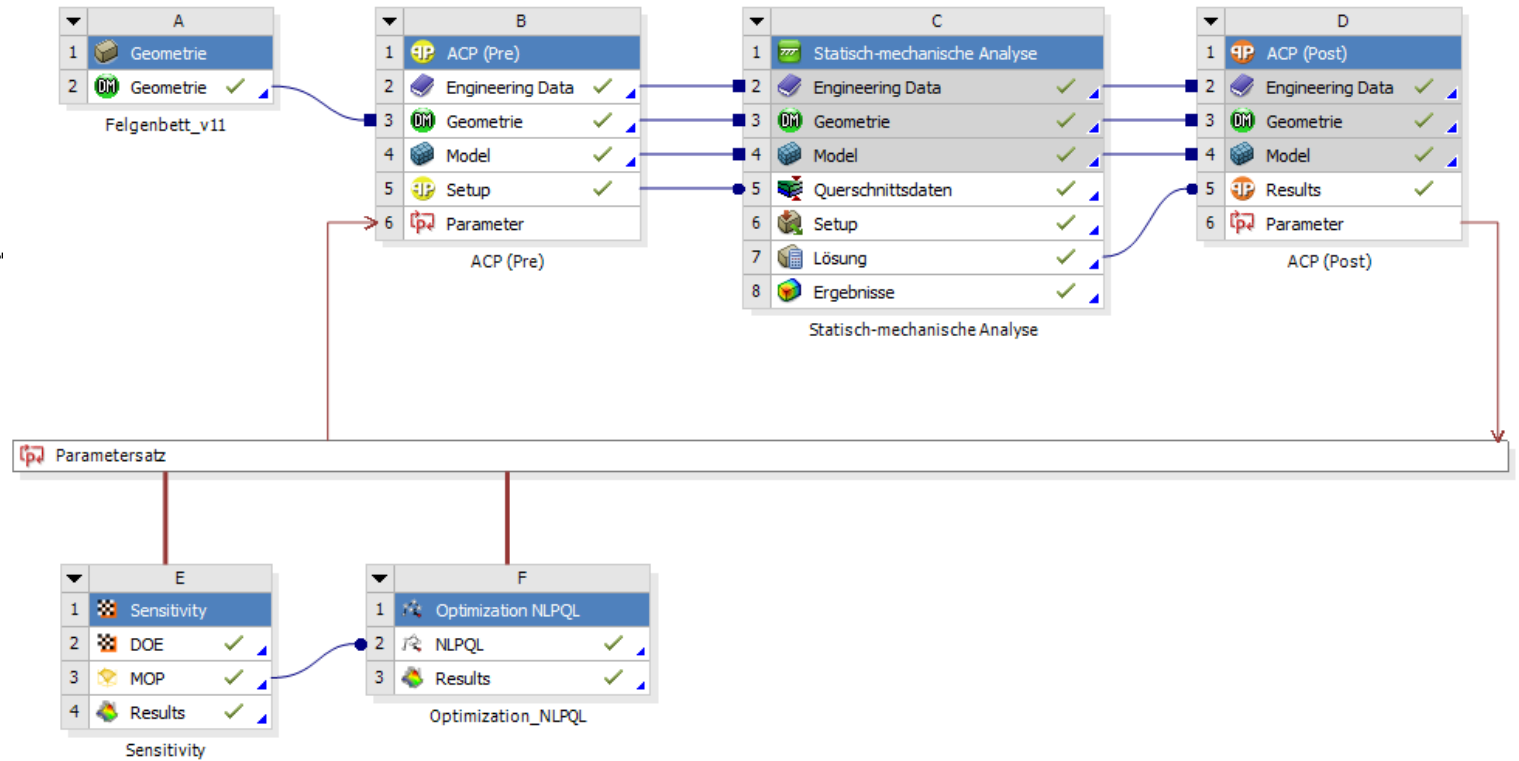


Optimization - Workflow

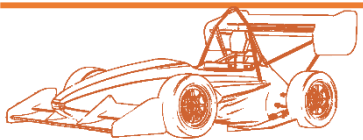
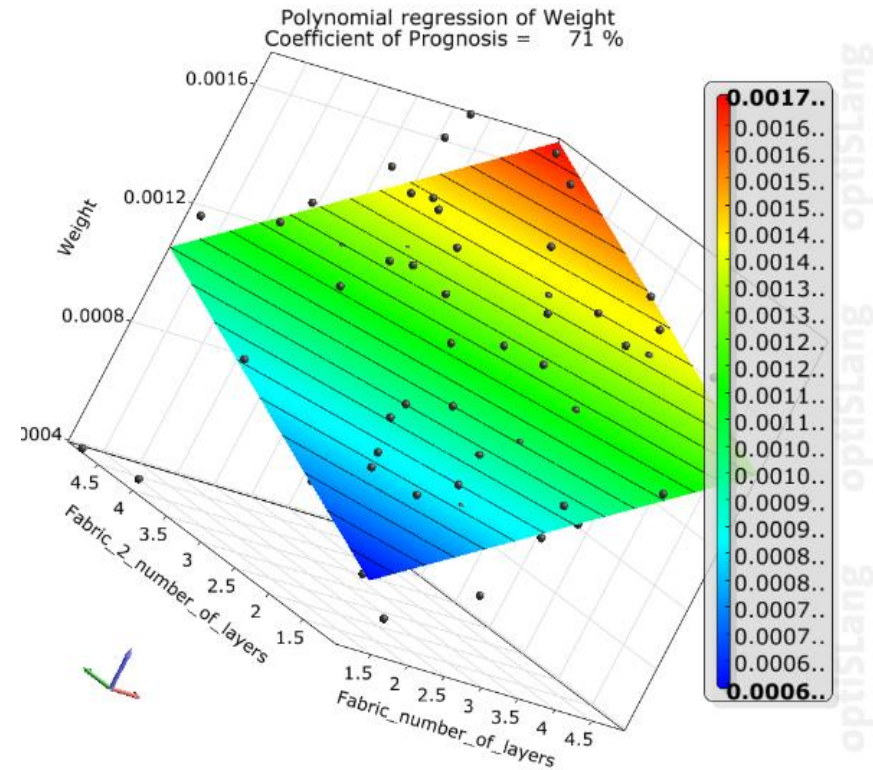
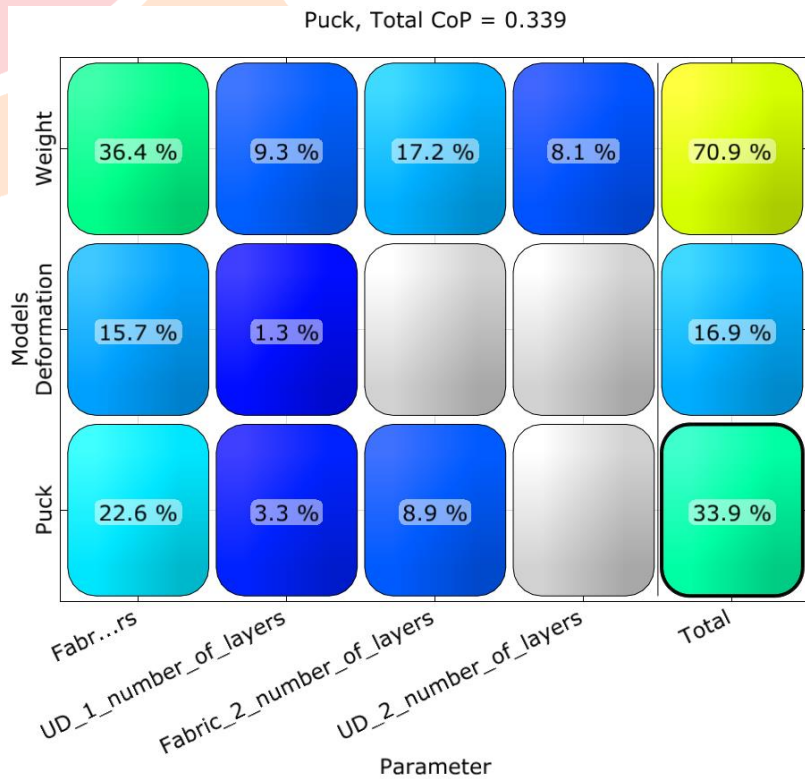


C: Statisch-mechanische A
 Statisch-mechanisch
 Zeit: 1, s
 26.05.2016 14:17

- A** Externe Kraft: 3854, N
- C** Externe Kraft 2: 4796, N
- D** Externe Kraft 3: 9042, N
- E** Druck: -0,1 MPa
- F** Externe Verschiebung

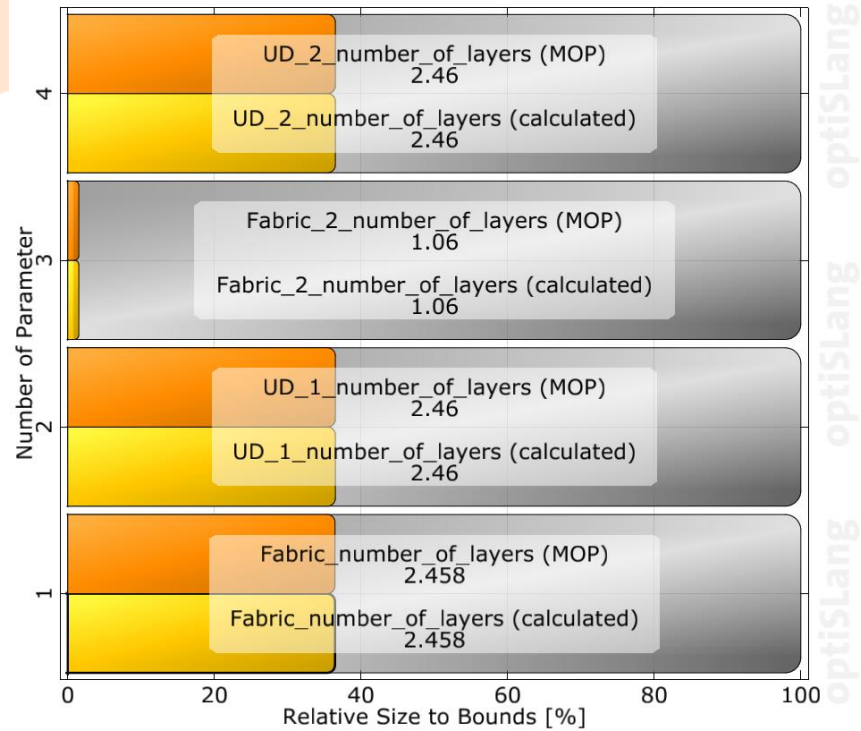


Optimization – Sensitivity Analysis

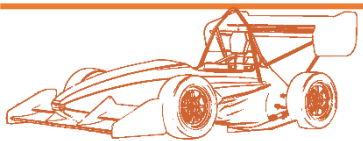
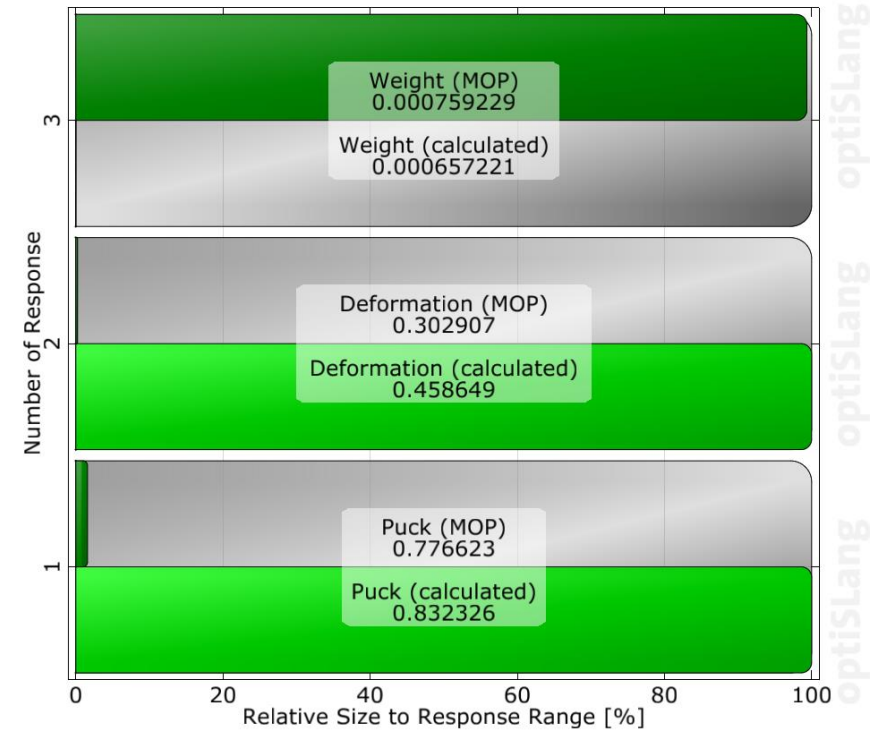


Optimization - Results

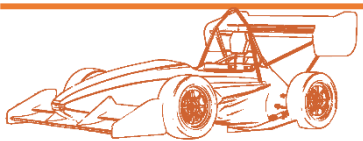
Best Design #2



RESPONSE DATA: (Best Design #2)

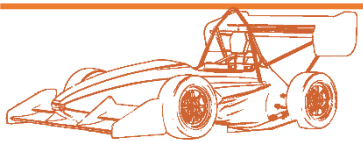
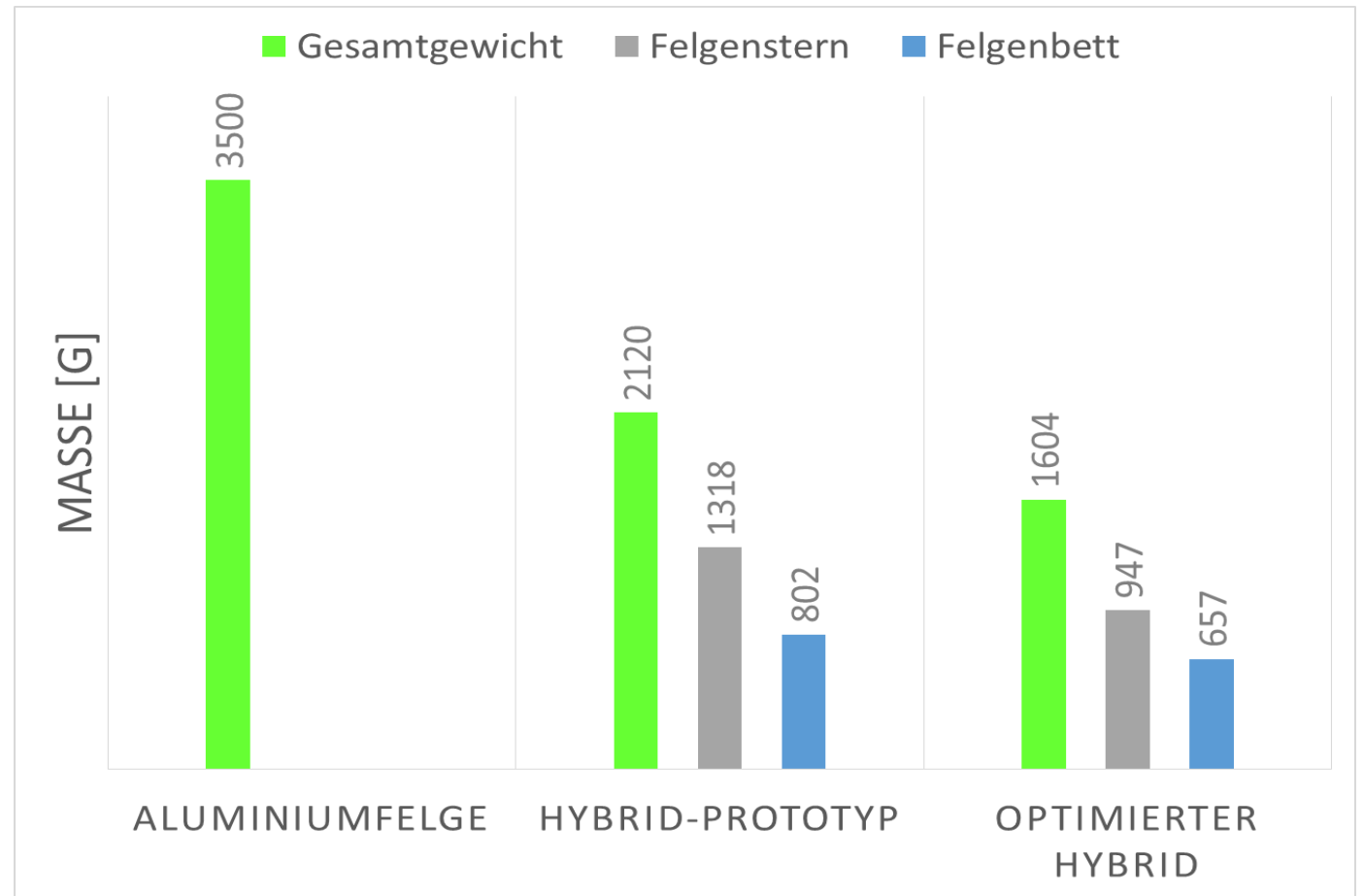


Optimized CFRP-Hybrid



Weight Comparison

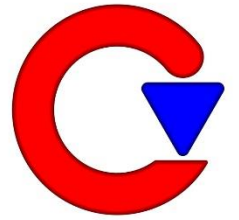
- Weight Reduction Wheel Base: 18%
- Weight Reduction Overall: 40%



Supporter



Carbon-Werke
Weißgerber GmbH & Co KG



dynardo

dynamic software & engineering

BATZ BURGEL
METALLHANDEL UND METALLBEARBEITUNG

ANSYS
CADFEM



SGL GROUP
THE CARBON COMPANY



HSC ZERSpanungstechnik

LIEBHERR

