SIMULATION

Development of a test setup for the static and cyclic testing of a CF-SMC brake calliper within the framework of an integrative simulation workflow

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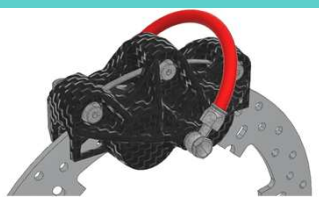
Aim and Objectives

Development of a test setup for the static and cyclic characterization of a novel motorcycle brake calliper design made of a thermoset-based carbon fiber reinforced sheet molding compound (CF-SMC).

Challenges:

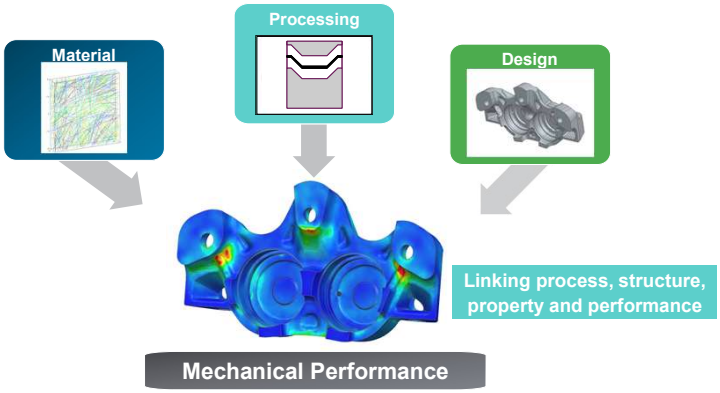
- Testing machine limitations → spatial boundaries, max. force
- Stiffness of the setup → superimposed deformations
- Load introduction → equivalent to real world conditions
- Complex material behavior → local anisotropy (fiber orientation)

Thick-Walled CF-SMC Brake Caliper



Integrative Simulation – ICME

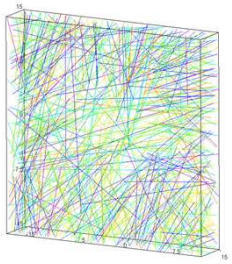
ICME … **I**ntegrative **C**omputational **M**aterials **E**ngineering

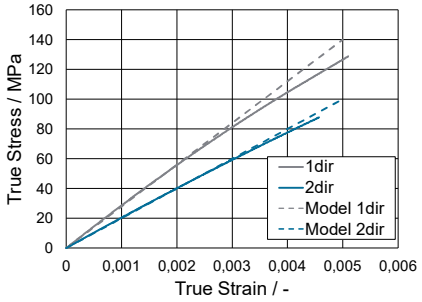


Material Modelling & Fiber Orientation

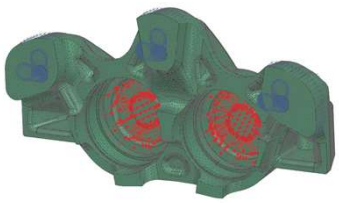
The material model of the CF-SMC material is reverse engineered by optimization of the unknown matrix properties using Simcenter MultiMech and Simcenter HEEDS.

- Calibration done on a RVE
- Based on experimental tensile test results





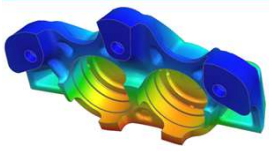
Results



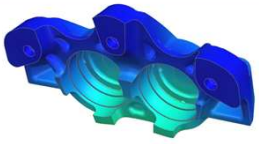
Calliper at operating loads

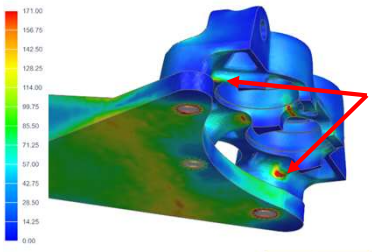
- SOL 402 Multi-Step Nonlinear Kinematics
- Fixed at attachment points
- Brake pressure of 5 bar

Deflection without FO



Deflection with FO



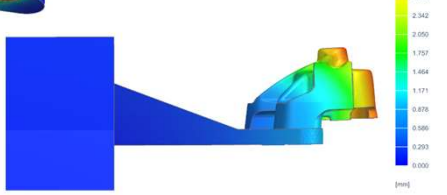


Highly loaded regions close to the rips

$\sigma_{max} \geq \sigma_{al,SMC} = 171\ MPa$

Superimposed deformations of calliper & setup:

$u_{max} = 3.5\ mm$



Conclusion & Outlook

- Fully integrative simulation workflow provides deeper insights to deformation behavior of SMC materials
  - Complex material behavior (local anisotropy)
  - Influence of process induced fiber (re)orientation
- Setup optimization needed
  - Superimposed deformation of calliper and setup
- Outlook
  - Fatigue analysis of whole setup

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FFG Forschung wirkt.

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