# AMECOMP – Composite forming simulation for non-crimp fabrics based on generalized continuum approaches

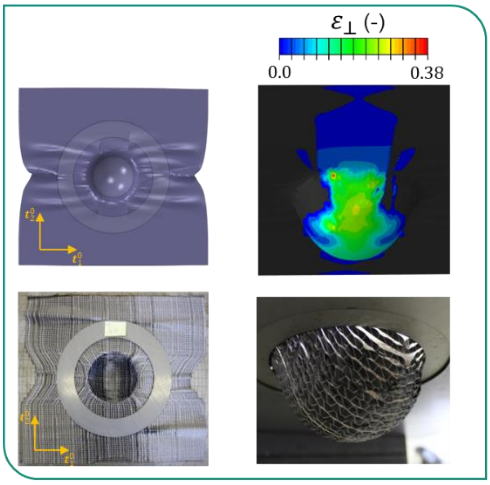
## 06/2020 - 06/2023

AMECOMP is an international collaborative research project of the German Karlsruhe Institute of Technology (KIT) and the French National Institute of Applied Sciences of Lyon (INSA), funded by the German Research Foundation (DFG) and the French National Research Agency (ANR). The central objective of the project is the development of forming simulation methods based on generalized continuum mechanics that are capable to describe the complex deformation mechanisms of NCF reinforcements. Currently applied conventional approaches are limited in the deformation mechanism, which can be described in a macroscopic simulation to efficiently predict manufacturing effects and defects on an industrial component level. Generalized continua approaches will improve the predictability of local forming effects like fibre waviness, gaping and local fibre volume content, as well as global fibre orientation and wrinkling. If forming simulation is capable to predict local as well as global effects, it can also be used inversely to design the forming process (e.g. by modified gripper strategies or reduced curvature radii) in such a way that an overall optimal fibre alignment is achieved and defects are minimised.

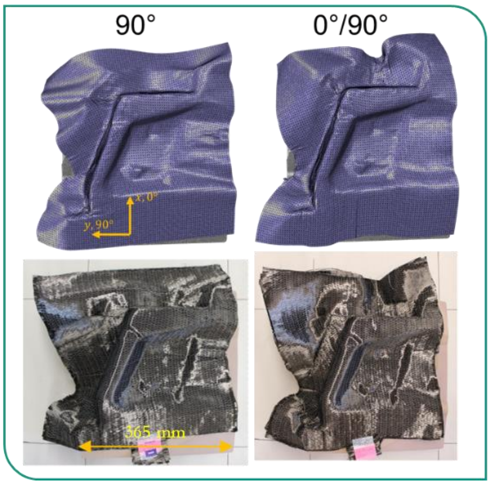
The following objectives are the main focus of this project:

- Experimental characterisation of UD-NCF and Biaxial-NCF on coupon level as well as roving and stitching characterization
- Mesoscopic modelling (individual modelling of each yarn and stich) of UD-NCF and Biaxial-NCF will be developed to analyse the formation of gaping during forming and to conduct virtual material characterisation to parametrise the macroscopic approaches based on generalised continua.
- Modelling approaches based on conventional Cauchy mechanics are insufficient for the forming simulation of fibrous material. Therefore, macroscopic forming simulation methods (homogenized description of the yarns and stitching together) for UD-NCF and Biaxial-NCF based on generalized continua approaches will be developed to correctly describe the influence of both the slip between the fibres and the bending stiffness of the fibres, in order to predict forming effects like fibre wrinkling and gaping.
- Three-dimensional finite element formulations, will be developed to model the out-of-plane compaction of UD-NCF and Biaxial-NCF.

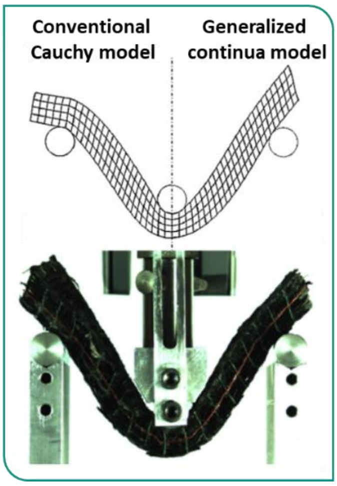
**Local forming effects (e.g. wrinkling)**




**Global forming effects**




**Deformation mechanisms (e.g. fibre bending)**





| | KIT, Germany | INSA, France |
|---|---|---|
| **Project Coordinators** | Dr. Luise Kärger | Prof. Dr. Philippe Boisse |
| **Contact** | M.Sc. Bastian Schäfer<br>bastian.schaefer@kit.edu<br>https://www.fast.kit.edu/lbt | M.Sc. Ruochen Zheng<br>ruochen.zheng@insa-lyon.fr<br>http://lamcos.insa-lyon.fr |