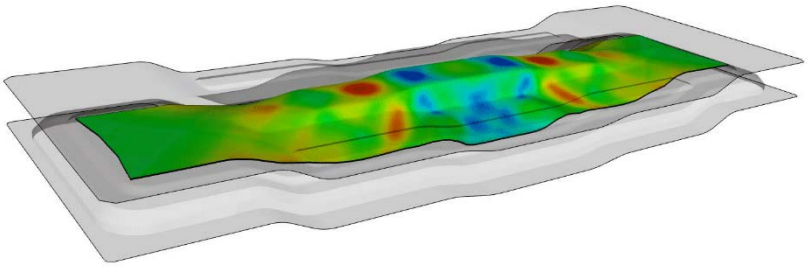
MSc Assignment – Production Technology Chair

Accurate Finite Element modelling for bending of composite laminates in forming conditions

Project description

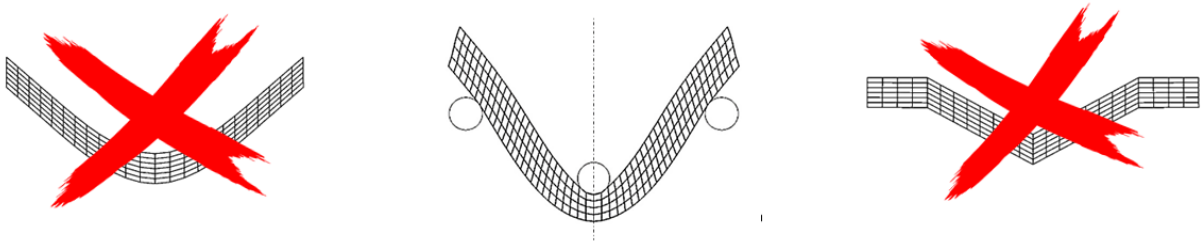
Thermoplastic composites (TPCs) are increasingly used by the industry due to their exceptional specific mechanical properties and rapid processing capabilities. Hot press forming is one of the most used manufacturing processes. Press forming may, however, lead to process induced defects such as waviness and wrinkling, which negatively affect the mechanical performance (in particular the compression strength) of the formed parts. Composites forming simulations can be used to predict the forming behaviour of these TPCs and thus to avoid such defects from occurring by changing the design before the forming tools have been manufactured.



Despite decades of finite element development, the bending behaviour of these laminates is still only rudimentary described. Few FE formulations are suited to handle the combined low bending stiffness, high in-plane stiffness and low transverse shear stiffness typical for TPCs in forming conditions. The objective of this assignment is to analyse the possibilities for a more accurate and physically correct finite element representation for this highly anisotropic material behaviour.

Tasks for the **student**

You are asked to perform a numerical study on finite element representations. To keep the theory and complexity manageable, the analysis will be restricted to two dimensions only (i.e. the cross-section as illustrated below).



After having familiarized yourself with previous work and literature on this topic, you will:

1. implement a shell formulation which is able to capture those phenomena simultaneously [1,2];
2. adapt it such that a measured constitutive relationship in terms of rotations can be included [3];
3. develop, from this, a solid element representation which can describe the same deformation field and which is suited for a multi-layer model [4].

You will critically assess the performance of these FE representations, compare those to literature findings and project your formulations against future 3D implementation of this approach in a written scientific report.

Interested in this assignment? Please contact:

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References

1. https://doi.org/10.1007/s10443-018-9719-8
2. https://doi.org/10.1002/nme.1620020310
3. https://doi.org/10.1016/j.compositesa.2017.05.032
4. https://doi.org/10.1016/j.compositesa.2009.03.004