Chair of Carbon Composites
Department of Mechanical Engineering
Technical University of Munich

Bachelor's Thesis, Term Project, Master's Thesis

Development of an Analytical Model to Predict Lay-up Defects During Automated Fiber Placement for Aerospace Applications

The Automated Fiber Placement (AFP) process is increasingly used for the manufacturing of structural aircraft components made of CFRP. The base materials for this process are pre-impregnated carbon fiber tapes (prepreg tapes), whose material properties have a significant influence on the processing. The tackiness for example, directly affects the lay-up rate and the occurrence of defects. Current trends in aerospace development – such as hybrid-electric flying – create the need for new materials whose suitability for the AFP process must be analyzed for future applications. The Chair of Carbon Composites (LCC) currently investigates materials with fillers in the matrix. These fillers have an effect on essential material properties such as tackiness and stiffness of the prepreg, which directly influence the processing efficiency during AFP.

Efficient AFP manufacturing can only be achieved if the optimum process parameters and the occurrence of lay-up defects are predicted beforehand. In literature, there are various models that can reproduce the lay-up phenomena partially. The aim of this work is to enhance the existing analytical models and to develop new approaches. The models for the buckling of prepreg tapes during lay-up along curved paths (steering) have to be extended by the temporal change of the material properties. In addition, models for the tape peel-off on convex and concave geometries have to be developed. The developed solutions will finally be applied to case studies. For this purpose, calculations will be carried out on geometries relevant to aerospace components with existing experimental or generic material data.

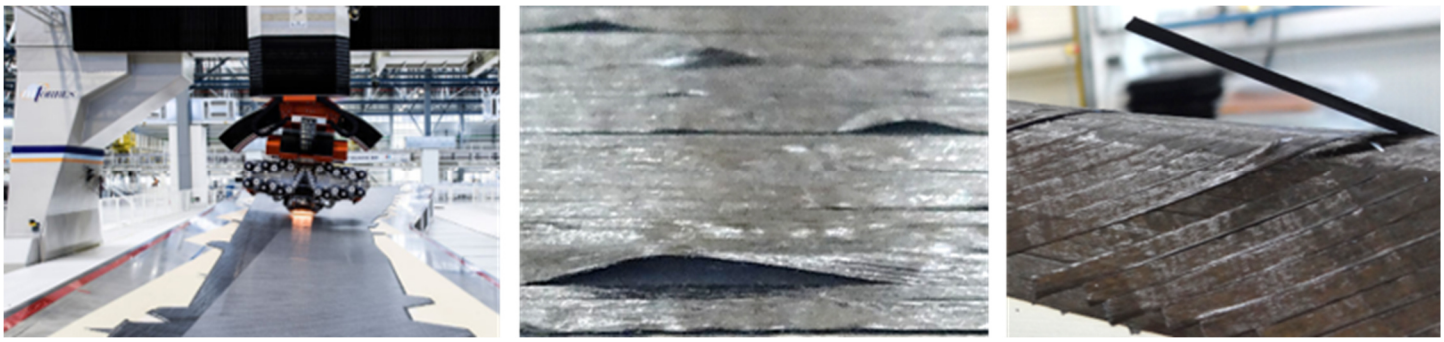

Figure: Automated Fiber Placement [Airbus] (left), lay-up defect out-of-plane buckling (middle), lay-up defect tape peel-off (right)

Research focus of the thesis

- Literature review on the modelling of lay-up defects during AFP
- Enhancement of existing models, development of new models
- Implementation in in MATLAB/Python or similar
- Application of models to case studies
- Documentation

Requirements

- Basic knowledge about composite materials beneficial
- Programming skills beneficial
- Structured and independent work attitude

Starting date: Now

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