COMPOSITE MANUFACTURING SUPPORTED BY SIMULATION

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Present day computational simulation tools extend structural analysis capabilities to include the manufacturing process of composite parts. By including manufacturing process and composite material parameters in the simulation e.g. curing temperature and chemical shrinkage, the design and manufacturing process can be adjusted beforehand to enable first time right products. Because the residual stress after manufacturing is known a better prediction of structural instabilities and strength can be made. In this presentation the current work performed in virtual manufacturing for composite at the NLR will be presented and an outlook of the future will be given. Examples of predictive simulation approaches where the results are used to analyse the structural properties of the manufactured part, and to improve the manufacturing process will be discussed.

In the EU LOCOMACHS project a curing and deformation of Resin Transfer Moulding (RTM) parts has been investigated. An in-house code has been developed to investigate the curing process parameters on the deformation. The simulation includes thermal effects and the curing process of the resin itself. The approach has been demonstrated on RTM aircraft fuselage frames. The RTM mould design can be adjusted to enable first time right products.

Grid stiffening is a process where local thick unidirectional sections (so called ribs) are co-cured within the laminate. Designs have been created for fuselage sections and wing-box sections. However this process can create considerable thermal stress at the interface between the skin sections and the ribs itself due to the large a-symmetry of the laminate. This effect is being investigated with the curing and deformation simulations of which results will be shown.

Other current research in this field apart from the before mentioned curing and distortion prediction include infusion simulation and fibre placement simulation to predict the behaviour of the composite tow during placement. Prediction of the braiding process and the resulting fibre angles and fibre offsets in the product is currently ongoing work from which also results will be presented.

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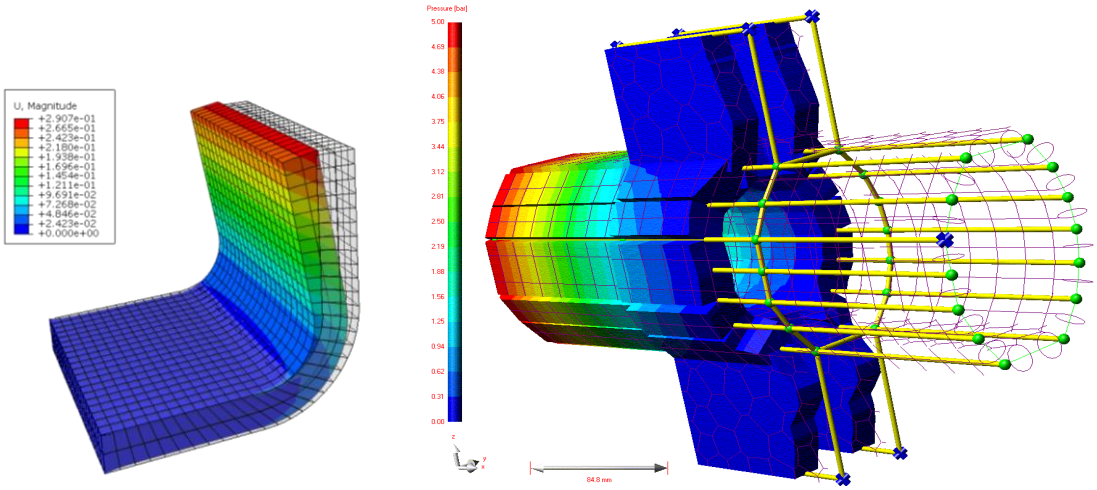

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