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Technologies for series production of near-net-shape textile preforms

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1. Introduction

Fibre-reinforced composites offer a number of attractive material properties, most prominently high stiffness and strength (Jones, 1999) combined with low density. Therefore, they have been the materials of choice for space and military aircraft applications for a long time and are now conquering the conservative field of commercial transportation. In this context the cost-efficient production of fibre-reinforced plastic (FRP) components for structural applications is a great demand of the automotive and aerospace industry.

Structural components often have specific properties such as 3D-geometries that include apertures, different levels of strength and energy absorption capability. Additionally the integration of inserts and functional elements is required. One possible process chain for the mass production of near-net-shape FRP components is the manufacturing of dry textile reinforcement structures (textile performs) and the impregnation and consolidation by resin injection moulding processes. A key challenge for the realisation of this process chain is the economic production of dry textile preforms that fulfil the requirements regarding geometry, functionalisation, structural mechanics and the impregnation process.

Today 50 % of the production costs for FRP components are used for the production of textile reinforcement structures. Therefore, automated production technologies are necessary for an economic success. Thus, automated textile preforming is the key for the commercial breakthrough of FRP in large series.

There are different textile technologies available that are capable for producing and assembling complex textile structures. The technologies to produce textile preforms can be differentiated in single-step and multi-step preforming processes. Below, an overview over the latest single-step and multi-step preforming processes is given and an approach to design and evaluate multi-step preforming processes is introduced.

2. Preforming technologies

3D-rotary braiding and overbraiding technology are examples for single-step preforming processes. Using these technologies, textile preforms with complex geometries can be produced in a single production step starting from the yarn and ending up with the complete textile preform. Both processes provide a high degree of automation.

2. 1. 3D-rotary braiding

Using 3D-rotary braiding technology not only complex profile geometries like continuous changes in cross section geometry can be realized. Also complex yarn architectures can be produced due to an individual

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