

Simulations of the braiding process for RTM preforms

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Introduction

Complex composite parts, for example a helicopter trailing arm, can be manufactured with the Resin Transfer Moulding Technique. This process requires the use of preforms. Automated braiding is a suitable process for manufacturing reproducible, complex preforms. Furthermore, the interlaced nature of braids provides high levels of impact strength.

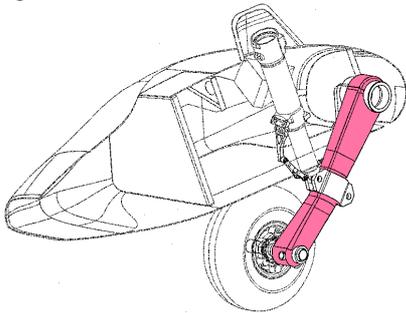


Figure 1 Trailing arm

Objective

So far, it was by no means trivial to predict the mechanical properties of a complex braid reinforced product, firstly because the fibre directions could not be predicted in advance. The objective is to develop a model which calculates the fibre directions on a complex preform in advance.



Figure 2 Braiding machine

Methodology

Based on five assumptions, four equations are formulated. These equations form the basis for the model, which employs a linear prediction and a nonlinear correction. With a geometrical simplification, based on Du [1], this leads to a low-cost numerical algorithm. The model shows quadratic convergence with decreasing step size.

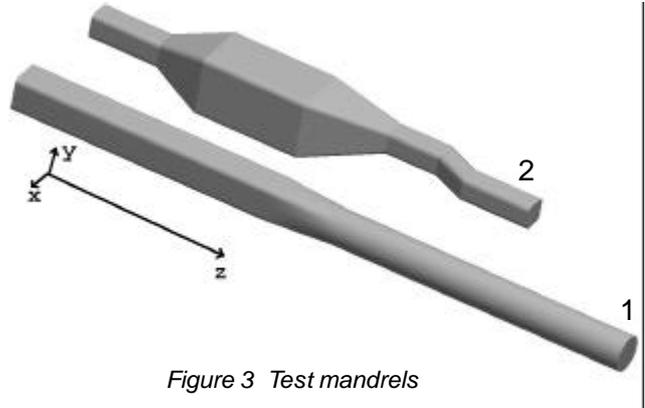


Figure 3 Test mandrels

Results

Two test mandrels were braided on a 96 spool braiding machine at EuroCarbon in the Netherlands. The analytical predictions and the experimental results agree very well.

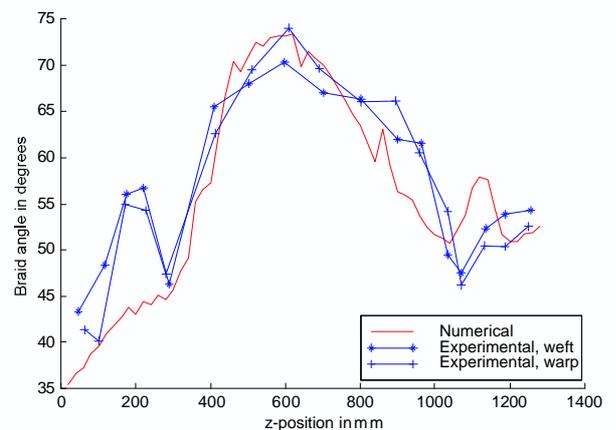


Figure 4 Braid angles on the second mandrel

Discussion

Even for non-circular, complex mandrels the model is able to predict the fibre angles very well in advance. The model is fast enough to use optimization strategies of an indirect nature for calculating the machine parameters from the desired product properties.

Acknowledgment

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References

- 1 G.W. Du and P. Popper, *Analysis of Circular Braiding Process for Complex Shapes*, Journal of the Textile Institute, 85: 316-337, 1994
- 2 J.F.A. Kessels, *Braiding of Preforms for Resin Transfer Moulding*, WB.00/TM-4561, University of Twente, 2000