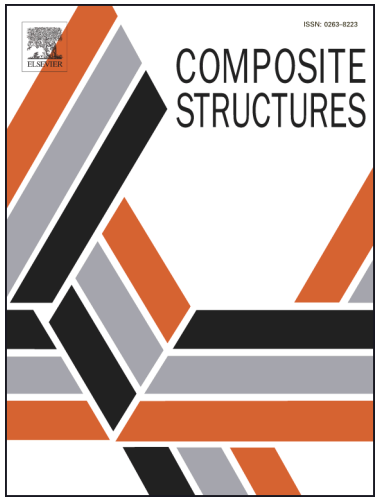

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Modelling the orthogonal cutting of UD-CFRP composites: Development of a novel cohesive zone model

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Abstract

The inhomogeneous and anisotropic nature of CFRP presents a challenge achieving accurate simulations largely due to limitations of current material constitutive relationship, in particular for predicting debonding of the matrix and fibre. Following a comprehensive review of the various published cohesive models a new approach for representing the fibre-matrix interface is proposed for a three-dimensional FE model of orthogonal cutting of UD-CFRP. While severe deformations of the cohesive elements are generally observed when surrounding elements fail, excessively strong bonds are typically formed when employing surface-based cohesive behaviour. The proposed approach overcomes these limitations by employing zero thickness cohesive elements based on a traction-separation law, which are deleted from the analysis if any of the surrounding elements fails. The FE models were validated in terms of predicted cutting and thrust forces against published data for different fibre orientations. Cutting forces showed good agreement to experimental results for 90°and 135°(error within 5%), while thrust forces are generally underestimated.

Keywords: Cohesive zone, Carbon Fibre Reinforced Composites (CFRP), Orthogonal cutting, Finite Element

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