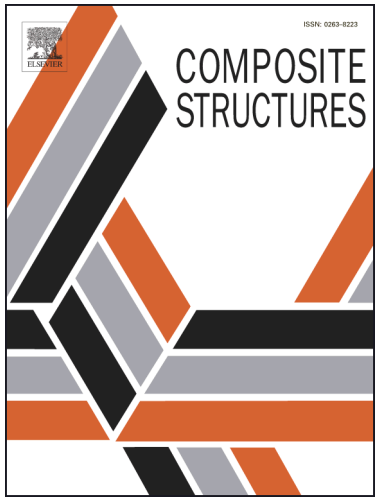

Dynamic Simulation of Machining Composites Using the Explicit Element-Free Galerkin Method

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Dynamic Simulation of Machining Composites Using the Explicit Element-Free Galerkin Method

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Abstract

Machining operations are performed on composite parts to obtain the final geometry. However, machining composites is challenging due to their low machinability and high cost. Numerical modelling of machining presents a valuable tool for cost reduction and a better understanding of the cutting process. Meshfree methods are an attractive choice to model machining problems due to their capability in modelling large deformations. This work presents an explicit meshfree model for orthogonal cutting of unidirectional composites based on the Element-Free Galerkin (EFG) Method. Advantages of the proposed model include: simple and automated preprocessing, advanced material modelling and ability to model high-speed machining. Workpiece material is modelled as orthotropic Kirchhoff material with a choice of three failure criteria: maximum stress, Hashin and LaRC02. Frictional contact calculations are performed based on central differencing, therefore avoiding the use of penalty parameters. Validation of the EFG model is conducted by comparing cutting forces against orthogonal cutting experiments on GFRP samples using a vertical milling machine. It is found that while the numerical cutting forces are in good agreement with experimental ones, the numerical thrust forces are significantly under-estimated. Analysis of failure showed that chip is formed along the fibre direction in the studied range.

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