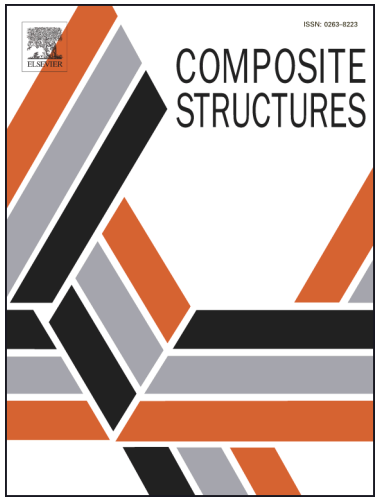

Strain Invariant Failure Theory – Part 1: An extensible framework for predicting the mechanical performance of fibre reinforced polymer composites

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Strain Invariant Failure Theory – Part 1: An extensible framework for predicting the mechanical performance of fibre reinforced polymer composites

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Abstract

Failure prediction for composite materials is still a major area of interest within both the academic literature and the composite industry. This paper presents a modelling and experimental framework which has been developed for the application of Strain Invariant Failure Theory (SIFT), but which can be adapted to other failure prediction methods if required. SIFT is set of physics-based failure criteria developed to predict the onset of irreversible deformation of glassy polymers. The paper provides an overview of the available evidence for SIFT and provides a complete methodology for applying SIFT to predict the onset of failure in a composite component.

Fundamental to the method presented is a modular and hierarchical dehomogenisation procedure; allowing for the evaluation of stress and strain state variables within the constituent components of the composite. Due to the constant evolution of composite characterisation techniques, the method presented in this paper is designed to be extensible (i.e. accommodating of new materials and product forms) and modular (i.e. subsections of the method can be easily substituted or refined). Known limitations of the current method are clearly presented and discussed. A companion paper will present validation of the approach for simple uniaxial and biaxial coupon experiments and will discuss how the method can be applied to a range of existing composite characterisation testing standards.

Keywords

Fibre Reinforced Composites; SIFT; Composite Failure Prediction; Composite Micromechanics