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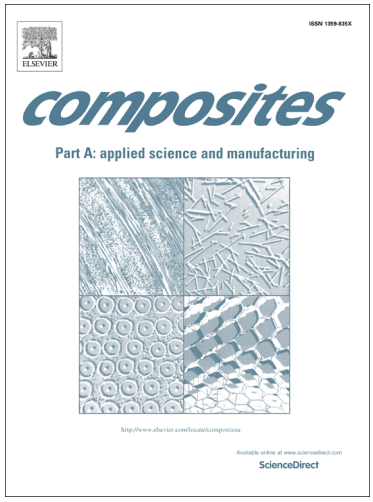

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Modelling and simulation of tow-drop effects arising from the manufacturing of steered-fibre composites

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Abstract

The introduction of Variable-Stiffness Laminates requires not only the use of advanced numerical simulation tools but also better understanding of manufacturing induced effects. These computational tools can give beneficial insight that will lead to an effective reduction of test campaigns as well as to increase design possibilities. This paper presents a virtual testing approach to study the influence of tow-drop effects, generated in the manufacturing of steered-fibre composites, by means of nonlinear finite element analyses within the framework of fracture and damage mechanics. X-ray computed tomography was used to characterize the embedded resin-rich areas. Both the progressive failure mechanisms and the ultimate failure loads can be predicted with high realism when compared with experimental observations. In addition, the differences of the tow-drop effects on plain and notched laminates can also be predicted accurately.

Keywords: B. Defects; C. Finite element analysis (FEA); E. Automated fibre placement (AFP); Variable-Stiffness Panels

1. Introduction

The use of lightweight laminated composites combined with the capacity for large-scale automation of the laminated production process has increased significantly in the aeronautical industry. Currently, the use of Automated Fibre Placement (AFP) technology, allows large and complex composite aircraft components to be manufactured with high quality, accuracy and repeatability. In addition, the introduction of tow-steered panels with curved

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