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Performance-driven 3D printing of continuous curved carbon fibre reinforced polymer composites: a preliminary numerical study

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Abstract

This paper presents a new concept to place continuous curved fibres for carbon fibre reinforced polymer (CFRP) composites, which can be fulfilled by potential additive or hybrid manufacturing technology. Based on the loading condition, principal stress trajectories are generated through finite element analysis (FEA) and used as the guidance for the placement paths of carbon fibres. Three numerical cases including an open-hole single ply lamina under uniaxial tension and open-hole cross-ply laminate under biaxial tension and normal pressure are studied and compared with traditional reinforced composites with unidirectional fibres. The modelling results show that the stress concentration in both fibre and matrix are reduced significantly by the curved fibre placement and the stiffness of CFRP composites have been improved. This concept of performance-driven optimization method could lead to a useful tool for the design of future 3D printing process for fibre reinforced composites.

Keywords

CFRP; Curved fibres; Performance-driven manufacturing; 3D printing; FEA.

1. Introduction

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