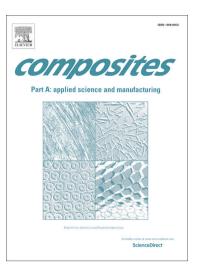
## Accepted Manuscript

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## ACCEPTED MANUSCRIPT

# Exploring the pseudo-ductility of aligned hybrid discontinuous composites using controlled fibre-type arrangements

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#### Abstract

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Pseudo-ductility presents a potential means for preventing catastrophic failure in composite materials; large deformations will prevent brittle fracture and provide warning before final failure. This work explores how the pseudo-ductility and strength of aligned hybrid discontinuous composites can be controlled by manipulating the arrangement of different fibre types. Aligned carbon/glass hybrid specimens with different fibre arrangements are manufactured and tested using a modification to the High Performance Discontinuous Fibre (HiPerDiF) method. Experimental results are complemented by an improved virtual testing framework, which accurately captures the fracture behaviour of a range of hybrid discontinuous composite microstructures. With a randomly *intermingled* fibre arrangement as a baseline, a 27% increase in strength and a 44% increase in pseudo-ductility can be achieved when low elongation fibres are completely *isolated* from one-another. Results demonstrate that the HiPerDiF method is the current state-of-the-art for maximising the degree of intermingling and hence the pseudo-ductility of hybrid composites.

Keywords: Pseudo-ductility, hybrid, microstructures, fracture,

### 1. Introduction

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Composite materials are widely used in aerospace and automotive applications due to their high specific strength and specific stiffness [1]. However, composite materials often fail in a brittle manner, which may lead to catastrophic failure; consequently, composite structures are often over-designed and overweight. There is therefore a strong desire for

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