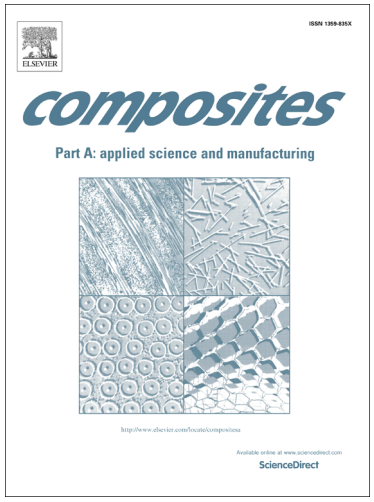

Data-Rich Characterisation of Damage Propagation in Composite Materials

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Data-Rich Characterisation of Damage Propagation in Composite Materials

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ABSTRACT

A novel methodology for the synchronised capture of high resolution white-light and infra-red (IR) images during a fatigue test is described. The approach allows digital image correlation (DIC) and thermoelastic stress analysis (TSA) to be applied practically simultaneously without the requirement to pause the cyclic load. The methodology is demonstrated on cross-ply carbon-epoxy specimens that have experienced damage induced by intermediate strain rate loading. Similar undamaged specimens are studied and the results from each compared. Various damage types are identified which include transverse cracking, delaminations and longitudinal splitting. The results are verified using X-ray computed tomography (CT).

KEYWORDS

Polymer-matrix composites (PMCs), Damage tolerance, Fatigue, Optical techniques, Thermal analysis

Introduction

As the use of fibre-reinforced polymer (FRP) materials increases across a wide range of structural applications, damage tolerance to impact events and subsequent in-service performance of such materials is of paramount importance. Whilst the quasi-static behaviour of FRP materials has been generally well studied, e.g. [1], their behaviour at increased strain rates and during subsequent service life are less well defined [2], making damage-tolerant design challenging. Typical sources of high strain rate damage include a bird strike or hail impact on a wing leading edge, an explosive blast near a military vehicle or slamming encountered by small vessels in rough seas. It is therefore important to assess how FRP materials behave after a damage causing event to assess the degradation in structural