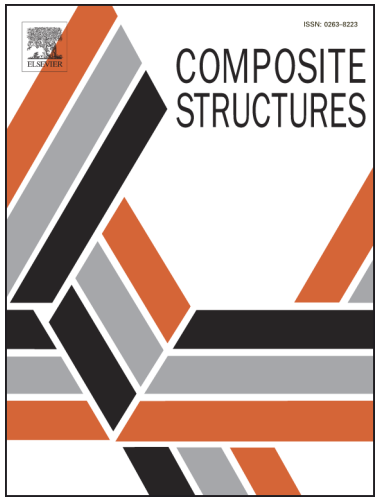

Mapping Interior Deformation of a Composite Sandwich Beam Using Digital Volumetric Speckle Photography with X-Ray Computed Tomography

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Mapping Interior Deformation of a Composite Sandwich Beam Using Digital Volumetric Speckle Photography with X-Ray Computed Tomography

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Abstract: Sandwich beams or plates with a soft core and stiff face sheets have been used extensively as a structural engineering material because of its high strength-to-weight ratio. While many studies have been devoted to understanding its failure mechanism, much remain unknown. For example while its main failure mode is a 45^{o} shear crack in the core and delamination at the core/face sheet interface, its exact mechanism remains somewhat a mystery: where and how the crack is initiated and what effects its propagation. One of the main reasons is the lack of an effective experimental tool to monitor, in situ, the failure process and thereby quantify the stress/strain field as it progresses. In this paper we present a new tool called DVSP (Digital Volumetric Speckle Photography) that is capable of mapping quantitatively the interior deformation of sandwich beams/plates as it is being loaded. We have applied the technique to a sandwich beam under 3-point bending. Full field deformation in the form of displacement and shear strain contours of 6 transverse and 3 longitudinal sections of the beam are presented. It is believed that this technique will shed much light on the failure mechanism of sandwich beams/plates in the future.

Keywords: Composite sandwich beam; Interior deformation; Shear strain; Digital volumetric speckle photography; X-ray computed tomography

1. Introduction

Composites have become a ubiquitous engineering material because of its highly advantageous strength to weight ratio. Thin composites have been successfully applied to aerospace structures: Boeing company's 787 airplane is the most prominent example of this application [1]. Thicker