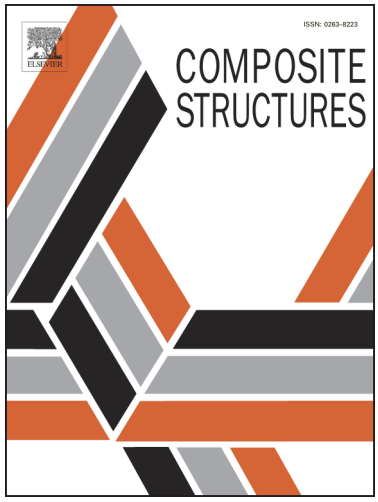

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Abstract

The aim of this study is to identify disbond and high-density (HD) core region in a honeycomb composite sandwich structure (HCSS) using ultrasonic guided waves (GWs) and surface-bonded piezoelectric wafer transducers (PWTs). Towards this, an organized theoretical, numerical and experimental study has been carried out in order to understand the characteristics of GW propagation in a HCSS. A global matrix method based efficient and fast two dimensional (2D) semi-analytical model is used to study transient response and dispersion characteristics of the healthy HCSS under PWT excitations. Numerical simulation of GW propagation in HCSS with disbond and HD-core is then carried out using finite element package, ABAQUS. Laboratory experiments are then carried out to validate the theoretical and numerical results. A good agreement is observed between the theoretical, numerical and experimental results in all cases studied. It is found that the presence of HD-core region leads to decrease in amplitude of the propagating GW modes and the presence of disbond leads to substantial amplification of the primary anti-symmetric mode. Finally, based on these changes in modal behaviors, the location and size of unknown disbond and HD-core region within the PWT array are experimentally determined using a probability based damage detection algorithm.

Keywords

Honeycomb composite sandwich structure; Guided wave; Piezoelectric wafer transducers; High-density core; Disbond; Group velocity