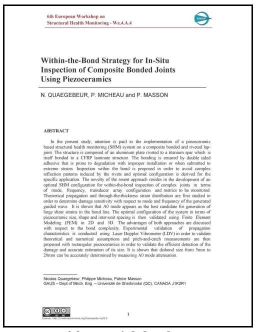
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Within-the-Bond Strategy for In-Situ Inspection of Composite Bonded Joints Using Piezoceramics

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ABSTRACT

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In the present study, attention is paid to the implementation of a piezoceramic based structural health monitoring (SHM) system on a composite bonded and riveted lap-joint. The structure is composed of an aluminum plate riveted to a titanium spar which is itself bonded to a CFRP laminate structure. The bonding is ensured by double sided adhesive that is prone to degradation with improper installation or when submitted to extreme strains. Inspection within the bond is proposed in order to avoid complex reflection patterns induced by the rivets and optimal configuration is derived for the specific application. The novelty of the resent approach resides in the development of an optimal SHM configuration for within-the-bond inspection of complex joints in terms of mode, frequency, transducer array configuration and metrics to be monitored. Theoretical propagation and through-the-thickness strain distribution are first studied in order to determine damage sensitivity with respect to mode and frequency of the generated guided wave. It is shown that A0 mode appears as the best candidate for generation of large shear strains in the bond line. The optimal configuration of the system in terms of piezoceramic size, shape and inter-unit spacing is then validated using Finite Element Modeling (FEM) in 2D and 3D. The advantages of both approaches are discussed with respect to the bond complexity. Experimental validation of propagation characteristics is conducted using Laser Doppler Vibrometer (LDV) in order to validate theoretical and numerical assumptions and pitch-and-catch measurements are then proposed with rectangular piezoceramics in order to validate the efficient detection of the damage and accurate estimation of its size. It is shown that disbond size from 5mm to 20mm can be accurately determined by measuring A0 mode attenuation.

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Ключевые слова:

Содержание