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In Situ Damping Characterization for Improved Imaging in Structural Health Monitoring

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The damping of a material affects the distance over which guided waves can travel, determining the effective area of a structure which can be monitored by a given configuration of actuators and sensors in structural health monitoring (SHM). The attenuation of waves practically limits the efficiency of damage imaging approaches based on Time of Flight. More recent damage strategies exploiting propagation models such as Excitelet rely on the knowledge of material properties and damping has not been considered up to now. This paper presents the preliminary results of a method based on guided wave propagation for in-situ estimation of material damping. This parameter, together with other parameters such as Young's modulus, Poisson's ratio and density, could then be used in the propagation models used for damage imaging. The method evaluates the attenuation of a material by correlating time domain measurements, with model-based predicted dispersed versions of an excitation signal, generated by a piezoceramic actuator. Predicted dispersed versions of the excitation signal are generated by a propagation models using complex wavenumbers, where the imaginary parts represent the damping coefficient. The approach is first validated numerically using a finite element model (FEM) of three isotropic structures having different damping coefficients. In these models, the generation of a windowed burst onto the structure is simulated using an actuating bonded PZT. The time signal of the generated burst at the emitter is dispersed using propagation models. The damping is estimated using a genetic algorithm, by finding the optimal complex wavenumbers in the propagation model leading to the highest correlation between the FEM measurement measured and the model-based predicted dispersed time signals. An experimental assessment of the approach is then carried out on a 2.33 mm thick composite plate. Measurement points are taken using Lased Doppler Vibrometer (LDV). The results obtained in this work show the potential of the approach to estimate accurately the damping of a material.

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Ключевые слова:

Содержание