Spatial attenuation prediction of Lamb waves in composite materials

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Abstract:

For the inspection and detection of damage in composite materials, Lamb waves are particularly effective because they can propagate over relatively large distance and hence can be used to cover a large area with few testing time and equipment. However, predicting simply and reliably the spatial attenuation of Lamb wave, which is the decreasing amplitude of wave over propagation distance, is still a challenge. In addition, there are rare practical cases studies reported up to date that are associated with estimating lamb wave attenuation for structures large enough to industrial scale. Thus the authors propose a simple approach to predict the S0 mode attenuation coefficients of Lamb wave under different frequencies, which takes Hysteretic and Kelvin-Voigt damping models into account. This approach is derived directly from dispersion equations by solving the complex wavenumber and the attenuation coefficients are extracted from its imaginary part. Two engineering components in airplane, FCS and IFS are tested to verify the proposed model, in which the linear regression technique is used to identify the S0 mode attenuation coefficients under different frequencies from experimental data. Comparison between the numerically predicted attenuation coefficients and the experimentally identified results successfully validates the feasibility and efficiency of the proposed approach.

Keywords: Structural heath monitoring, Lamb wave, attenuation prediction, composite materials, viscoelastic damping.