THE DETERMINATION OF INDIVIDUAL MODES IN OBSERVED EXPERIMENTAL SIGNALS IN RODS AND PLATES

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Guided waves are widely used in Structural Health Monitoring (SHM) for evaluating structures since the waves can propagate large distances with minimal attenuation allowing a large area to be interrogated. In SHM, guided waves are primarily encountered in geometries like plates, tubes, and rods. However, guided waves are dispersive at higher frequencies, which can complicate interpretation of these signals.

Both plane waves and the harmonic solutions to infinite geometries (i.e. Rayleigh-Lamb, Pochhammer-Chree, etc.) are used to describe the propagation of guided waves in plates and rods. When used in interpreting experiments, plane waves provide a physical explanation of arrivals in a signal when wave speeds are constant. For more complex signals that exhibit dispersion, the group velocity curves from the frequency equation of the harmonic solutions are often used to interpret the information. Unfortunately, the excitation of multiple propagating modes complicates the interpretation of a signal from the group velocity curves. For these signals the relative amplitudes of the excited modes should also be considered, which requires an analytical model.

This work shows how semi-analytical models can be used to physically interpret complex experimental signals in terms of propagating modes. Models for guided waves in finite plates and finite length circular bars are presented. Some discussion of previous misinterpretations is included and the semi-analytical models are used to help clarify these issues.

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