

Ultrasonic structural health monitoring – current applications and potential

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Background, Motivation and Objective

There is growing interest in moving from periodic inspection (NDT) to quasi-continuous monitoring (SHM) with ultrasonic based methods, and current applications of both bulk wave and guided wave systems will be reviewed. Ultrasonic guided waves are particularly attractive in SHM because of their ability to give large area coverage from a limited number of transducers. Permanently installed sensors were originally deployed to reduce the access cost of repeated inspection but an improvement in detection sensitivity is also obtained. For example, guided wave NDT of pipelines using the fundamental torsional $T(0,1)$ mode has been shown to reliably detect large corrosion-like defects which result in 5% cross-sectional area (CSA) loss. Permanent installation and frequent data collection enables the reliable detection of smaller corrosion patches of the order of 0.5-1% CSA loss with current signal processing methods.

Statement of Contribution/Methods

The detection sensitivity in monitoring is a function of the stability of the signals received in the absence of any damage growth and a great deal of research has been done on the compensation of the effects of temperature and other factors on the signals. Most compensation schemes cover the whole signal via, for example, stretching to compensate for velocity changes with temperature, or overall phase changes. However, recent work has shown that these ‘global’ schemes can be supplemented by additional, point-by-point compensation to take account of changes in attenuation or the mix of modes generated with temperature. This can give a substantial further improvement in performance.

Results/Discussion

Results will be presented from a variety of test cases, both in the lab and in the field. It will be shown that wall loss down to 0.1% cross section area and below can be achieved in guided wave monitoring. Improved compensation continues to be a fruitful research avenue and this will be discussed, along with likely future ultrasonic monitoring application areas.