WAVLET-BASED ACTIVE SENSING FOR HEALTH MONITORING OF PLATE STRUCTURES USING BASELINE FREE ULTRASONIC GUIDED WAVE SIGNALS

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Abstract. A wavelet-based active sensing technique for health monitoring of isotropic thin plate-like structures using baseline-free ultrasonic guided Lamb wave signals is presented. In this technique, a built in clock-like piezoelectric (PZT) wafer array of small footprint comprising of a single transmitter and multi-receivers (STMR) is considered. The recorded signals in absence of defects are compared with a theoretical model first, and the velocity and amplitude dispersion of guided waves are studied in an effort to tune an appropriate guided wave mode. A five cycle Hanning pulse is transmitted, and the pulse-echo data recorded at the receivers is processed using two novel algorithms, namely damage index 1 (DI1) and damage index 2 (DI2), based on wavelet transformation to identify defects in the form of cracks and loose rivet holes, which are located both near and far away from the array. In both cases, damage index (DI) maps are generated for identification of defects in a particular coverage area on demand by considering the reflected fundamental guided wave modes. Simulation studies are also carried out to demonstrate the effectiveness of the proposed sensing technique. The DI maps clearly show higher values of DI at

defect locations enabling identification of multiple defects. The DI2 is found to produce better angular resolution of the defect location than the DI1.

Index terms*:* ultrasonic guided waves, embedded circular PZT array, wavelet transformation, baseline free algorithms, damage index.