Abstract

Structural health monitoring (SHM) is used in aerospace, civil, naval, and automotive industries to monitor structures for damage, stress/strain, and vibrations. The aim is to ensure reliability through continuous/active/online monitoring that is as reliable as proven non-destructive techniques (NDT). Ultrasonic-guided waves (GW) are a promising technique for SHM, but dispersion effects, electromagnetic noises, and environmental factors can affect the accuracy of the data collected.

The research aims to develop an effective multistep damage identification process (detection, localization and quantification) using the proposed SHM-GW method. The proposed multi-step method was tested on many isotropic and anisotropic structures with different kinds of damage and also using various types of sensing units. In this research work, an improved GW damage localization technique with sector-based elliptical (SEC) methodology is developed to localize damages in various structures. The research also showcases quick damage detection and damage quantification methods. The SEC effectively identified damage at multiple locations, sizes, and types. The technique originally developed for piezoelectric sensors and laser Doppler vibrometry (LDV)-based scanning points were later applied to the GW sensing study using fiber optic Bragg grating (FBG) sensors.

The implementation of hybrid FBG-PZT sensors in damage identification is also carried out in this research using the proposed method. The use of remote FBG bonding and direct bonding strategies for GW sensing is also studied along with the application of the varying bond (adhesive) line length as a parametric factor. The proposed damage identification multi-step methodology was also tested on numerical finite element models (FEM) to validate the experimental FBG-PZT studies.

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