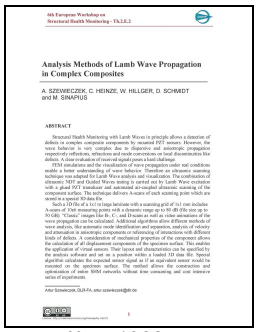

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Analysis Methods of Lamb Wave Propagation in Complex Composites

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Structural Health Monitoring with Lamb Waves in principle allows a detection of defects in complex composite components by mounted PZT sensors. However, the wave behavior is very complex due to dispersive and anisotropic propagation respectively reflections, refractions and mode conversions on local discontinuities like defects. A clear evaluation of received signals poses a hard challenge.

FEM simulations and the visualization of wave propagation under real conditions enable a better understanding of wave behavior. Therefore an ultrasonic scanning technique was adapted for Lamb Wave analysis and visualization. The combination of ultrasonic NDT and Guided Waves testing is carried out by Lamb Wave excitation with a glued PZT transducer and automated air-coupled ultrasonic scanning of the component surface. The technique delivers A-scans of each scanning point which are stored in a special 3D data file.

Such a 3D file of a 1x1 m large laminate with a scanning grid of 1x1 mm includes A-scans of 10e6 measuring points with a dynamic range up to 80 dB (file size up to 50 GB). "Classic" images like C-, and D-scans as well as video animations of the wave propagation can be calculated. Additional algorithms allow different methods of wave analysis, like automatic mode identification and separation, analysis of velocity and attenuation in anisotropic components or referencing of interactions with different kinds of defects. A consideration of mechanical properties of the component allows the calculation of all displacement components of the specimen surface. This enables the application of virtual sensors. Their layout and characteristics can be specified by the analysis software and set on a position within a loaded 3D data file. Special algorithm calculates the expected sensor signal as if an equivalent sensor would be mounted on the specimen surface. The method allows the construction and optimization of entire SHM networks without time consuming and cost intensive series of experiments.

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Ключевые слова:

Содержание