EXPERIMANTAL AND NUMERICAL STUDY OF ELASTIC PLATE WAVE PROPAGATION FOR STRUCTURAL HEALTH MONITORING

Bernd Köhler, Frank Schubert, Norbert Meyendorf

Fraunhofer IZFP-D, Krügerstrasse 20, 01326 Dresden

Lamb waves have been discussed extensively in the past few years as an effective mean for wide area damage detection in plate-like structures. Automatic damage detection systems can be designed exciting and receiving Lamb waves by appropriate built in or surface mounted transducers. In the simplest case the damage is identified by comparing sensor signals before and after the damage event. The difference is the scatter signal originating from the defect.

Efficient structural health monitoring along this line requires a clear understanding of the wave phenomena involved. Dispersion of the Lamb waves in the damage free plate, scattering at structures like stringers and scattering at damaged areas must be studied. For layered composite materials also the influence of the deviation from elastic isotropy has to be estimated.

The wave propagation phenomena were studied by numerical and experimental methods. For numerical analysis the Elastodynamic Finite Integration Technique (EFIT) is applied. On the experimental side a non-contact detection technique using a modified laser vibrometer is used for visualizing wave propagation.

It is demonstrated, how wave modes can be exited selectively and how the directivity of the modes can be influenced. This is done for metallic structures containing stringers and for complex plates of fiber reinforced plastics.

Key words: Lamb waves, structural health monitoring, visualization, transducer, impact damage.