

Approaches for localization of damage in composites using propagation of Lamb waves

Kaleeswaran Balasubramaniam^{*,1, a}, Tomasz Wandowski^{1,b}, Pawel Malinowski^{1,c}

¹Institute of Fluid Flow Machinery ,Polish Academy of Sciences
Department of Mechanics of Intelligent Structures,
Fiszera 14, 80-231, Gdansk –Poland.

Email: ^{a,*} kaleeswaranb@imp.gda.pl, ^b tomaszw@imp.gda.pl, ^c pmalinowski@imp.gda.pl
Web page : <https://www.imp.gda.pl/en/o4/z1/>

ABSTRACT

Keywords : composites, SHM, numerical simulation, Lamb waves, guided waves

Composites are now commonly used in various industries ranging from building to space science. The damage analysis in composites is an important task to ensure safe uses and prevent failures. Structural health monitoring (SHM) approaches are developed to identify the damage in various structures.

This research focuses on the guided wave-based SHM. The guided waves of the SHM method propagates throughout the material and gets reflected at the obstacles or after reaching the boundaries. This is the basis for the damage detection method. The elliptical and hyperbolic approaches are studied here with which the time of flight for the healthy,damage cases are analysed. The frequency range of 200 kHz is used with a periodic cycle of 5 to analyse the wave pattern over the surface of the composite material. Thus, the change in the signals can be extracted through the developed algorithms and the damage location can be indicated. The studies comprised of scanning laser measurements as well as piezo sensors-based studies. A simple composite GFRP plate was studied as well as a plate with a L-stiffener. The damage localisation algorithms were employed for simulated damage as well as for stiffener disbonding. The studied comprised both on experimental works as well as numerical based on commercially available finite element method (FEM) calculation software. The combined analysis from the experimental and the numerical calculations provides further information about the damage location and its influence on the wave propagation.