World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:10, No:03, 2016

Excitation of Guided Waves in Finite Width Plates Using a Numerical Approach

Authors : Wenbo Duan, Hossein Habibi, Vassilios Kappatos, Cem Selcuk, Tat-Hean Gan

Abstract : Ultrasonic guided waves are often used to remove ice or fouling in different structures, such as ship hulls, wind turbine blades and so on. To achieve maximum sound power output, it is important that multiple transducers are arranged in a particular way so that a desired mode can be excited. The objective of this paper is thus to provide a theoretical basis for generating a particular mode in a finite width rectangular plate which can be used for removing potential ice or fouling on the plate. The number of transducers and their locations with respect to a particular mode will be investigated, and the link between dispersion curves and practical applications will be explored. To achieve this, a semi-analytical finite element (SAFE) method is used to study the dispersion characteristics of all the modes in the ultrasonic frequency range. The detailed modal shapes will be revealed, and from the modal analysis, the particular mode with the strongest yet continuous transverse and axial displacements on the surfaces of the plate will be chosen for the purpose of removing potential ice or fouling on the plate. The modal analysis is followed by providing information on the number, location and amplitude of transducers needed to excite this particular mode. Modal excitation is then implemented in a standard finite element commercial package, namely COMSOL Multiphysics. Wave motion is visualized in COMSOL, and the mode shapes generated in SAFE is found to be consistent with the mode shapes generated in COMSOL.

Keywords : dispersion analysis, finite width plate, guided wave, modal excitation
Conference Title : ICNTE 2016 : International Conference on Nondestructive Testing and Evaluation
Conference Location : Madrid, Spain
Conference Dates : March 24-25, 2016