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Investigation of Guided Ultrasonic Waves in Fiber Metal Laminate using Integrated Fiber Bragg Grating in Different Orientations and Damaged Conditions.

ABSTRACT - Masterthesis

Fibre metal laminates (FML) are light weight high strength materials that are being used to reduce the weight of different aircraft structures heavily which will also reduce the substantial amount of fue1 cost. Despite having a lot of benefits FMLs are rarely used in large scale applications. For several years, structural health monitoring (SHM) techniques for FML have been researched with a lot of efforts in order to solve this problem. Literature research was conducted on various types of fibre metal laminates and their background history, as well as SHM methodologies and procedures in this thesis.

This research carefully investigates and compares ultrasonic guided waves detection by using two different sensors. Ultrasonic guided waves generated by Vallen transducer were propagated through carbon fibre reinforced plastic steel laminate (CFRP-steel) and detected by fibre Bragg grating (FBG) sensors and piezoelectric wafer active sensor (PWAS). The schematic layout between actuator and sensors has been designed to investigate and detect the guided waves under normal and artificial damaged conditions. Experimental layout has been implemented to investigate the direction dependency of FB G in comparison with PW AS. Time of flight of both sensors has also been discussed. Characteristics of both FBG and PW AS sensors has been compared systematically in ultrasonic guided wave detection.

It is constructed from the results that both FBG and PW AS sensors can be employed to detect guided ultrasonic waves in CFRP-Steel laminates. Also the orientation of FBG has an influence on the detection of the guided waves. Furthermore, it has also been investigated whether position of the damage on the plate has an influence on the detected signals.