Identification of Local Defect Resonances using global and local mode separation procedure

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ABSTRACT

The increasing use of advanced materials requires accurate and complex health monitoring techniques for assessing structural integrity. Among them, a novel non-invasive method that uses ultrasonic frequency excitation tuned to the defect to activate its resonant response was proposed. The principle behind this is that embedded defects result in a local loss of stiffness that gives rise to characteristic resonant frequencies of the defect itself, known as Local Defect Resonances (LDR). The article deals with the identification and characterization of LDRs. The idea of the method assumes that the damaged area is characterized by different local structural parameters than the undamaged area. These parameters depend mainly on the location of the area, its geometry, and changes in structural parameters due to damage. Broadband, high-frequency excitation generated by a low-profile piezoelectric transducer was used to detect LDR areas in damaged structures. A non-contact measurement method - laser vibrometry - was used to measure the response signal. Frequency characteristics were determined for individual points of the measurement grid. Then, local and global vibration modes were separated using an algorithm based on comparing local amplitudes and global vibration amplitudes. On this basis, damage maps were developed, showing the location and approximate geometry of the damage. The results were compared with the damaged structure model.