Investigation of Interactions of Lamb Waves with Corrosion Damage in Plate Structures

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Corrosion damage changes the wave propagation signatures of Lamb waves. In general, several characteristics are effected by the damage such as the signal amplitude and the time of flight. New wave features can also be generated as the result of the wave interaction with the damage, which include reflected signal as well as new wave modes due to mode conversion. These characteristics and features have been extensively studied in the past and utilised to develop corrosion monitoring and evaluation techniques based on ultrasonic Lamb waves for certain shapes of damage, e.g. blind hole or uniform loss of plate thickness. However, corrosion has many driving mechanisms and appearances. Even for the same structure, loading and environmental conditions the shape of damage can vary significantly. Therefore, the practical applications of the developed techniques have many limitations and may be ineffective if the shape of the actual corrosion damage is very different from the one tested and evaluated in laboratory conditions. The current work systematically investigates the effect of the shape and dimensions of corrosion damage on the wave propagation signatures of Lamb waves using the Finite Element Method. The outcomes of numerical simulations are validated by experimental studies for several damage configurations and Lamb wave excitation parameters. The ultimate objective of the current work is to identify the set of quantitative characteristics and features generated by the wave interactions with various damage types and shapes, which can help improving the reliability and confidence in the detection and evaluation of corrosion damage for the purpose of Non-Destructive Testing and structure Health Monitoring.