Global fault detection in adhesively bonded joints using artificial intelligence

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Abstract-

In general, non-destructive evaluation is applied to detect and localize structural faults using a signal with a wavelength smaller than the detected fault. But the method requires analyzing the object in numerous small sections to detect the damage. Non-invasive diagnosis methods for fault detection are used in different industrial sectors. In this work, the main focus is on global fault detection for structural mechanical components such as a bonded beam using artificial intelligence, i.e., neural nets. Therefore, the fault detection procedure requires only a global measurement in the structural component in operational conditions. An experimental setup using two aluminum beams bonded with an adhesive was used to simulate a bonded joint. Different sizes of adhesive surface simulate faults in the original adhesive joint. Thereafter, resonance frequency shifts in the Frequency Response Functions (FRFs) were used to detect structural faults. Damage in structures causes small changes in the structural resonances. Then, the FRFs were used as an input into an artificial supervised neural network. This work considers global non-destructive tests focused only on the soundness estimation of the system. The neural network involved is a supervised feed-forward network with Levenberg-Marquardt backpropagation algorithm, which classifies the beams in four clusters. The classification consists in beam damaged or not damaged. If the beam is damaged the intensity of the fault is established.

Index Terms- Neural networks, fault diagnosis, Frequency Response Functions (FRFs), bonded joints

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