The vibrational response of a turbine blade under thermosonic excitation

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Abstract
Thermosonics is a rapid and potentially cost-saving NDT screening technique. The reliability of the thermosonic technique is not well established for inspecting complex components, such as turbine blades. In particular the vibrational energy generated within a component during a thermosonic test is often highly non-uniform, leading to the possibility of missing critical defects. This paper presents a methodology, using a combination of vibration measurements and finite element analysis (FEA), to model the vibrational energy within a turbine blade in a typical thermosonic inspection scenario. Laser vibrometry measurements were used to determine the steady-state vibration response at several locations on a blade and used to identify the prominent spectral components. These were then used to generate an excitation function for the FEA approach. After validation of the FEA model, the vibration response across the whole blade was simulated. Finally, the predicted displacement field was used to determine the vibrational energy at every point on the blade which was mapped onto a CAD representation of the blade, thereby highlighting areas on the blade that were below the defect detection threshold.

Keywords: Thermosonics, finite element modelling, vibration analysis, turbine blade