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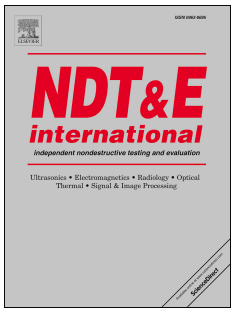

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Assessment methodology of defect characterisation using ultrasonic arrays

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Abstract

There has been a rapid increase in the use of ultrasonic arrays for non-destructive evaluation in recent years and new methods for defect characterisation are now emerging. However, it is also known that defects can show a very different reflectivity depending on their relative location with respect to the array. In this paper, a mapping approach is introduced to evaluate the spatial performance of characterisation methods against a range of key variables including crack size and orientation, as well as to explore the influence of structural noise. This spatial method takes advantage of computer power and fast hybrid modelling techniques to simulate crack-like defects at different locations on a mesh-grid in front of the array and apply the characterisation method of interest to each simulated defect separately. As a case study, the spatial mapping procedure is applied to a characterisation method based on the measurement of the scattering matrices and comparison with a pre-computed database. Dramatic spatial performance variations are observed in the simulations and this is corroborated experimentally. These performance variations are explained by a combination of the defect signal-to-noise-ratio (SNR) and the feature density of the scattering matrix (S-matrix) of the defect. Optimal characterisation performance being achieved when both the SNR and the S-matrix feature density are high.

1 Introduction

When solid structures go through normal operating conditions such as temperature and humidity fluctuations and fatigue loading, defects such as cracks can be produced that can eventually cause structural failure [1]. Therefore, reliable inspection and maintenance during