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A Hybrid Technique for Modelling the Ultrasonic Response from Surface-Breaking Defects

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Computational modelling is an efficient and cost effective alternative to experimental data collection for the design and justification of ultrasonic non-destructive inspections. Semi-analytical models are commonly used within the nuclear industry, however they place limitations on the size and geometrical complexity of the defect that can be modelled, as well as on inspection parameters such as mode and frequency. The inability to quantify the effect of increased complexity on an ultrasonic inspection regularly leads to a rise in the conservatism of the inspection sensitivity, which increases the probability of reporting innocuous defects.

The Finite Element Method (FEM) provides the capability to model elastic wave scattering from complex defect morphologies in 2D and 3D. However, the use of FEM for simulating a complete ultrasonic inspection is limited by the associated computational cost. Recent work on a finite element – semi-analytical hybrid model has unified the strengths of both semi-analytical and numerical methods to provide the capability to efficiently model the ultrasonic inspection of complex defects. It is commonly required for ultrasonic inspections to detect and characterise surface-breaking defects. The work presented here extends the efficient hybrid model approach to simulate the bulk wave inspection of surface-breaking defects. The model can be used to investigate the scattered signals from surface-breaking defects in a typical inspection scenario and provides a means to investigate the effect of defect morphology on inspection performance.

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