Quantifying Performance of Ultrasonic Immersion Inspection Using Phased Arrays for Curvilinear Disc Forgings

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Use of full-matrix capture (FMC) combined with the total focusing method (TFM), has been shown to provide improvements to flaw sensitivity within components of irregular geometry[1][2]. Ultrasonic immersion inspection of aerospace discs requires strict specifications to ensure full coverage – one of which is that all surfaces should be machined flat. The ability to detect defects through curved surfaces, with an equivalent sensitivity to that obtained through flat surfaces could bring many advantages. In this work, the relationship between surface curvature and sensitivity to standard defects is quantified for various front wall radii. Phased array FMC immersion inspection of curved components was simulated using finite element modelling, then visualized using surface-compensated focusing techniques. This includes the use of BRAIN software developed at the University of Bristol, and cuART developed by the University of Strathclyde. Modelling results were compared to experimental data from a series of test blocks with a range of curvatures, containing standard defects. The sensitivity to defects is evaluated by comparing the performance to conventional methods. Results are used to highlight the benefits and limitations of these methods relating to the application area of aerospace engine disc forgings.

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References: