The Development of a 2D Ultrasonic Array Inspection for Single Crystal Turbine Blades (Springer Theses)

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This thesis describes the development of a new technique to solve an important industrial inspection requirement for a high-value jet-engine component. The work – and the story told in the thesis – stretches all the way from the fundamentals of wave propagation in anisotropic material and ultrasonic array imaging through to device production and site trials. The book includes a description of a new method to determine crystallographic orientation from 2D ultrasonic array data. Another new method is described that enables volumetric images of an anisotropic material to be generated from 2D ultrasonic array data, based on measured crystallographic orientation. After extensive modeling, a suitable 2D array and deployment fixtures were manufactured and tested on in situ turbine blades in real engines. The final site trial indicated an order of magnitude improvement over the best existing technique in the detectability of a certain type of root cracking.

The Development of a 2D Ultrasonic Array Inspection for Single Crystal Turbine Blades should be an inspiration for those starting out on doctoral degrees as it shows the complete development cycle from basic science to industrial usage.

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