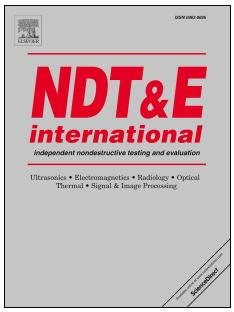
Accepted Manuscript



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PII: S0963-8695(18)30078-1

DOI: 10.1016/j.ndteint.2018.02.002

Reference: JNDT 1952

To appear in: *NDT and E International*

Received Date: 7 July 2016

Revised Date: 7 August 2017

Accepted Date: 5 February 2018

Please cite this article as: Ramatlo DA, Wilke DN, Loveday PW, Development of an optimal piezoelectric transducer to excite guided waves in a rail web, *NDT and E International* (2018), doi: 10.1016/j.ndteint.2018.02.002.

Development of an Optimal Piezoelectric Transducer to Excite Guided Waves in a Rail Web

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Abstract

Ultrasonic transducers have demonstrated the ability to effectively excite guided waves that can propagate over long distances and are thus employed in monitoring systems. An ultrasonic piezoelectric transducer that strongly excites a mode travelling in the web of the rail is required to detect cracks in the rail web. A numerical method referred to as the Coupled Semi-Analytical Finite Element - 3 Dimensional Finite Element (Coupled SAFE-3DFE) method is employed to model the excitation of guided waves in a rail by a transducer. The aim of this study is to demonstrate that the Coupled SAFE-3DFE method used in conjunction with mathematical optimization methods, can automate the optimal design of a transducer. The optimal transducer was constructed and experimental measurements were found to agree with the predicted performance.

Keywords

Guided Waves, Coupled SAFE-3DFE, Piezoelectric Transducer, Optimization, Response Surface