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Electro Thermal Modeling for Defect Depth Estimation in Quadratic Frequency Modulated Thermal Wave Imaging

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Infrared thermography for subsurface analysis is gaining interest due to its whole field, non-contact and non destructive testing modality. Motivated by its depth resolution and low peak power stimulation, recent past witnessed a tremendous improvement in the research on non stationary coded thermal wave imaging through the introduction of novel processing methods and refinement in its stimulation mechanism. It makes use of stimulated thermal contrast initiated by defect bound in-homogeneity to identify defect signatures, supported by suitable processing methodologies. Various processing methods, numerical and electro thermal modelling have been proposed to obtain thermal response.

This paper proposes a mathematical framework for peak delay dependent correlation based methodology for estimating the defect depths using recently proposed quadratic frequency modulated thermal wave imaging. It employs an electro-thermal modelling and extracts mathematical analysis for peak delay to estimate defect depth using a RC ladder network. The proposed method has been validated through a finite element based numerical modelling using flat bottom holes embedded in a mild steel specimen.

Keywords: Infrared thermography, Correlation analysis, Electro thermal modeling, Peak delay, Depth estimation.