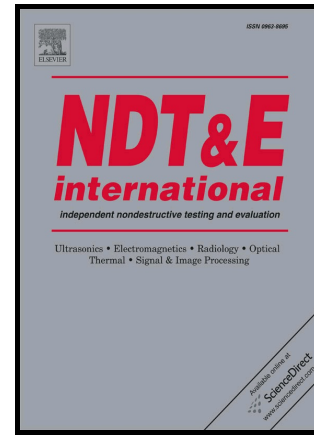


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Pulse-modulation Eddy Current Probes for Imaging of External Corrosion in Nonmagnetic Pipes

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Abstract:

Since the nonmagnetic pipe is normally utilized in corrosive and hostile environment, it is prone to the external corrosion which occurs on the outer surface of the pipe and severely undermines the structural integrity and safety. Although Pulsed eddy current technique (PEC) is currently preferred for detection and evaluation of subsurface defects in tubular conductors, it is subject to technical drawbacks. In light of this, Pulse-modulation Eddy Current technique (PMEC) is intensively investigated in the paper for enhancement of the evaluation sensitivity to external corrosion and accuracy of corrosion imaging. Closed-form expressions of the PMEC response and its sensitivity to external corrosion in tubular conductors are formulated via the Extended Truncated Region Eigenfunction Expansion (ETREE) modeling. Following simulations for analysis and comparison of field signals and evaluation sensitivities of PMEC and PEC, experiments of PMEC for evaluation and imaging of external corrosion are carried out. Through theoretical and experimental investigation, it has been found that regarding the evaluation and imaging of external corrosion in nonmagnetic pipes, the PMEC-based probe have higher sensitivity and imaging accuracy than that based on PEC. The superiority of PMEC to PEC in inspection of tubular conductors is further identified.

Keywords: electromagnetic non-destructive evaluation; pulse-modulation eddy current technique; tubular conductor; corrosion imaging; sensitivity analysis

1. Introduction

Nonmagnetic pipes usually employed in such mechanical structures as airplanes, nuclear power plants, oil-production wells, etc. are prone to corrosion in the external surfaces of pipes (namely external corrosion) because of hostile and corrosive environment. Since external corrosion conceals itself inside in-service structures, it poses a severe threat to the structural integrity, and is one of the

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