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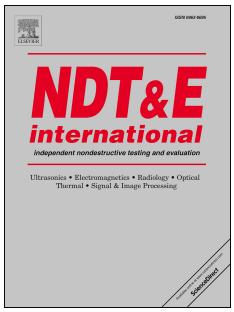

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Analytical Model of the Eddy Current Response of a Drive-Receive Coil System inside Two Concentric Tubes

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Abstract— A semi-analytical model of the eddy current response of a drive-receive coil configuration inside two conducting concentric tubes, where the coil axes are perpendicular to the inner tube's surface, is solved using the second-order vector potential formalism. This model determines the voltage response in the receive coil under a constant amplitude alternating drive voltage, accounting for all possible coupling terms in the system. Modeled receive coil voltage responses to changes in outer tube diameter, greater than the drive-receive coil spacing, are compared with experimental measurements and finite element method (FEM) modeling in the impedance plane. Analytical model results are found to be in excellent agreement with both experiment and FEM model results, thereby verifying the solutions.

Index Terms—Eddy current, analytical model, second order vector potential, nondestructive testing

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