DETERMINING THE STEP-CHANGE CONDUCTIVITY PROFILES WITHIN LAYERED METAL STRUCTURES USING INDUCTANCE SPECTROSCOPY

Wuliang Yin[1,2] and Anthony J Peyton

[1]School of Electrical and Electronic Engineering, University of Manchester, M60 1QD, UK

[2] School of Automation, Tianjin University, Tianjin, China

Email: wuliang.yin@manchester.ac.uk

Abstract – This paper presents an inverse method for determining the conductivity distribution of a flat, layered conductor using a multi-frequency electromagnetic sensor based on phase signature alone. Eddy current sensors are used in a wide range of non-destructive testing (NDT) applications. Single frequency sensors are very common, however, the potential of an eddy current sensor with spectroscopic techniques offer the ability to extract depth profiles and examine more fully the internal structure of the test piece. In this paper, we found a simplified model that can estimate the phase signature of a cylindrical coil above a conductor with an arbitrary conductivity profile. This simplified model improves the computational efficiency by many fold compared to the complete analytic solution. For inverse solution, a simplex search method was used to fit a set of multi-frequency phase values in a least-squared sense. Experimental eddy-current tests are performed by taking the difference in inductance of the coil when placed in free space and next to a layered conductor over the range 100Hz -1MHz. Good estimates for the conductivity profile from experimental and simulated data were obtained.