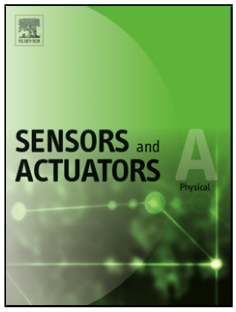

Title: Eddy Currents Testing Probe With Magneto Resistive Sensors and Differential MeasuRement

Author: Luis S. Rosado Filipe A. Cardoso Susana Cardoso Pedro M. Ramos Paulo P. Freitas Moisés Piedade

PII: S0924-4247(14)00137-X
DOI: http://dx.doi.org/doi:10.1016/j.sna.2014.03.021
Reference: SNA 8722

To appear in: *Sensors and Actuators A*

Received date: 10-9-2013
Revised date: 13-3-2014
Accepted date: 14-3-2014

Please cite this article as: L.S. Rosado, F.A. Cardoso, S. Cardoso, P.M. Ramos, P.P. Freitas, M. Piedade, Eddy Currents Testing Probe With Magneto Resistive Sensors and Differential MeasuRement, *Sensors and Actuators: A Physical* (2014), http://dx.doi.org/10.1016/j.sna.2014.03.021

EDDY CURRENTS TESTING PROBE WITH MAGNETO-RESISTIVE SENSORS AND DIFFERENTIAL MEASUREMENT

Luis S. Rosado[1,2,3], Filipe A. Cardoso[4], Susana Cardoso[1,4], Pedro M. Ramos [1,3], Paulo P. Freitas[1,4], Moisés Piedade[1,2]*

[1] IST Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisbon, Portugal

[2]INESC-ID Instituto de Engenharia de Sistemas e Computadores Investigação e Desenvolvimento,1000-029 Lisbon, Portugal

[3] IT Instituto de Telecomunicações, 1049-001 Lisbon, Portugal

[4] INESC-MN Instituto de Engenharia de Sistemas e Computadores Microsistemas e Nanotecnologias, 1000-029 Lisbon, Portugal

* Corresponding author e-mail address: luis.rosado@ist.utl.pt

Abstract - Magneto-resistive (MR) sensors have been applied for Eddy Currents Testing (ECT) usually in the inspection of buried defects (at low frequency operation) but they can also be used for the detection of surface breaking defects using higher frequencies. Although the MR sensors bandwidth is high (up to hundreds of MHz), the operating frequency of eddy current probes using these MR sensors is usually much more limited. The presence of inductive coupling in the sensors interconnections results in an additional voltage contribution to the measured signal whose frequency is equal to the primary magnetic field and whose amplitude therefore increases with frequency. Depending on the probe design, this undesired voltage contribution can surpass the sensor response when the selected operating frequency is moderately high. In this paper, a MR sensors based EC probe designed for the detection and characterization of surface breaking defects is presented. The probe and the measurement setup were designed to evaluate two compatible techniques targeting the reduction of the inductive coupling on the measured signals and thus enabling higher frequency operation. One measurement technique relies on using two sensors in a differential measurement while the other technique employs heterodyning principles to generate a low frequency component to recover the magnetic field detected by the sensors. The results using the employed techniques improved by more than 20 dB the signal to noise ratio at which defects can be detected and by around 70 times the relative variation of the measured signal when operating at 100 kHz. An application result in friction stir welding samples demonstrates the ability to detect crack defects with depth around 400 μm.

Keywords - Magneto-Resistive Sensors; Eddy Current Testing; Non-Destructive Testing; Differential; Heterodyning.