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Uniform eddy current probe based on GMR sensor array and image processing for NDT

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Abstract: The utilization of uniform eddy current techniques to detect anomalies in conductive plates represents an important issue. This article presents novel uniform eddy current probe architecture with a planar excitation coil and a magnetic field sensing array of GMR magnetometer sensors. A set of PXI modular instruments, the designed and implemented uniform eddy current probe and an X-Y scanning system are part of a non-destructive testing (NDT) system used to detect, localize and characterize defects associated with the tested conductive plates. Sinusoidal excitation is applied to the planar spiral rectangular coil of the sensor while a set of GMR magnetometer sensors detects the induced magnetic field in specimens under test. The usage of the GMR magnetometer sensor array as part of the uniform eddy current probe reduces the testing time and increases the reliability of the system, avoiding defect detection failure. Considering the dispersion of the GMR sensors characteristics a practical approach concerning the magnetic biasing and appropriate image processing techniques including image filtering, background subtraction image merging, 2D correlation for the merged image and a 2D template matching are included in the paper.

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☰ Contents

I. Introduction

Non-destructive testing of metallic nonmagnetic materials such as aluminum is a growing area that requires novel sensing solutions. Nowadays the NDT is entering in a new era replacing the traditional inductive sensors [1] [2] [3] of the eddy current probes (ECP) characterized by fully coupled architectures by new sensors that combine solid state magneto resistive sensors (anisotropic magneto resistance-AMR, "giant" magnetoresistance - GMR, tunneling magnetoresistance-TMR) [4]–[5] as detection component and planar PCB coils as excitation component [6] [7].

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