Editorial

Special issue on the progress of eddy current based nondestructive testing

Stepping into a new century, the International Journal of Applied Electromagnetics and Mechanics wanted to address the present situation and prospective in a field of ever-increasing interest among industrial users – that is in an applied field as is characteristic for our journal. The domain of this special issue is chosen as the nondestructive testing performed by means of eddy current inspection techniques. For the purpose was addressed, several of the most advanced research teams in this field are invited to contribute accounts of present and future developments in this area.

Both the aspects of the forward problem (Numerical Simulation of the ECT signals) and inverse problem (flaw characterization and shape reconstruction) were considered in the papers presented in this issue.

The paper by Albanese, Tubinacci, Tamburrino and Villone describes an efficient forward scheme based on an integral formulation in terms of two-component current density vector potential expanded over edge-elements. The examples include simulation of crack signals from widely used magnetic sensors – all compared with experimental results. The inverse problem is addressed both by genetic algorithm approach and by a method taken from digital communications application (as the search for the shortest path on a proper trellis – presented in part 4.1).

The second paper (Yusa, Chen, and Miya) focuses on inversion of the eddy current signals by means of both artificial neural networks and deterministic inverse strategy. After reviewing the developments in this technique (with emphasis on the research performed by teams in Japan), the paper describes a novel technique that is capable to tackle reconstruction of cracks with contacted surface. The accuracy of the proposed method has been further enhanced by applying the shift aperture algorithm and signal processing techniques.

Next invited paper (Xiang, Ramakrishnan, Cai, Ramuhalli, Polikea, S. Udpa and L. Udpa) address an automatic technique for characterization of the eddy current testing signals by using the rotating multi-frequency probe. After data preprocessing and conditioning, a process of relevant feature extraction from the data is set up by means of a decision tree application. Furthermore, a neural network is used to identify signals from different defect types as well as from flawless structures in a classification process. The final step represents a blind deconvolution based characterization stage in order to accurately estimate size and orientation of the defect. The presented approach looks like a very promising one for the automatic characterization of ECT signals.

The last invited paper (Dobmann) focused on application the eddy current technique to the inspection of material degradation and damages. As all micro-magnetic NDT techniques are based on a cyclic magnetization of a certain volume of the material under inspection – ECT inspection of ferromagnetic material can be seen as a micro-magnetic technique magnetizing the material in the reversible regime. An important material parameter, – incremental permeability, is successfully measured by integrating the ECT and the micro-magnetic techniques. A 3MA approach (Micro magnetic, Multiple parameter, Microstructure, and Stress Analysis) – introduced by the Fraunhofer Institute for NDT, has been also applied in the system integration of this new technique.
It is the editor's hope that the selected papers can provide basic understanding on the present status of the ECT researches, and stimulating the research activities for its further progress.

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