Models coupling for fast simulation and diagnostic applied to electromagnetic non-destructive evaluation

Christophe Reboud[1], Roberto Miorelli[1], Xavier Artusi[1], Anastassios Skarlatos[1], Edouard Demaldent[1]

[1]Departement Imagerie Simulation pour le Controle, CEA LIST, France

Low frequency electromagnetic techniques like eddy current testing or Magnetic flux leakage are widely used in many industrial sectors for flaw detection and characterization. Efficient modelling of such techniques proves very useful for many purposes like probe design, performance demonstration of a procedure or sensitivity studies for instance. This communication presents the strategy followed at CEA LIST for designing fast and robust diagnostic tools based on simulation, which combines three key steps. The first one is a coupling of electromagnetic models to benefit from speed and accuracy of semi-analytical methods and the generality of numerical ones. The second step consists in accurately approximating, in a specified range of inputs variations, the forward solver with a metamodel able to generate signals in quasi real time. To achieve this, a database of simulated signals is firstly built in an adaptive way, and then a regressor is fitted onto it. The metamodel accuracy is checked using a cross-validation process implemented into the CIVA software developed at CEA LIST. Finally, the metamodel can be intensively evaluated in order to perform flaw classification or characterization by means of iterative or non-iterative techniques. Results obtained in different industrial applications of eddy current testing will be presented and discussed.