4.5.13. SIMULATION OF COMPLEX ULTRASONIC NDT CASES USING COUPLED ANALYTICAL-NUMERICAL METHOD: THE MOHYCAN PROJECT

Mahaut S., Leymarie N., CEA, LIST, Gif-sur-Yvette, France;
Fouquet T., Dupond O., EDF EDF/R&D, Clamart, France;
Bonnet-Ben Dhia A.-S., Joly P., Collino F., POEMS, Paris Cedex, France;
Foucher F., CEDRAT, Meylan, France

Introduction. The simulation of Non Destructive Testing (NDT) plays an increasing role as it provides, for instance, an efficient way to conceive and optimise NDT methods or probes, to help for data interpretation, and to support inspection qualifications. In order to assess such ambitious objectives, different modeling strategies may be involved : analytical, semi-analytical (namely, integral techniques), numerical techniques (finite elements, finite differences…). Although semi-analytical techniques lead to accurate results within reduced computation times and memroy burden, their application is somewhat restricted within their range of validity. Usually, semi-analytical techniques aim at predicting specific phenomena involved in the NDT response, which both allows to get accurate and fast results. Pure numerical techniques offer a wider range of applications, as they solve the exact wave propagation equations within the whole space of the NDT configuration. But those techniques exhibit more important computation times and memory load, which may be a limitation, especially for 3D applications.

In order to get advantage of both approaches (computation efficiency of semi-analytical techniques and genericity of numerical techniques), the MOHYCAN project (Hybrid MOdeling and Coupling Analytical/Numerical method for ultrasonic NDT simulation), supported by the ANR (National Research Agency in France) aims at extending the features of ultrasonic NDT simulation tools to deal with 3D industrial, and potentially complex configurations.

Results. In order to assess such configurations, the MOHYCAN project is based on a coupling method between a semi-analytical code (developed at CEA, LIST) to predict the radiated field, and a numerical method (Finite Element: Athena module, developed at EDF) performed in a restricted area around the flaw. This hybrid method is based on coupling boundary conditions modified with respects to prior studies. The modification of the coupling conditions, as proposed by POEMS, allow to greatly reduce the size of the FEM box, which may be as close as possible to the flaw, which was not possible with previous coupling conditions. This modification has been first achieved on the 2D hybrid code.

In order to handle 3D configurations, developments have been carried out to build a parallel code allowing to run the FEM calculations over different hardware configurations (standard PC or clusters) in order to take advantage of their resources. Finally, a series of experimental validations will be performed during the project in order to validate the simulation tools prior to their integration inside CIVA.

Application to complex industrial configurations. In the second part of the paper, several examples of application of the simulation tools described in the first part will be given for illustrating their capabilities. Simulation results shown will address both standard and more complex cases, as well as experimental validations upon 2D or 3D representative industrial configuration cases.