

SIMULATION OF GUIDED WAVES SHM SYSTEM IN CIVA PLATFORM

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Abstract

Guided Waves (GW) show a great potential to inspect large composite structures from a limited number of transducers point thanks to the capability of these waves to propagate over large distances. However, the multimodal and dispersive nature of GW, combined with the anisotropic nature of composite materials makes it difficult to analyze and interpret the signals. Predicting the response of a guided wave SHM system in industrial configuration with complex geometries is therefore very difficult, which is a serious impediment for the development of such technology.

This has motivated the development at CEA LIST of a simulation tool dedicated to GW inspection implemented in the version 11 of CIVA software. This guided wave module allows to simulate, using an hybrid modal/finite element formulation, the full inspection configuration: transducer generation, guided wave propagation, diffraction by the defect and reception by the transducer. The signal that would be measured in in pulse-echo or pitch-catch configurations can therefore be determined. This is can be used to optimize the experimental setup and to predict the inspection system performances before any long and costly experimental campaigns.

However, in CIVA 11 GWT, the implemented models have some limitations that restrict the practical use of the module for composite plates that are typical of aeronautic structures: at the present time, the material is limited to (multilayered) isotropic and only 2D simulations are possible for plate-like structures.

We present here the current capabilities of CIVA software and the developments in progress that will be integrated into future versions of CIVA GWT for SHM:

- Multilayered anisotropic material
- Complete 3D composite plate simulation of inspections with realistic source (PZT transducer) and defects
- Probability of Dispersion (POD) curves determination of the inspection system using simulation

The presentation will be illustrated with different simulation examples of inspection systems using guided waves (corrosion detection, delamination, debondings of stiffener).