Defect sizing in composite structure using deep neural networks and kernel methods in SHM

Clément Fisher[1], Roberto Miorelli[1], Olivier Mesnil[2], Oscar D'Almeida[3]

[1]NDE Department, CEA-List, France, [1]NDE department, CEA-List, France, [1]Sensor and applications, Safran Tech, France

In Guided Wave Structural Health Monitoring (GW-SHM), structures are instrumented by sparse transducers arrays to detect defects through the tiny change induced by the presence of a defect on the GW propagation within the structure. Due to the complexity of the GW propagation, various post-processing techniques have been proposed to analyze the measurements, among which guided wave imaging (GWI) allows both defect detection and localization at the same time. Defect quantification is also possible with post processing techniques such as guided wave tomography; however, such approaches require a large number of sensors and a good knowledge of the specimen to achieve the quantification, hence are not applicable in uncontrolled environment and if the number of sensors is limited. Moreover, defect sizing based on image processing techniques is not directly possible from GWI as the images depend on a wide variety of parameters such as transducer positions and number, wavelength of inspection and even defect position. This communication presents the localization and the inversion of defect size based on guided wave imaging acquired with a sparse transducer array on a composite structure with an impact-caused delamination. Two machine-learning approaches are studied: a kernel based method and deep neural network. Both strategies are trained on the same database of several thousands of images obtained with the CIVA software.