An Iterative Design of Experiments Based Data Collection Approach for Ultrasonic Guided Waves

Mark R. Courtier\textsuperscript{1}, Anthony J. Croxford\textsuperscript{1} and Kathryn Atherton\textsuperscript{1}, Department of Mechanical Engineering, University of Bristol, Queen's Building, University Walk, Bristol, BS8 1TR, United Kingdom and \textsuperscript{2}Airbus Operations Ltd., Filton, Bristol, BS34 7PA, United Kingdom

To validate modelling results it is necessary to collect experimental data, in this case ultrasonic guided wave measurements to validate a forward model of an acoustic emission system on a complex structure. Traditionally when ultrasonic data is collected over an area of a structure it is collected in a raster scan. This approach comprehensively covers the area of interest at a desired resolution which is determined by the feature of the signals that needs to be measured. In most cases however the feature of interest, such as a defect or, in this work, a geometrical feature, is only present in a small portion of the measurement region. In the remainder of the region the ultrasonic behavior tends to be more consistent and well understood and therefore this remaining area is effectively oversampled. If the data collection process is fast, then this is not a problem. However, in the case of performing manual guided wave measurements across a large structure, repositioning the transducer is the most time consuming part of the experiment. If the number of measurements taken in the regions where the ultrasonic behavior is simple can be reduced, this will save both time and effort. The approach demonstrated here is based upon the HilomotDoE (Hierarchical Local Model Tree for Design of Experiments) algorithm [1]. The algorithm and therefore the data collection is iterative. In each iteration data points are collected in the region where there is the most difference between the model of the experimental data and the actual experimental data. This means the model is refined in regions where there is the greatest change from a simple polynomial model. This corresponds with taking more experimental measurements in regions where the ultrasonic response is changing the most. This typically corresponds to regions of interest such as geometrical features. The algorithm will be tested on guided wave measurements collected on a real structure and its performance is compared with a raster scan.

Acknowledgement:

Mark Courtier is enrolled in the Engineering Doctorate Programme in NDE at University of Bristol. He is funded by the Engineering and Physical Science Research Council (EPSRC) through the UK Engineering Doctorate Centre in Non-Destructive Evaluation and by Airbus Operations Ltd.

References: