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Operational NDT Simulator, Towards Human Factors Integration in Simulated POD

Damien Rodat¹, Frank Guibert¹, Nicolas Dominguez¹, Pierre Calmon², ¹Airbus Group Innovations, Toulouse, France and ²CEA LIST, Saclay, France

In the aeronautic industry, the performance demonstration of Non-Destructive Testing (NDT) procedures relies on Probability of Detection (POD) analysis. This statistical approach measures the ability of the procedure to detect a flaw with regards to one of its characteristic dimensions. The inspection chain is evaluated as a whole, including equipment configuration, probe efficiency but also operator manipulations. Traditionally, a POD study requires an expensive campaign during which several operators apply the procedure on a large set of representative samples. Recently, new perspectives for the POD estimation have been introduced using NDT simulation to generate data. However, the best approach to take into account the influence of the operator is still under debate. For instance, even if the probe positioning uncertainty can be theoretically modeled, the choice of the underlying probability distribution is often poorly justified. Cognitive aspects are excluded from this approach. To address these difficulties, we propose a concept of operational NDT simulator [1]. This work presents the first steps in the implementation of such simulator for ultrasound phased array inspection of composite parts containing Flat Bottom Holes (FBH). The final system will look like a classical ultrasound testing equipment with a single exception: the displayed signals will come from numerical simulations. Our hardware (ultrasound acquisition card, 3D position tracker) and software (position analysis, inspection scenario, synchronization, simulations) environments are developed as a bench to test the meta-modeling techniques able to provide fast-simulated hyper-realistic ultrasound signals. The early results obtained by on-the-fly merging of real and simulated signals confirm the feasibility of our approach: the replacement of real signals by purely simulated ones has been unnoticed by operators. Thus, we believe this simulator paves the way for significant improvements in POD studies (accuracy, costs, study scope, etc.) but also for richer inspection scenarios in operators training.

References:

1. N. Dominguez and D. Simonet, "Method of simulating operations of Non-Destructive Testing under real conditions using synthetic signals", US Patent 2014/0047934 A1, 20-Feb-2014, (EP Patent 2699895 A1, 26-Oct-2012).