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TITLE: INTEGRATION OF EXPERIMENTAL DATA IN MODEL ASSISTED PROBABILITY OF DETECTION COMPUTATIONS

ABSTRACTS

Probability of detection (POD) is a recognized performance indicator of non-destructive methods in various industrial fields, like Aeronautics or Energy. It consists in calculating the probability to detect a flaw in a specimen according to a characteristic parameter, usually linked to its size. To access this curve experimentally, one needs to establish a design of experiment (DoE) covering a certain range of random effects that may affect the specimen. To be pertinent, this DoE typically involves a quite large number of mock-ups and repeated inspections with different operators, which makes the complete process costly and time consuming. In recent years, the use of simulation has emerged to improve the calculation of PoD curves. This is known as Model-assisted Probability of Detection (MaPoD). The advantages of simulation is its competiveness in terms of cost and speed with respect to experimental approach, as well as its ability to investigate wider ranges of parameters (either characteristic or uncertain) and to produce large datasets that are statistically representative. The main problem with MaPoD in general is its arbitrary description of uncertainty, which has of course a great impact on the calculated POD and relies currently mainly on experts judgments. While some laws of these parameters are well characterized and easily accessible (for example in datasheets), others are more difficult to quantify (human factors). In this work, we propose to enhance and evaluate performance of a Bayesian Inversion implementation to infer the laws of uncertain parameters based on integration of information coming from real experiments. This methodology is evaluated on two use cases. The first one is purely numeric and allows us to access the limit of the method in terms of precision and data requirement to converge to the solution. The second one is experimental and consists in an inspection with an ultrasonic sensor of a planar specimen affected by calibrated defects. We monitor in real time the sensor position parameters (that are uncertain parameters in the context of a manual inspection) thanks to an optical tracking tool. With this system, we have access to the true distribution of uncertain parameters and we can validate the approach experimentally.

KEYWORDS

Probability of Detection | Uncertainty Quantification | Bayesian Inversion | Ultrasound |