ABSTRACTS

One of the challenging issues in aerospace industries is to configure a SHM solution for ageing aircraft structures. This is because of the lack of information regarding the current state of the material properties and the higher likelihood of damage to occur. Principally, when classical NDT actuators/sensors are embedded onto/into structures to perform real-time monitoring of tolerable damages, an SHM-solution is principally obtained. However, in reality this is not that much easy to be realised since most of the NDT techniques are off-line methods meaning they are human based and not implicitly ready for automation. Classical ultrasonic NDT methods like phased array ultrasonics have undergone technological innovations in terms of data acquisition and data representation through the development of Sampling Phased Array (SPA) and Reverse Phase Matching (RPM) methods. These methods have advantages in determining in-situ material properties and result in a comparatively higher probability of damage detection. Unlike the classical ultrasonic methods, where transducers can be virtually moved to any location on a structure, guided waves (GW) based sensing and actuation in SHM is fixed to a ‘static’ actuator/sensor network. In order to detect damages considered to be tolerable efficiently the optimal positions of actuators/sensor need to be identified in advance. To identify those optimal positions numerical simulation is indispensable, allowing something to be generated called differential imaging, that identifies where damage related sensor signals are to be recorded best. Laser Doppler Vibrometry (LDV) has proven to be another efficient tool for monitoring in the recent years often to be used as a means for validation. In addition to this, linear/nonlinear vibrational acoustics combined with thermography have shown a large potential in identifying particular types of damage where the response has been monitoring representative frequencies based on Local Damage Resonance (LDR). When such LDR frequencies are used to excite the ultrasonic actuators, the signal received from the sensors will be sensitive to the given damage to which the LDR frequency refers.

This paper will present how a ‘toolbox’ has to be configured such that approaches used in classical NDT including SPA, RPM and LDR along with numerical simulations can be applied to design SHM system solutions for monitoring isotropic and anisotropic structural parts.

KEYWORDS

SHM, Guided waves, Numerical simulation, vibrational analysis, Phased array ultrasonics