4.2.25. NUMERICAL AND EXPERIMENTAL INVESTIGATION FOR OPTIMUM PLACEMENT OF DIELECTRIC SENSORS TO A COMPOSITE PATCH REPAIRED STRUCTURE

Kalkanis K., Tsamasphyros G., Papathanasiou Th., Kanderakis G.,
The National Technical University of Athens, Athens, Greece

The increasing utilization of composite materials in the aerospace industry is due to the great advantages offered. Nevertheless these applications introduce the need of higher levels in structural integrity identification both during fabrication and in service of the specified materials. In addition the need for decrease of cost dictates more efficient repairs, avoiding replacement of components and simultaneously ensuring safety. The above facts have led to the investigation of combining a repair technique, Composite Patch Repair (CPR), with Structural Health Monitoring (SHM) by dielectric sensors. The initial and most important parameter in such a complex application is to define, given all the parameters set by the mode of repair and the sensing capabilities, the optimal sensor placements onto the flawed structure.

After performing stress analyses and determination/evaluation of the numerical results, an experimental investigation takes place is assessing the practical application. The drilling of stress relieving holes around the area of a crack before the application of CPR is considered. Stress Intensity Factors (SIF) are calculated by utilizing the finite element (FE) method. A representative case of bonded composite repair of a cracked metallic structure is examined and a series of 3D elasticity linear static FE models are developed. SIF reduction is found to be depended on both the holes' diameters and of the holes distance from the crack line. The SIF results taken for an optimally placed set of stress relieving holes show an improvement of SIF reaching a maximum value of 16%. The experiments are designed according to the numerical results but also bearing in mind the possibility of incorporating commercially available sensors in the specified structure geometry. Results demonstrate life increase, and offer the capability of housing commercially available sensors in the specified structure geometry.

Finally, further experimental investigation regarding SHM by dielectric sensors, exhibited identification of initiation as well as cure completion. In general, curing is completed prior to the end of the temperature treatment a fact that can potentially lead to important cost reductions.