Monitoring of Mixed I + II Mode Fatigue Crack Propagation in Adhesively Bonded Joints

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When compared to mechanical joints, such as bolting or riveting, adhesively bonded joints provide a number of advantages, such as reduced weight and improved stress distribution. For this reason, much interest has been devoted in recent years to employing adhesive bonding in an increasing number of applications. Adhesive bonding is being limited in its use for structural joints because of the current lack of established Non-Destructive Testing techniques able to detect, locate and quantify the presence of disbond defect that may arise and develop in the joints during service. This work focused on investigating the effectiveness of different NDT techniques in identifying the crack tip position of a debond damage. To achieve this, fatigue tests were conducted on steel Cracked Lap Shear specimens, which are commonly used to test mixed I+II mode loading in adhesively bonded joints. The techniques employed were Visual Testing, backface strain measuring using Optical Backscatter Reflectometry, and Digital Image Correlation. Each specimen was monitored with two or more of the considered techniques. Visual Testing provided an easy indication of damage growth. Digital Image Correlation provided information about the strain distribution around the debond region. Backface strain measuring was investigated as a non-invasive technique able to detect damage initiation and propagation. A Finite Element Model was developed and validated against the experimental data, and used to interpret the Optical Backscatter Reflectometry results.