Real-Time Phased Array Ultrasonic Monitoring of Debonding Growth Under Cycling Loading in CFRP

Yasemin Sahin Inc[1], Juha Kuutti[2], Kalle Raunio[3], tomi viitanen[3]

[1]Structural Integrity, VTT Technical Research Centre of Finland, Finland, [1]Structral Integrity, VTT Research Centre of Finland, Finland, [1]System and component performance , VTT Research Centre of Finland, Finland

Carbon Fiber Reinforced Polymer (CFRP) composites are widely employed in various industries due to their strength, corrosion resistance, and heat resistance. However, over time, service-induced damage can initiate failure that can threaten the operation's safety and reliability, especially in critical industries like nuclear and aerospace.The composite materials pose challenges to defect detection with Non-Destructive Testing (NDT) methods. Yet, Phased Array Ultrasonic Testing (PAUT) has been proven effective in the examination of complex materials., This study aims to demonstrate the applicability of PAUT for real-time monitoring of debonding growth in a fatigue test. The cyclic load was applied to the test specimens with up to one million cycles, and 64 elements 2 MHz linear PAUT probe were attached to the part. The acquired signals were analyzed and could also be recorded for offline processing or archiving. To validate the results, the performance of the PAUT was compared to that of Acoustic emission (AE), one of the recognized methods to detect and analyze the high-frequency signals generated by the material during deformation or damage, and both methods resulted in a similar trend of debonding growth. Furthermore, the final defect lengths were confirmed by the post-test ultrasonic C-Scans using through transmission technique and visual methods. Real-time monitoring of CFRP structures using phased array technology comprises a valuable tool for real-time assessment of debonding in the composite.