

MATERIALS AND STRUCTURES SYMPOSIUM (C2)

Space Structures 1 - Development and Verification (Space Vehicles and Components) (1)

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PRACTICAL APPLICATION OF DIC IN FATIGUE AND FRACTURE TOUGHNESS TESTING

Abstract

The present work demonstrates the practical application of digital image correlation (DIC) methodology in fatigue and fracture toughness testing. The experimental work is focused on determination of important fracture mechanics parameters from surface and crack tip displacements measured on a loaded specimen by DIC. A MatLab-based code has been developed to evaluate the fatigue crack opening load, stress intensity factor, plastic zone size and T-stress of CT specimen under constant amplitude loading during fatigue crack growth rate testing, and CMOD and crack length during fracture toughness testing in accordance to the ASTM standard procedures. AA2024-T6 aluminum alloy is used as the test specimen because of its wide application in aerospace industry. Results from DIC are validated by comparison with back-face strain gauge technique, visual measurements by travelling microscope and Finite Element Analysis (FEA). It is shown that the experimental results obtained by DIC are in very close agreement with the results obtained through conventional methods, FEA results and theoretical formulas. This approach offers the benefit of estimating all the parameters required for plotting da/dN vs. K curve and J vs. a curve of any metallic material by capturing digital images and extracting surface and crack tip displacement fields by a simple algorithm. The proposed technique can be easily applied to existing laboratory setup. The technique is simple and requires only commonly available digital cameras. The accuracy of the results can be improved considerably by employing high resolution cameras. Keyword: Digital image correlation, full-field displacement, fatigue crack growth rate, stress intensity factor, fracture toughness, crack length