Fatigue crack growth in metallic components: numerical modeling and analytical solution

Danilo D'Angela[1] and Marianna Ercolino[2]

[1]University of Greenwich School of Engineering
[2]University of Greenwich

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Abstract

The paper presents innovative approaches for the simulation of fatigue crack growth (FCG) in metallic compact tension (CT) specimens using finite element (FE) analysis and analytical solution. FE analysis is performed in ABAQUS using the extended finite element method (XFEM) coupled with the direct cyclic low-cycle fatigue (LCF) approach. Novel methods are developed for the computation of the numerical crack growth by processing the analysis outputs. The numerical modeling is validated by considering past experimental data. The analytical solution for the fatigue life evaluation is formally reviewed, and novel fatigue damage descriptors are defined. The influence of the main sample/testing features on numerical and analytical fatigue life is extensively assessed by a parametric study. The discrepancy between the numerical and analytical estimations of the fatigue life of the components is investigated and correlated to the features of the testing/modeling. A statistical-based correction factor is finally proposed in order to enhance the analytical solution.

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