The CA-XFEM for mixed-mode variable-amplitude fatigue crack growth considering the retardation effect

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Abstract

In this research, the extended finite element method (XFEM) in conjunction with the combined approximation (CA) is utilized for estimating the fatigue life of two-dimensional isotropic bodies under variable-amplitude loading. In the proposed method, called CA-XFEM, in addition to the fact that no re-meshing process is required, the crack growth path is determined without the need to solve the whole system of equations which these features significantly reduce computational costs. The Willenborg model is employed for modeling the retardation effect due to the overloads in the load history. For validation of the method, the numerical results are compared with the existing experimental data for a compact tension specimen made of Al 7075-T6 and a compact tension shear specimen made of Al 5083-H111. It is observed that the developed CA-XFEM Matlab code has excellent capability in modeling variable-amplitude fatigue crack propagation considering the retardation effect. Also, the effect of ratio and sequence of overload and mixed-mode overloading on the fatigue crack growth are studied.