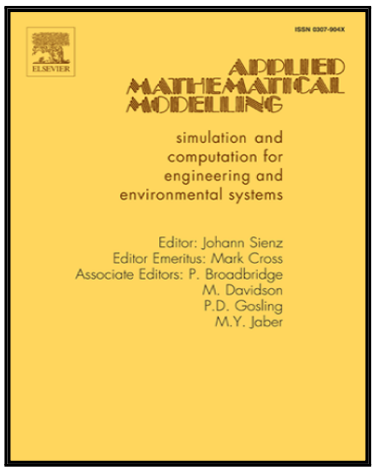

Analytical Bounds for Efficient Crack Growth Computation

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Abstract

In linear elastic fracture mechanics, the rate of crack propagation is proportional to the range of stress intensity factors. The most popular model relating these quantities is the Paris-Erdogan law. Crack growth computation is an initial value problem whose solution cannot be obtained in closed form, as stress intensity factors, hence crack growth rates, depend on the accumulated growth. For complex geometries, stress intensity factors are evaluated numerically, and crack growth computations can become computationally intensive. This paper presents a theoretical result establishing upper and lower bounds for the crack size function for any number of cycles. The bounds are very narrow, hence accurate crack size approximations can be obtained from only two stress intensity factor evaluations. This leads to a huge gain in computational effort for numerical crack growth computations. Two examples are used herein to explore the accuracy and efficiency of the proposed solution for the crack growth initial value problem.

Keywords

Fracture mechanics, Crack size; Paris-Erdogan law; Initial value problem; Fatigue;

Nomenclature

FE	Finite Element
H	Hypotheses
IVP	Initial Value Problem