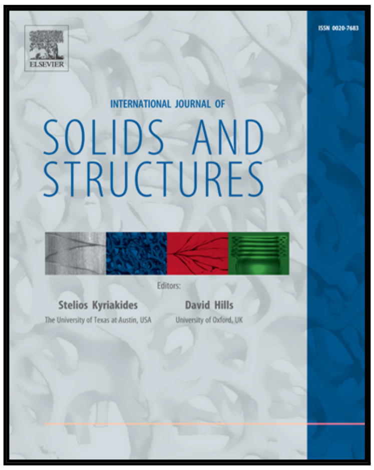

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Frequency-Dependent Cohesive-Zone Model for Fatigue

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Abstract

This paper is concerned with the development and application of a frequency-dependent cohesive-zone model (CZM) for crack-growth analysis of low and high-cycle fatigue. The new model makes use of recent advances by combining a modified version of a recently developed frequency-dependent trapezoidal cohesive-zone model [1] and a new *loading-unloading hysteresis damage model* with *fast-track* facility. The new combined model offers an alternative approach to capture frequency effects and at the same time deliver accuracy comparable to the *loading-unloading hysteresis damage model* along with the computational efficiency of the equally well-established *envelope load-damage model*. The model provides for the first time a methodology that accommodates frequency dependency yet delivers high computational efficiency.

In order to demonstrate the practical worth of the approach, the frequency effect observed with fatigue crack growth in austenitic stainless-steel 304 is analysed. It is found that the crack growth decreases with increasing frequency up to a frequency of 5 Hz after which it levels off. The behaviour, which can be linked to martensitic phase transformation, is shown to be accurately captured by the new model.

Keywords: fatigue crack growth; cohesive zone model, frequency dependence; computational efficiency.

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1. Introduction

Austenitic stainless-steel 304 is widely used in many structural and mechanical applications common to automotive industries and power plants, where toughness and resistance to corrosion are required [2]. The austenite phase in this stainless-steel is unstable and easily transforms to martensite under plastic deformation. Although, this feature makes this type of stainless-steel a good candidate for many applications, it is important to appreciate that for