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Minmao Liao, Di Dong

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An accurate and efficient approach coupling quadrature element method and subregion generalized variational principle for fatigue crack growth modelling

Minmao Liao[a,b,*], Di Dong[a]

[a]School of Civil Engineering, Chongqing University, Chongqing 400045, China

[b]Key Laboratory of New Technology for Construction of Cities in Mountain Area, Ministry of Education, Chongqing 400045, China

[*]Corresponding author: liaom@cqu.edu.cn

Abstract

Fatigue crack growth is modelled using a quadrature element method (QEM) in conjunction with a subregion generalized variational principle. Introducing the exact crack-tip stress field to the complementary energy subregion leads to accurate computation of stress intensity factors (SIFs), and applying the global high-order QEM to the potential energy subregion results in the least mesh effort and thus improved remeshing efficiency. With the aid of the fatigue crack growth criterion, structural fatigue life and crack path are predicted in an incremental manner. By specifying the remeshing rule that requires minimal effort, the entire growth process is modelled automatically. Several numerical examples are presented to demonstrate the effectiveness, accuracy and efficiency of the proposed approach.

Keywords: Fatigue life; Crack; Quadrature element; Subregion generalized variational principle; Stress intensity factor.

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