估算裂纹应力强度因子的新方法

吴志学

扬州大学机械工程学院，225009

摘要　　根据裂纹形状与裂纹尖端应力强度因子分布之间的固有关系，在线弹性断裂力学条件下，提出了一种按已知I型裂纹应力强度因子分布规律求裂纹形状及相应应力强度因子的无梯度迭代法．通过有限厚度、有限宽度板穿透裂纹和表面裂纹的数值模拟实例验证了所提出方法的有效性和实用性，并对不同应力强度因子分布规律对裂纹形状以及相应的应力强度因子大小的影响进行了分析和讨论．所提出的方法有助于提高实际扩展裂纹应力强度因子的估算精度以及更合理地预测疲劳裂纹形状演化．

关键词　　应力强度因子,线弹性断裂力学,表面裂纹,穿透裂纹,三维有限元分析

分类号　0346.1

A new method for evaluating stress intensity factors of planar crack in 3-D solid

扬州大学机械工程学院，225009

Abstract

According to the inherent relation between the crack shape and the stress intensity factor (SIF) distribution along the crack front, a gradientless iterative method is proposed for obtaining the shape and the corresponding SIF of mode-I planar crack with a given SIF distribution function under the condition of Linear Elastic Fracture Mechanics. Numerical examples for planar cracks in through-cracked and surface-cracked plates with limited thickness and width are presented to show the validity and practicability of the proposed method. The effects of various SIF distribution functions on the shape and the corresponding SIF of cracks are analyzed and discussed. The presented method is shown to be an effective alternative for the evaluation of SIFs and the prediction of shape evolution for growing cracks.

Key words　stress intensity factor　linear elastic fracture mechanics　surface-crack　through-crack　3-D finite element analysis

通讯作者　zhixue_wu@yahoo.com