ENHANCEMENT OF NEAR-FRONT APPROXIMATION FOR LINEAR FRACTURE ANALYSIS BY BIEM

Tarit Rung-aree[1], and Jaroon Rungamornrat[1,*]

[1] Applied Mechanics and Structures Research Unit, Department of Civil Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok, Thailand 10330.

[*]Corresponding author address: Jaroon.r@chula.ac.th

Abstract

This paper presents a simple procedure to enhance the near-front approximation in the stress analysis of a three-dimensional, isotropic, linearly elastic, cracked medium by the boundary integral equation method. The information of the asymptotic crack-front behavior is utilized as the basis for the enhancement of the approximation of the relative crack-face displacement. Two different schemes are proposed in the present study. In the first scheme, the available 9-node crack-tip elements are generalized by adopting the p-refinement in the direction perpendicular to the crack front. This clearly enables the resulting crack-tip elements to accurately capture high-order terms in the asymptotic near-front expansion of the relative crack-face displacement without the need to reduce the size of the elements. The invented crack-tip elements with the p-refinement can then be utilized along with the standard elements with the h-refinement without the deterioration of the accuracy. The second scheme is based upon the use of available 9-node crack-tip elements together with the newly invented elements, termed back crack-tip elements, in the approximation of the relative crack-face displacement. The idea is to supply the square-root feature from the asymptotic crack-front field to the crack-tip elements and the elements behind them. In this way, the size of a region on the crack surface where the square-root behavior is captured accurately will not be reduced when the uniform h-refinement is employed to improve the solution accuracy. The two proposed elements are successfully implemented within the framework of a weakly singular symmetric Galerkin boundary element method. A selected set of results is then reported to demonstrate the computational performance of the proposed elements.

Keywords: *Boundary Integral Equation Methods, Back Crack-tip Elements, Crack-tip Elements, Relative Crack-face Displacement, Stress Intensity Factors*