A Reanalysis based Fast Analysis method for Crack Propagation by using X-FEM

***Zhenxing Cheng[1], Hu Wang[1]**

[1] State Key Laboratory of Advanced Design and Manufacturing for Vehicle Body, Hunan University, Changsha, 410082, P.R. China

*Presenting author: zxcheng@hnu.edu.cn

Abstract

This study presents a reanalysis based fast analysis method for crack growth simulation which is based on the extended finite element method (X-FEM). It is well known that the X-FEM has been developed to be a vital numerical method for crack growth simulation due to its superiority of modeling both strong and weak discontinuities within a standard finite element framework. However, there are still some limitations on the number of crack growth iterations. Because the ideal computational situation would be to have a very refined mesh with a very small increment of crack growth, but this is not computationally feasible especially for fatigue crack growth simulation. In order to break through the bottleneck, reanalysis algorithms have been adopted into the X-FEM. Reanalysis algorithms are well developed in the areas of design and optimization for modification of the finite element stiffness matrix due to its high efficiency in predicting the response of additional or modified degrees of freedom (DOFs). In this paper, it is observed that modeling quasi-static crack growth by the X-FEM will bring the additional DOFs in every iteration and this will lead to a local change of stiffness matrix. Therefore, an exact reanalysis algorithm called indirect factorization updating (IFU) method is introduced for modeling quasi-static crack growth in the X-FEM. To verify the performance of the reanalysis-based X-FEM, several typical numerical examples have been analyzed and the results demonstrate that this method is a high-efficient method with high accuracy.

Keywords: Reanalysis algorithm, Indirect factorization updating, Extended finite element method