Investigation Stress Intensity Factor in Centre Crack and Edge Crack Plate Using Isogeometric Analysis

Seyed Yousef Ahmadi brooghani*, Hassan Rayegan†

* Department of Mechanical Engineering, University of Birjand, Birjand, Iran
Email: syahmadi@birjand.ac.ir

†Department of Mechanical Engineering, University of Birjand, Birjand, Iran
Email: hassanrayegan@birjand.ac.ir

ABSTRACT

In this paper concept of isogeometric analysis is utilized in analysing of stationary cracks in plates to calculate stress intensity factor for mode I. In the isogeometric approach, Non-Uniform Rational B-Spline (NURBS) basis functions in CAD system is directly utilized to discrete and solve equation of motion. The NURBS basis function that considered in this study has a degree equal to three in both directions X and Y.

In the previous researches there are some methods like Extended Isogeometric Analysis (XIGA) that adds enrichment functions in crack tip to approximate the unknown fields and Isogeometric Boundary Element Method (IGABEM) to calculate stress intensity factor in the crack tip.

In this research three methods are used to mesh and analyse centre and edge crack plates by using a simple isogeometric method. First method uses a simple and uniform mesh. In the second method a refinement introduced for elements that include crack tip's node to solve the problem. In third method a different mesh is used that gradually become finer in the crack tip. Uniform mesh is not able to calculate displacement at the crack tip correctly and applied refinement that introduced in second method shows a better result for displacement near the crack tip. In second method the coordinate of nodes that used to calculate stiffness matrix in elements which included the crack tip's node has been changed. Since the basis function are of third degree, the crack tip's are included in four elements and the refinement are applied only at these elements. The presented methods has been coded and executed in MATLAB.

Two problems are investigated in this research. The first a plate with a centre crack. To model this problem a quarter of the plate has been modelled and the symmetry boundary condition has been applied. The second problem is an edge crack plate in which a half of plate is modelled by using the symmetry boundary condition. In both problems a uniform tensile stress is applied at the upper edge of plates.

The stress intensity factor is evaluated by a simple method of correlation between stress in front of crack and stress intensity factor. The results which has been obtained from these three methods are compared and verified against analytical solution. The calculated stress intensity factor shows around five percent error comparing with analytical methods.

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