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INNOVATIVE NUMERICAL METHODS BASED ON SFEM AND IGA FOR COMPUTING STRESS CONCENTRATIONS IN ISOTROPIC PLATES WITH DISCONTINUITIES

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ABSTRACT

The stress concentration in discontinuous zones is known to be a significant issue in mechanics, since the presence of a discontinuity, even in a simple structure model, makes it complicated to analyze. To this end, the application of numerical methods would require a sufficiently fine mesh for a realistic prediction of stresses around critical zones as cracks or discontinuities. Despite the large effort related to the finite element method as numerical approach to predict stress concentrations, results are still not satisfactory. In this work we propose two innovative numerical approaches to determine the stress concentration factors, with a reduced computational cost. A strong formulation finite element method, its localized version, and the isogeometric approach, are herein applied to study some classical examples, as the plane stress plates with circular holes, U-holes, or V-notches. All the numerical results obtained with both approaches in terms of stress distribution and stress concentration factors are compared to the theoretical and experimental predictions available in the literature and the numerical solutions found with finite element method. A very good agreement between the numerical and the reference results confirms the potentials and accuracy of the proposed methodologies to capture the stress concentrations in fracture mechanics, also for coarse mesh discretizations.

Keywords: Stress Concentration Factor, Strong Formulation Finite Element Method, Generalized Differential Quadrature, Fracture Mechanics, Isogeometric Analysis, NURBS.

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