

On the development fracture mechanics analysis software system
(crack propagation analysis, automatic meshing technique and evaluations
of crack parameters based on FE model composed of tetrahedral elements)

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Abstract:

In this research, we have been developing a fracture/crack propagation analysis system for damaged structures [1]. The system can fully automate the crack propagation analysis. The analysis system is based on:

1. Finite Element Method (FEM) to perform the solid mechanics analysis
2. Delaunay tessellation technique to generate the finite element mesh
3. VCCM (Virtual Crack Closure-Integral Method) and interaction integral method for the evaluations of stress intensity factors

In the seminar, I will briefly present the Delaunay tessellation technique to generate the finite element mesh first and will carry out detailed discussions on methods to compute crack parameters such as J-integral, VCCM and interaction integral ([2], [3] and [4]). Then, the results of several numerical demonstration problems are presented (for example [5]).

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- [2] H. Okada, H. Kawai and K. Araki, "A virtual crack closure-integral method (VCCM) to compute the energy release rates and stress intensity factors based on quadratic tetrahedral finite elements", *Engng Fract. Mech.*, 75, 4466–4485, (2008).
- [3] R. Daimon and H. Okada, "Mixed-mode stress intensity factor evaluation by interaction integral method for quadratic tetrahedral finite element with correction terms", *Engng Fract. Mech.*, 115, 22–42, (2014).
- [4] H. Okada and S. Ohata, "Three-dimensional J-integral evaluation for cracks with arbitrary curvatures and kinks based on domain integral method for quadratic tetrahedral finite element", *Engng Fract. Mech.*, 109, 58–77, (2013).
- [5] K. Arai, K. Yodo, H. Okada, T. Yamada, H. Kawai and S. Yoshimura, "Ultra-large scale fracture mechanics analysis using a parallel finite element method with submodel technique", *Finite Elements in Analysis and Design*, 105, 44-55, (2015).