8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

ELUCIDATION OF VARIOUS DYNAMIC FRACTURE MECHANISMS USING THE MOVING FINITE ELEMENT BASED ON DELAUNAY AUTOMATIC TRIANGULATION

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Key Words: *Dynamic Fracture Simulation, Fracture Path Prediction, Moving Finite Element Method.*

ABSTRACT

Recently the author presented basic concepts for fracture path prediction simulation. These are types of fracture simulations, hybrid experimental-numerical method, Explicit and Implicit fracture path prediction theories, the variational principle for fracturing solid, moving finite element method. These concepts are effectively utilized in fracture path prediction simulations. Especially the moving finite element method based on Delaunay automatic triangulation made it possible to predict complicated fracture paths such as multiple dynamic crack branching, dynamic kinking and curving fracture phenomena.

Branched cracks are often observer in brittle materials and structures. Many researchers [1-8] However, the mechanism or the governing condition of dynamic crack branching has not been fully clarified. Thus, for humankind, the dynamic crack bifurcation problems has remained important unsolved problems for long time, until recent our study [9].

The author and coworkers[10] have developed the moving finite element method based on Delaunay automatic triangulation, this method made it possible to simulate very complicated dynamic fracture phenomena. Figure 1 shows one of the frames of ultrahigh-speed video recoding of multiple dynamic crack branching phenomena.

Figure 2 shows the simulation result obtained by the moving finite element method based on Delaunay automatic numerical simulation was carried out using moving finite element method based on Delaunay automatic triangulation. Numerical result agrees excellently with the experiment (see figure 1).

Itis extremely interesting to see in Fig 3 that the Φ_{total} criterion is repeatedly satisfied in the multiple dynamic crack branching phenomena.

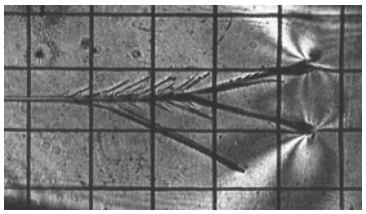


Fig 1A ultra-high speed photograph of multiple crack branching phenomena

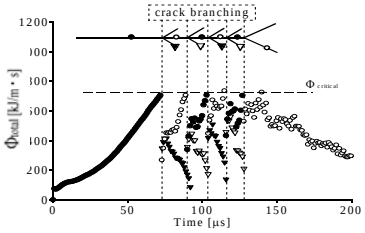
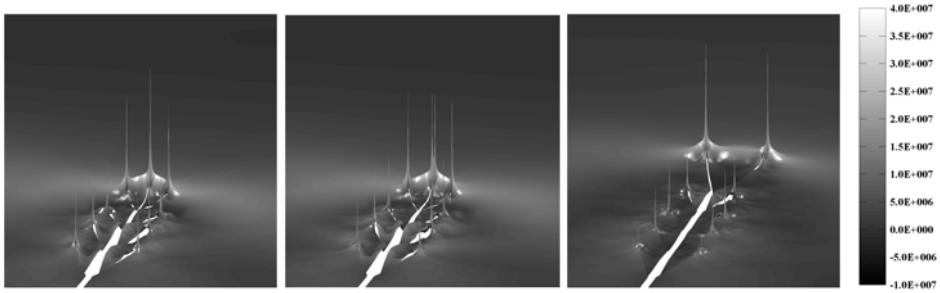


Fig 3$\mathbf{\Phi_{total}}$ in multiple crack branching



(a) 127 μ s (b) 128 μ s (c) 150 μ s

Fig.2 Equivalent stress distribution at multiple branching area

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