Analysis of 3D non-planar crack propagation with smoothed particle hydrodynamics method

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ABSTRACT

The estimation of the fatigue damage is essential to ensure the safety of the mechanical structures. The fatigue crack propagation is one of the dominant phenomena about the fatigue damage. Accordingly, such FEM methods for the crack propagation problem as the X-FEM [1] have been applied to the above problems. It is, however, well recognized that the meshing methods as the FEM are difficult to deal with some complex situations, such as the separation of a crack into multiple cracks and the merging problem of cracks or defects [2].

On the other hand, the mesh-less methods as the particle methods are considered to be effective for the above situations. Then, we have applied the smoothed particle hydrodynamics method (SPH) [3] to the linear elastic fracture mechanics and the planar fatigue crack propagation in the three-dimensional body [4], where the planar fatigue crack propagation is well simulated by using the special crack front particles.

In the present study, the above method is upgraded to solve the non-planar crack propagation in the three-dimensional body. To ensure the validity of the proposed method, a fatigue crack propagation in the CT specimen [5] with a hole near the crack tip is computed and compared with fatigue test result. It is shown that the crack propagation history of the computed result is almost the same as that of the fatigue test result.

REFERENCES


