Data reusing techniques to accelerate a crack propagation boundary element method code

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ABSTRACT

Fracture mechanics is a very active research area. Several numerical methods are used to model crack problems, for example: the Finite Element Method, the Boundary Element Method (BEM) and the Discrete Element Method. One of the main advantages of the BEM is the reduction of one dimension of the problem. An interesting approach of BEM is the Symmetric Galerkin BEM (SGBEM). SGBEM is based on a variational (weak) version of the integral equations, thus entailing double integrations, and leads) to matrix operators which exhibit symmetry and sign-definiteness. Since its introduction by Rokhlin [1], the Fast Multipole Method (FMM) is used to extend the BEM to large scale problems.

Trinh [2, 3] combined the SGBEM with the FMM to model crack problems in elastostatics, but calculation time grows continually during the propagation. In this work, the FMM algorithm for propagation is accelerated. The first modification applied is to make some data unchanged during propagation. Then, these data are saved and reused during the propagation. This allows a very fast calculation of the necessary matrices after the first propagation cycle. Moreover, non-zero initial guess is used to accelerate the iterative solver. The performance of the new code is confirmed with many simulations including 3D multicrack propagation in mixed mode. The speedup is about 10 and can reach 20.

Keywords: SGBEM, FMM, crack propagation, data reusing

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