

New Approach of Characteristic Tensor to Mixed Mode Crack Propagation

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Abstract: Characteristic tensor is a tensor which is derived from the characteristic stress field near to a crack tip and is strongly related to fracture mechanics parameters in principle. Each component of characteristic tensor consists of an invariant quantity which defines intensity of stress singularity, corresponding to the stress component. Since it contains the information about not only intensity but also direction of the singularity, characteristic tensor can be a possible candidate which evaluates characteristics of cracking and its propagation direction under various complex loading conditions we have to assume for the practical analysis. Though parameters based on fracture mechanics have been successfully utilized for issues in the industrial field, the situation to be applied is still limited due to intensive requirements for modellings and computation conditions for its accuracy and the specific calculation scheme. On the other hand, the computation procedure for characteristic tensor is quite simple and easy to be applied to any structural analysis with finite element method (FEM). Therefore, the analysis with this tensor can provide significant contribution to practical use of crack analysis and design processes of products in the industry field. In order to discuss the effectiveness and accuracy of the new method, it is important to identify how characteristic tensor is related to other conventional parameters. In this study, the reliability of characteristic tensor is proved, identifying the relation between the tensor and the stress intensity factor under mixed loading condition. The stress intensity factor estimated from characteristic tensor which is derived from analytical stress field is compared to theoretical value. Characteristic tensor derivation from FEM is also demonstrated. Furthermore, the possibility of new criterion for crack propagation analysis under complex loading condition is discussed.