Generalized Finite Element Method and the Splitting Method as a Framework for Multiple Site Damage

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In this work, fracture mechanics problems of multiple site damage in two-dimensional domains are treated by combining the Splitting Method [1, 2] and a partition of unity approach as the Generalized Finite Element Method (GFEM) [3, 4].

When applying the splitting method, the given problem is split into one global sub-problem consisting of the uncracked global domain which includes all the prescribed boundary conditions. The solution of this problem provides stress distributions which are interpolated over the previously known crack lines by using a polynomial basis. In the sequence of the procedure, a set of two auxiliary local and global problems is defined aiming to account for the stress concentration effects and also the interactions among the cracks.

The final solution for the given problem must be such that the stress distributions resulting from a linear combination of the first global problem and the set of auxiliary local and global problems are null on each crack faces.

On the other hand the main feature of the partition of unity methods such as the generalized finite element method (GFEM) is their ability for exploring a priori knowledge about the solution of a problem in the form of enrichment functions.

The Generalized Finite Element Method is hereby applied to the analysis of the local sub-problem generated by the splitting method and consisting of an isolated crack submitted to a certain number of loading cases applied on its faces. Accurate estimates of the stress intensity factors are provided by the GFEM, especially when customized enrichment functions are used in the local analysis. In order to assess the efficiency of the numerical framework, some examples varying from a single to multiple site crack problems are considered.

References

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