

## **Multiscale simulation of crack propagation using variable-node finite elements**

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### **Summary**

A novel multiscale finite element (FE) scheme is proposed for a simulation of crack propagation in the heterogeneous media including randomly distributed microstructures, such as voids, rigid fibers. A fine scale mesh is employed to capture the singularity of the crack tip and the effect of microstructures at the vicinity of crack tip. On the other hand, a region far from the crack tip is composed of coarse scale mesh, wherein the effect of the microstructures is averaged through the homogenization theory. An interface between the fine scale mesh and the coarse scale mesh is connected by variable-node finite elements in a seamless way. As moving the crack tip, the elements including the crack tip are automatically remeshed with the conventional quarter-point singular element. To verify the effectiveness of the proposed scheme, several numerical examples are presented, and the effect of microstructures on the crack path is considered in terms of the parameters of fracture mechanics.

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