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Finite strain fracture of plates and shells with configurational forces and edge rotations

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ABSTRACT

We propose a simple and efficient algorithm for FEM-based computational fracture of plates and shells (cf. [1]) with both brittle and ductile materials based on edge rotation and load control. Rotation axes are the crack front nodes and each crack front edge in surface discretizations affects the position of only one or two nodes. Modified positions of the entities maximize the mesh quality complying with the predicted crack path (which depends on the specific propagation theory in use). Compared with XFEM or with classical tip remeshing, the proposed solution has algorithmic and generality advantages. The propagation algorithm is simpler than the aforementioned alternatives and the approach is independent of the underlying element used for discretization. For history-dependent materials, there are still some transfer of relevant quantities between elements. However, diffusion of results is more limited than with tip or full remeshing. To illustrate the advantages of our approach, three prototype models are used: tip energy dissipation (LEFM), cohesive-zone approaches and ductile fracture.

Both the Sutton crack path criterion and the path estimated by the Eshelby tensor are employed. Traditional fracture benchmarks, including one with plastic hinges, and newly proposed verification tests are solved. These were found to be very good in terms of crack path and load/deflection accuracy.

REFERENCES

[1] P. Areias and T. Rabczuk. “Finite strain fracture of plates and shells with configurational forces and edge rotations”, *Int J Numer Meth Eng* , **94**, 1099-1122 (2013).