SM19L_10038

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

A Cohesive Approach to Thin Shell Fragmentation

Fehmi Cirak[1], Michael Ortiz[2], Anna Pandolfi[3]

(1) *CACR, Caltech, Pasadena, USA*
(2) *Galcit, Caltech, Pasadena, USA*
(3) *DIS, Politecnico di Milano, Milano, Italy*

We propose a cohesive approach to the finite element simulation of static and dynamic fracture in Kirchhoff-Love thin shells. Shells are spatially discretized with subdivision shape functions, as originally proposed in Cirak *et al.*, 2000; and Cirak and Ortiz, 2001. Fracture is allowed only along element boundaries, and the progressive separation of the fracture surfaces is governed by cohesive elements. The irreversible cohesive law accounts for the normal and tangential opening displacement of the crack flanks, and it is able to distinguish between bending and tearing modes of fracture. Owing to the non-locality of the subdivision functions, the topological transitions attendant to fragmentation are difficult to account for. We provide an approach that allows simply for arbitrary topological transitions, fragmentation patterns and their evolution. In particular, the shell remains fully coherent up to fracture initiation. The efficiency of the approach is demonstrated through the simulation of petalling experiments in aluminum plates.

View the extended summary