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Least Action Principle extended to gradient damage modeling under dynamic conditions

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Extended Abstract

Abstract

Local damage models generally exhibit sensibility to mesh size or orientation. A common way to regularize them consists in incorporating gradient damage terms which involve a length scale. This class of models has been extended to dynamics damage context. These studies rely on the least action principle of whose justification remains to be established for dissipative structures. Recent contributions address the dynamic damage modeling by considering an extended Lagrangian approach for the reversible part which includes the gradient damage term and then treating the evolution laws. The present study aims at establishing in one step the principle of least action for gradient damage models. To this end, we rely on generalized Lagrange equations including evolution laws to identify an extended Lagrangian when one deals with the so-called simple dissipative systems, that are those for which the total energy dissipated up to the present instant depends only on the value of the state variables at that instant. The solution to the resulting variational problem is obtained by adopting a Newmark-type time integration scheme for elastodynamics, and then an energy minimization procedure to obtain the damage field. The established

and numerically implemented model is considered for simulations of the dynamics damage and fracture of a pre cracked plate and of the standard Kalthoff dynamical test.

Keywords:

Dynamic damage Dynamics fracture Least Action Principle Variational approach Numerical simulations