Nearly Non-Spurious Oscillations Time Scheme in Finite Element Analysis of Non-linear Wave Propagation and Dynamic Fracture Mechanics

R. Kolman\textsuperscript{1*}, S. S. Cho\textsuperscript{2}, K. C. Park\textsuperscript{3,4}

\textsuperscript{1} Institute of Thermomechanics, Academy of Sciences of the Czech Republic, v.v.i., Dolejškova 5, Prague 8, Czech Republic, kolman@it.cas.cz
\textsuperscript{2} Reactor Mechanical Engineering Division, Korea Atomic Energy Research Institute, 999-111 Daedeok-Daero, Yuseong-gu, Daejeon 305-353, Korea
\textsuperscript{3} Department of Aerospace Engineering Sciences, University of Colorado, Boulder, CO 80309-429, USA
\textsuperscript{4} Division of Ocean Systems Engineering, Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon 305-701, Korea

In this contribution, the near non-spurious oscillations time integration scheme [1, 2] for finite element numerical solution of transient problems in solids [3] is presented and tested in linear and mainly non-linear wave propagation of stress discontinuities in solids [4] and dynamic fracture mechanics [5]. Special attention is paid to numerical solution of propagation of stress discontinuities, wave-fronts interactions (loading and unloading effects) and also problems with reflections due to boundaries. Implementation into the Tahoe program [6], behaviours and properties, accuracy and stability analysis of the numerical method based on the classical (Lagrangian) linear finite element space discretization and the special front shock capturing explicit time scheme are mentioned and commented in details.

The nominated explicit near non-spurious oscillations method [1,2] is used in numerical evaluation of dynamic stress factor intensity for stationary cracks and also in numerical solution of dynamic crack propagation [5], where crack growth is modelled by cohesive type finite element frameworks (for examples, Xu–Needleman model [8], Tvergaard–Hutchinson model [9], etc.). The crack speeds and crack paths are compared with experimental and numerical results of crack propagation under dynamic tension and shear failure, and mainly in asymmetric impact of an edge cracked plate.

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