Technische Universität Braunschweig

GRK 2075

Vortrag im Gästeprogamm des GRK 2075 -
Modelle für die Beschreibung der Zustandsänderung bei Alterung von Baustoffen

Mijo Nikolić

University of Split - Croatia

Energy balance in simulations of complex failure mechanisms with interacting localized fractures by the strong discontinuity approach

Dienstag, 16.10.2018, 14.00 Uhr
Institut für Wissenschaftliches Rechnen
Mühlenpfordtstrasse 23, 8. OG, Raum 812

The total energy balance in dynamically driven localized failure propagation is presented. The full energy balance is investigated on the well known benchmark problems where pre-notched plate is subjected to edge impulsive load causing the dynamic crack propagation until the complete failure [1].

The localized failure in material is represented by embedded strong discontinuity formulation exhibiting the jump in the displacement field leading to correct formulation for strain softening response which remains independent on the chosen mesh. Moreover, we are interested in complex failure mechanisms where multiple fractures initiate, grow, interact, merge or branch which usually leads to many difficulties in convergence of nonlinear solvers.

For this purpose, the methodology based on the discrete lattice model, built on Voronoi tessellation and cohesive links with enhanced kinematics, is presented [2]. Enhanced kinematics is coupled here with plasticity (or damage) softening law where progressive degradation of cohesive links leads to the failure of the structure. No tracking algorithms are required with such methodology, which increases the computational robustness of the code. Crack path is guided by the stress redistributions and the state of the stress at the crack tip. High stress concentrations are obtained at the crack tip and effects of linear elastic fracture mechanics can be observed there. Moreover, the crack interaction is not limited by stress concentrations and the multiple stress singularities interfering at the crack tips.

The failure mechanisms in dynamic systems are followed by the calculation of the total energy. Moreover, input work introduced into the system by external loads is monitored in time, while internal energy balance in damage and plasticity softening is maintained by exchanging the kinetic energy, strain energy, plastic free energy and dissipated energy in time. The role of plastic free energy is explained through the energy balance principles. The common mistake of neglecting the role of plastic free energy is also given, and its influence on fracture energy pointed out.

[1] M Nikolic, XN Do, A Ibrahimbegovic, Z Nikolic. Crack propagation in dynamics by embedded strong discontinuity approach: Enhanced solid versus discrete lattice model. Computer Methods in Applied Mechanics and Engineering, 340: 480-499, 2018.
[2] M Nikolic, E Karavelic, A Ibrahimbegovic, P Miscevic. Lattice element models and their peculiarities. Archives of Computational Methods in Engineering 25 (3): 753-784, 2018.

Kontakt
Institut für Statik
Technische Universität Braunschweig
Beethovenstraße 51
38106 Braunschweig
0531 - 391-3668
grk-2075@tu-bs.de
www.tu-braunschweig.de/grk-2075