# Enhanced embedded strong discontinuity quadrilateral for dynamic crack propagation

**Andjelka Stanić[1]*, Boštjan Brank[2] and Adnan Ibrahimbegovic[3]**

[1]* Institute of Scientific Computing, Technische Universität Braunschweig,
Mühlenpfordtstrasse 23, 38106 Braunschweig, Germany
e-mails: a.stanic@tu-braunschweig.de

[2] Faculty of Civil and Geodetic Engineering, University of Ljubljana,
Jamova cesta 2, 1000 Ljubljana, Slovenia
e-mail: bbrank@fgg.uni-lj.si

[3] Université de Technologie de Compiègne – Sorbonne Universités, Centre de Recherches de
Royallieu, Laboratoire de Mécanique, 60203 Compiègne, France
e-mail: adnan.ibrahimbegovic@utc.fr

## ABSTRACT

We present a novel embedded discontinuity quadrilateral finite element that is improved by incompatible mode parameters. In order to describe a crack formation and opening in quasi brittle 2d solid under a dynamic load we use the method of embedded strong discontinuity in displacements. It provides mesh-independent solution for the reason that the fracture dissipation energy is associated with the discontinuity and does not depend on the finite element size. Crack opening is expressed as a combination of basic separation modes (mode I and mode II). The cohesion tractions in the crack are described by damage-softening constitutive relation. Results of failure analysis of structural elements subjected to dynamic loads are provided in order to assess the performance of the novel enhanced quadrilateral finite element formulation and the crack tracing algorithm.

## REFERENCES

[1] Ibrahimbegovic, A., 2009. *Nonlinear Solid Mechanics*. Springer Netherlands, ISBN: 978-90-481-2331-5.

[2] Nikolic, M., Nam Do., X., Ibrahimbegovic, A., Nikolic, Z. 2018. *Crack propagation in dynamics by embedded strong discontinuity approach: Enhanced solid versus discrete lattice model*. Comput Methods Appl Mech Engrg 340: 480-499.

[3] Stanic, A., Brank, B., Korelc, J., 2016. *On path-following methods for structural failure problems*. Comput Mech 58 (2): 281-306.

[4] Stanic, A., 2017. *Solution methods for failure analysis of massive structural elements*. PhD Thesis. Université de Technologie de Compiègne - Sorbonne Universités, France and University of Ljubljana, Slovenia. 179 p.