Applications of the Distinct Element Method (DEM) in Structural Geology and Geomechanics

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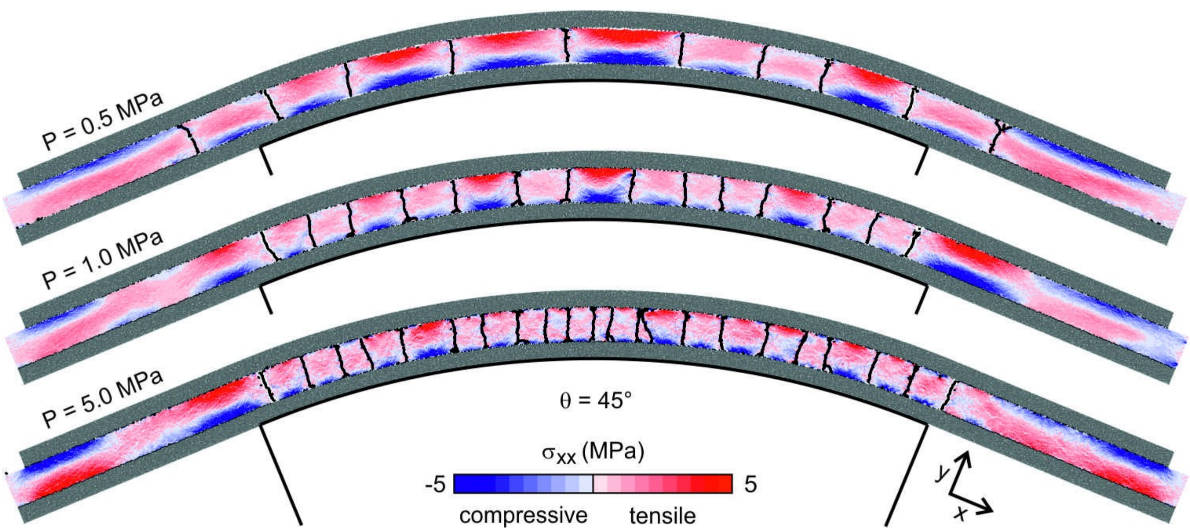
when: 18th of October 9:00-17:30

where: Institute of Geophysics AVČR, Boční II/1401, Prague 4

Please let us know about your participation to zavada@ig.cas.cz, jerabek.petr@natur.cuni.cz



DEM models illustrating that the spacing of bending fractures ('fold related joints') decreases with increasing overburden pressure (P). Particles of central brittle layer are coloured for layer parallel normal stress. Black lines are broken inter-particle bonds (fractures). The fold interlimb angle θ is 45°.

Aims

To familiarize Earth Scientists with the DEM and how it can be used to address and model problems in Structural Geology and Geomechanics. No prior knowledge of numerical modelling is required, but could be beneficial. This is not a software training course, but it is expected that hands-on experience with the method will provide a better understanding of rock mechanics.

Requirements

Each course attendant should bring his/her own laptop with a PFC Demo Version (limited to 1000 elements) installed (Operating System: Windows 7 or later).

Course outline

Morning

1. Introduction to the Distinct Element Method (DEM) as implemented in PFC (Particle Flow Code)

    Balls in a box: Introduction to PFC environment

    Dropping balls: The importance of damping

    Angle of repose: Micro-macro-property relation of granular materials

2. Comparison of DEM results with continuum mechanics solutions

    Micro-macro-property relations of regular lattice models

    Displacement profiles of cracks and comparison with continuum mechanics solution

    Effective properties of cracked solids

3. The numerical rock laboratory

    Confined compression and extension tests and construction of failure envelopes

    Reactivation of planes of weakness

Afternoon

4. Stability of (submarine or dry) slopes on a weak layer and applications to salt tectonics

    Tilting of a layer with uniform thickness resting on a plane of weakness

    Stability of a slope on a horizontal plane of weakness

5. Rock joints

    Formation of layer-confined joints under layer parallel extension

    Formation of bending fractures

6. Normal faulting

    Basement induced normal faults in homogeneous materials

    Normal fault zone development in mechanically layered sequences

Recommended reading prior to course attendance

Introduction to PFC and the numerical rock laboratory

Potyondy, D.O., Cundall, P.A. (2004). A bonded-particle model for rock. International Journal of Rock Mechanics and Mining Sciences 41, 1329-1364. https://doi.org/10.1016/j.ijrmms.2004.09.011

Slope stability

Lehner, F.K. & Schöpfer, M.P.J. (in press). Slope stability and exact solutions for cohesive critical Coulomb wedges from Mohr diagrams. Journal of Structural Geology. https://doi.org/10.1016/j.jsg.2018.04.021

Rock joints

Schöpfer, M.P.J., Arslan, A., Walsh, J.J. & Childs, C. (2011). Reconciliation of contrasting theories for fracture spacing in layered rocks. Journal of Structural Geology 33, 551-565.
https://doi.org/10.1016/j.jsg.2011.01.008

Normal faulting

Schöpfer, M.P.J., Childs, C. & Walsh, J.J. (2007). 2D Distinct Element modeling of the structure and growth of normal faults in multilayer sequences. Part 2: Impact of confining pressure and strength contrast on fault zone geometry and growth. Journal of Geophysical Research 112, B10404.
https://doi.org/10.1029/2006JB004903