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

Dr Martin Schöpfer

Department for Geodynamics and Sedimentology, University of Vienna, Austria (martin.schoepfer@univie.ac.at)

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 $\theta$ 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


Slope stability


Rock joints


Normal faulting