

DISCRETE FRACTURE NETWORK (DFN) MODELING FOR OPEN-PIT SLOPE STABILITY ANALYSIS

Purpose(s): 3D Discrete Fracture Networks (DFN) calibration and generation

Client: CSIRO

Date: January 2007

Partners : Itasca Consulting Group

Location : Australia

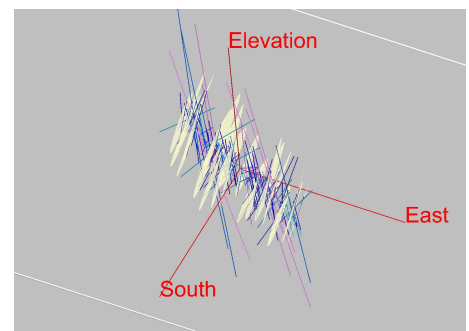
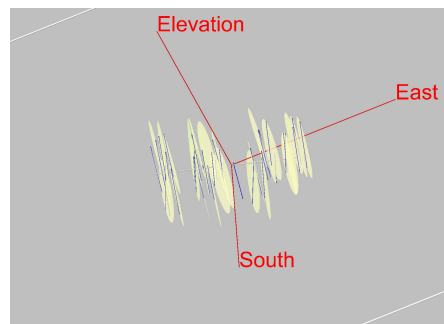
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Code(s) used: 3FLO, PFC^{2D}

As part of the feasibility analysis of slope stability in a **large open-pit** mine, Itasca was put in charge of defining and generating a **3D calibrated Discrete Fracture Network (DFN)**. The slope stability analysis uses the concept of **Synthetic Rock Mass (SRM)** analysis with **PFC^{2D}**. **SRM** links the properties of the intact rock mass with the presence of discrete fractures (or joints). The **DFN** must reflect **the statistical fracture properties of the rock mass**. These properties can be observed on excavation walls, such as **orientation and densities (measured along scan lines) of fracture traces**.

The volume of interest is typically of the order of kilometres. Several networks of fractures are defined with fracture traces ranging in size from 10 meters, for joints, to 300 to 400 meters for faults, with a spacing ranging from 5 meters to 150 meters.

The objective of this analysis is to generate a **two-dimensional DFN** that is **compatible with the initial synthetic data** obtained by **intersecting an initial 3D network with a 2D vertical plane**.



(above) calibration phase illustration: fractures (clear disks) intersecting a scanline and corresponding fracture traces on a fictive wall: left) only one fracture set; right) traces from several fracture sets. The 3D fracture density is calibrated such that the expected spacing on the scanline is matched.

(opposite): calibrated realization for two fracture sets and two joint sets on a wall of size 500 m.

KEYWORDS:

- Discrete fracture network
- Fault, joint
- Stereological analysis
- Fracture trace map
- Slope stability

⇒ RESULTS:

- The 3D DFN properties are calibrated such that input statistical properties observed of the 2D plan section are matched
- After the calibration stage, a random seed is chosen to provide one realization of the DFN.
- The 2D DFN provided arises from intersection of the 3D DFN and a vertical plan section (striking 66°). At the outcome, the 2D and the 3D DFN are defined with the expected properties.