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Softwares for the Hough-transform-based stress tensor inversion

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Stress tensor inversion is a wide-spread technique to estimate crustal stress state from fault-slip orientations. As an answer to the recent requirement for dealing with temporal and spatial heterogeneity in stress, an inversion method based on Hough-transform was developed (Yamaji et al., 2006), which can detect multiple stress states from a population of faults. Hough transform itself is a technique of image processing used to detect multiple linear structures from a raster graphics image. Faults and stresses correspond to pixels in a image and linear structures, respectively. The Hough-transform-based inversion method (HIM) has another advantage that it can utilise incomplete fault data such as ones without striation orientations or shear senses (Sato, 2006). This paper introduces a set of softwares for fault-slip analyses through HIM.

The processes of an analysis are as follows.

A fault-slip datum is composed of fault plane orientation, slip orientation, and shear sense. They are described by azimuth and plunge angle of dip direction of fault plane, those of slip direction, and a character which distinguishes shear senses. These values are arranged in a line, and are listed in a ASCII file. If a data set includes incomplete fault-slip data, a character is added at the head of each line to indicate data type (complete or incomplete).

Two processors perform an analysis. The main processor reads the fault data file and finds compatible reduced stress tensors for each fault according to the assumption that a slip direction is parallel to the shear stress direction (Wallace-Bott hypothesis). A reduced stress tensor carries principal stress orientations (σ_1, σ_2, and σ_3-axes) and a stress ratio ($\Phi = (\sigma_2 - \sigma_3)/(\sigma_1 - \sigma_3)$), which has one-to-one correspondence to point

on the five-dimensional (5-D) unit sphere (Sato and Yamaji, 2006). After all faults vote their compatible stresses, the numbers of votes are assigned to grid points on the 5-D unit sphere. The post processor detects the peaks of compatibility. Local maxima give stress solutions.

A software for visualisation is also provided. The principal axes of stress solutions are plotted on paired stereograms for σ_1 and σ_3-axes. The plotted symbols are coloured to show the values of stress ratios. The visualiser has additional functions to assess the solutions by calculating misfit angles between shear stress directions and observed fault striations. A normalised Mohr's circle is also useful to examine the ratios between normal and shear stress magnitudes on fault surfaces and to make further approach to estimate absolute stress magnitudes (e.g. Angelier, 1989).

The above-mentioned softwares are open to the public on the author's web site (`http://earth.kumst.kyoto-u.ac.jp/~k_sato`).

References

Yamaji, A., Otsubo, M. and Sato, K., 2006. *J. Struct. Geol.* 28, 980-990
Sato, K., 2006. *Tectonophysics* 421, 319-330
Sato, K. and Yamaji, A., 2006. *J. Struct. Geol.* 28, 957-971
Angelier, J., 1989. *J. Struct. Geol.* 11, 37-50