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Win-Tensor, an interactive computer program for fracture analysis and crustal stress reconstruction

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The pioneering work of Jacques Angelier contributed largely to the formulation and dissemination of the crustal stress analyses and inversion techniques from, progressively raising them to the rank of standard tools in brittle structural analysis. Largely inspired by his abundant work, we developed the TENSOR computer program, initially to test and learn this new methodology 20 year ago. It rapidly evolved into a user friendly interactive program that was adopted by many for their crustal stress analysis, using both geological fault-slip data (faults with slip lines and fractures) and earthquake focal mechanisms. In 2004, a new Windows version (Win_Tensor) started to be developed, allowing further technical and user interface improvements. It is organized in linked data and processing sheets. Data can be entered in the data sheet by a direct controlled input, by copy-paste from an excel sheet, can be digitized from scanned stereonets and read directly from an appropriately formatted text file or excel sheet. They are converted into a standard format and assembled into subsets by the means of a Subset Index and a treeview Subset Manager. The processing sheet contains modules for rose diagrams, statistics, stress tensor determination by 3 different techniques (PBT, Right Dieder and Rotational Optimisation), Mohr diagrams and rotations. Both the PBT and the Right Dieder methods allow a direct estimation of the stress axes orientation and relative magnitude, respectively based on the average orientation of areas of p, b & t kinematic axes of all individual data and on areas of compression and extension associated to right dieders of all individual data combined in a single stereonet and representing the possible orientation of the sigma 1 and sigma 3 stress axes. These two methods produce approximate results that are refined with the Rotational Optimisation procedure, during which a number of solutions are tested by calculating the resolved stress on fault planes in order to minimize a misfit function. This misfit function combines a first term that exploits the directional part of the resolved shear stress (orientation and sense) for minimizing a misfit angle and a second term using the resolved magnitudes for optimizing the resolved normal and shear stresses magnitudes to favor slip on the plane. A special care has been paid to the interactive procedures for data filtering and separation into homogenous subsets, allowing several starting points. A quality ranking procedure was also developed in collaboration with the World Stress Map project. Win-Tensor has been widely distributed and applied to geological and sismotectonic case studies in a large variety tectonic settings. More informations on:
http://users.skynet.be/damien.delvaux/Tensor/tensor-index.html