Faulted geological contacts: constraining uncertainty of discontinuities orientation using triangulation and combinatorial algorithm

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Subsurface information is usually a limited resource in geological modelling. This is not the case, however, for the Kraków-Silesian Homocline in central Poland. It was subject to rapid exploitation of ore-bearing clays in the second half of the 20th century. Exhaustive geological documentation remained after this activity had ceased and it contains thousands of borehole records. A small part of this resource has recently been incorporated to propose a new method for determining the dominant orientation of a selected geological contact. This new method regarded Delaunay triangles as source of local orientations that were then analyzed on stereonets. The geological contacts in this region are inclined gently towards NE, but they are also faulted and indicate some stratigraphic noise which makes the extraction of dominant orientation a challenging task.

It is still unknown, however, to which extent the proposed modelling approach is capable of detecting faults and calculating their orientation. This is particularly important for the introduction of a new method for the recognition of faults based on investigating spatial distribution of orientation patterns. This expert-guided methodology assumes to relate orientation trends with genetic trends and investigate them on 2D maps.

In this research, we built synthetic models of faulted contacts to observe the behaviour of triangles intersecting the fault surface. To observe the variability of the orientation at larger scale, and perhaps to constrain it at the same time, we applied a combinatorial algorithm for creating all three-element subsets from an n-element set. The employment of this combinatorial approach allowed to achieve a better clustering effect around the expected orientation. The limitation of the proposed approach can be attributed to some unexpected and unintuitive orientations. Compared to previous studies these singularities seem to be geometrical and not numerical in nature.