"Geometric filtering" of remote-sensed lineaments and search for geological rules of their distribution. Application to the Monferrato succession marly-arenaceous succession (NW-Italy).

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The remote-sensed lineaments are usually used to simulate the fracture and fault networks. This procedure should be grounded on the similarity between the rules which arrange the statistic and spatial distribution of the lineament systems and those that control the distribution of the faults and fractures. The understanding of these rules depends on the reconnaissance of the structural association which the faults and fractures belong to. If this condition is satisfied, the remote sensed lineaments could be used for 2-3D modelling of fractures and faults.
In this study, statistical, geometrical and hierarchical comparisons between remote-sensed lineaments from the ERS-2 SAR and Spot HRV satellites and geological field data have been done on strongly deformed marly-arenaceous successions (Monferrato domain, NW Italy). The combined use of radar and optical images led to clearer identification of lineaments and reduce the influence of their illumination directions on lineaments identification.
A statistical and geometrical characterization was therefore made on the basis of their distribution and lineament length (frequencies classes and cumulative length), hierarchical relationships and type of intersection. Four lineament systems (L1M, L2M, L3M and L4M) were individuated which revealed distinct geometric similarities with the recognised fault and fracture systems.
The geological affinities of lineament and tectonic structures were instead difficult to establish. Nevertheless, a comparison has been tempted, since a detailed structural and kinematic model was available for the studied domain (Monferrato).
This comparison has been done in two ways:
- through the correspondence between the areal distributions of the lineaments and the faults and fractures. The lineaments were divided, according to their geometry, into three sectors that in fact correspond to main tectonic sub-domain or structurally homogeneous sectors;
- through the similarity between the geometry and hierarchy of the lineaments and those of the faults at all the scales.
In this way, has been possible to establish geological correspondences of lineament systems and faults and fractures well known on the field.
The L1M system architectures points to strongly fractured zones and it could correspond to transpressive shear zones consisting of many hierarchic orders of subsidiary shear planes; the L2M system has been related to left-lateral strike-slip fault systems; L3M system could correspond to pluri-kilometric throughgoing strike-slip fault zones that bound the main tectono-stratigraphic units of the Monferrato domain; and L4M system probably correspond to neotectonic faults whose understanding by field geologist is presently on-progress.
In conclusion, since the lineament systems correspond to actual tectonic structures they can be use to simulate faults and fractures network. In this way, the geometrical and statistical properties that rule the lineament distribution could be directly used for working out more realistic stochastic models.