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Machine Learning and Artificial Intelligence



High-order fault observation association using Random Forest from analog structural models

Amandine Fratani¹; Guillaume Caumon¹; Radu Stoica²; Jérémie Giraud³

¹RING, GeoRessources, Université de Lorraine/CNRS, France;

²Institut Universitaire de France; ³Université de Lorraine, CNRS, IECL, France

During the geological modelling process, the interpretation of 3D faults can be ambiguous and uncertain from incomplete observations such as fault traces of 2D seismic images or outcrops. The problem of associating partial fault observations has recently been formalized using a graph formalism in which each fault observation is represented as a graph node, and graph edges carry the potential of pairwise associations. The related likelihood of an association is computed using selected expert geological rules. However, fault observations are not pairwise independent, which prevents the consideration of higher-order effects such as the distribution of the throw along several aligned nodes. To complete this approach, we propose to consider a multiple-point likelihood computation to extend the graph. The definition of expert rules in a multiple-point problem is difficult because of the very high dimensionality of the problem. To mitigate this, we propose to augment or replace expert rules by inference from analog or partly observed data. The resulting supervised machine learning model is trained from a set of selected fault features (e.g., the length of the fault trace, the throw value, ...) which are computed from fault traces extracted from known 3D geological models. The association likelihood inference is formulated as a classification problem to determine the probability that k fault observations belong to the same fault object based on the independent variables. To prevent overfitting, we propose to mimic a partly interpreted case: we split the 3D domain in two disjoint, contiguous sectors A and B, and use sector A as training and sector B for testing. First results on 3-association indicated that Random Forest retrieve a probabilistic representation of the problem completing the existing pairwise representation.

Correspondence to

Amandine Fratani
amandine.fratani@univ-lorraine.fr

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