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Estimating the complexity of 3D structural models using machine learning methods

Pablo Mejía-Herrera (1), Maria Kakurina (2), and Jean-Jacques Royer (2)

(1) MIRA Geoscience, 512B-409 Granville st, Vancouver, V6C 1T, Canada, (2) Université de Lorraine, Georessources, Vandoeuvre-Lès-Nancy, France

Abstract

Quantifying the complexity of 3D geological structural models can play a major role in natural resources exploration surveys, for predicting environmental hazards or for forecasting fossil resources. This paper proposes a structural complexity index which can be used to help in defining the degree of *effort* necessary to build a 3D model for a given degree of confidence, and also to identify locations where addition efforts are required to meet a given acceptable risk of uncertainty. In this work, it is considered that the structural complexity index can be estimated using machine learning methods on raw geo-data. More precisely, the metrics for measuring the complexity can be approximated as the *difficulty* degree associated to the prediction of the geological objects distribution calculated based on partial information on the actual structural distribution of materials. The proposed methodology is tested on a set of 3D synthetic structural models for which the degree of effort during their building is assessed using various parameters (such as number of faults, number of part in a surface object, number of borders, ...), the rank of geological elements contained in each model, and, finally, their level of deformation (folding and faulting). The results show how the estimated complexity in a 3D model can be approximated by the quantity of partial data necessaries to simulated at a given precision the actual 3D model without error using machine learning algorithms.

Keywords: Structural complexity index, metrics, synthetic structural models, resources exploration.