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Interactive comment on "Semantic Description and Complete Computer Characterization of Structural Geological Models" *by* Xianglin Zhan et al.

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In the manuscript with the title "Semantic Description and Complete Computer Characterization of Structural Geological Models", the authors present an interesting approach for a semantic description of geological elements that are commonly used in the context of structural geological modelling. The approach is fitting very well into the evolving topic of topological and semantic analyses of geological models.

In this context, however, the exact contribution of the work is not entirely clear to me. The authors combine a very detailed semantic description of geological models with an application study and my further comments related to these two points separately.

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Discussion paper

Concerning the first point, many aspects of the included semantic description show a lot of similarity with the description in Thiele et al., 2016. Even though this paper is briefly referenced in the introduction, this similarity is not evident in the following own contribution in section 2. It is correct that the work of Thiele et al. focussed on the topological analysis, but it also went beyond a pure description of topological relationships and included geological aspects. In the same way as this manuscript, the work in Thiele and al was motivated by the Egenhofer and Hering (1990) paper, and the semantic associations in Fig. 3 of this manuscript are identical to the ones described in Fig. 1 of Thiele et al. To be sure, the more detailed analysis of the 9-intersection model provided here adds interesting aspects, but the relevance of these aspects is not entirely clear (note that Thiele et al. also describe temporal relationships - so, in fact, what is implemented here with the definition of primary and secondary structures on page 13, lines 8 ff.). In the terminology of the authors, the description of Thiele and al. also includes “advanced semantic entities”. Also, the authors only describe “primary” and “secondary” elements, but many geological systems are clearly affected by more than two tectonic events.

The semantic description is then applied in a case study to evaluate how adding this information improves model construction. In this application study, it seems that the authors are applying the concepts mainly to overcome problems in the specific interpolation approach they are using. However, there are by now many modeling approaches that include aspects of geological reasoning (e.g. Calcagno et al., 2009; Mallet et al., 2004; see also our recent overview in Wellmann and Caumon, 2018 for more references), as well as “advanced semantic aspects” like unconformities, faults, intrusions, etc. This does not mean that the analysis of topology may not add very important aspects that these methods still do not consider, but it should be mentioned more clearly what exactly the authors aim to add.

In my understanding, the main contribution in the case study is that the authors use semantic entities to quickly evaluate if a generated geological interpolation conforms to

the expected setting. If my interpretation is correct, then it would be good to focus the case study on this aspect and to describe more clearly how the semantic relations are estimated from (independent?) data. In Part 3./ page 21, the authors only describe that this information is taken from seismic data - but if this is the case, then is this based on 2-D or 3-D seismic data? And if 2-D: how many lines, and how is it evaluated if the 2-D analysis is really representative of the 3-D topology? In the section on model reconstruction (4.2), the semantic description is then used as a way to check model modifications - but it is not clear on which basis, for example, control points are added (line 22). Maybe a simple example would help here.

In section 5, the authors then describe their iterative approach of semantic evaluation and model construction. As stated before, this is a very interesting aspect in this paper. However, in the motivation of the approach, it is simply stated that existing modeling methods ignore these semantic aspects (page 31, line 5) - a statement that is (1) given without any references, and (2) not generally correct (see comments above). A clearer description of the own contribution would be helpful here, and a more detailed comparison to existing literature.

The organisation of the manuscript is overall clear, with the definition of the methods and the application in a case study. One aspect that should be adapted is the mixture between the “Methods” section 4 with the actual case study. It would be better to clearly separate both parts, or completely combine them into a section “Case study”. I personally found the detailed “workflow” descriptions in section 4.1.2 more confusing than valuable. Maybe a graphical representation in a workflow diagram would be better suited here.

Overall, the manuscript is written in clearly understandable scientific English. Some parts would benefit from a more thorough proof-reading, with several (minor) grammatical mistakes and unclear sentences. Some of the terminology in the section on the semantic elements is not consistent with commonly used terms in the field of structural geology - a thorough checking of these terms would be helpful. The figures are

generally clear and helpful, but some information is a bit redundant (e.g. Fig. 17) and several figures could potentially be combined in fewer figures (the manuscript currently contains 20 figures).

In summary, the manuscript contains many interesting aspects - but lacks almost completely references to previous work and other modeling approaches. This aspect is especially evident in the (very short) discussion, which does not place the contribution into the context of existing literature. Without a more detailed placement of the own work in the context of this previous work, the scientific contribution can hardly be judged. This refers to both the semantic description, as well as to the application in the case study. With more clarity about this aspect, the work could potentially add very interesting aspects to the field.

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