

## GENERAL COMMENTS:

The manuscript provides a new method for automatic fracture detection and analysis from 3D point-cloud data. I like the general approach taken here and I believe that this method could be of great benefit to practitioners who want to perform fracture characterization more efficiently. The manuscript is interesting, and once concerns have been addressed, should be of interest to a broad readership. The manuscript suffers from some major issues, however, and I therefore recommend Major Revision.

My greatest concern with the manuscript is that in its current form, not enough attention is given to ground-truthing of the proposed method. Given that this method is supposed to provide an accurate, efficient, and reliable approach for fracture detection, the authors need to prove that the technique actually works. The first time I saw any comparisons with field data was in the Discussion section – given the importance of ground-truthing, this data should be in the results sections, and probably very early on. Further, more detailed comparisons between digital and field data are needed.

>>> First of all, we would like to thank you for your useful comments on our manuscript. As you suggest, we will recast completely the discussion and the results sections, to move new data (field data and their comparison with the tool data, density calculations, ...) in the results part. In return, we will simplify and shorten the actual results description and also the geological context as you suggest in the other comments.

My second concern is that this code or workflow is not available for testing and implementation by reviewers and/or the wider community. If I am to critically assess this code, I need access to it.

>>> We sadly cannot provide the full code as it is implemented in the GeO2 visualization technology which is the property of Tessaël, and we plan to develop a business plan with this technology in the next development steps. The paper aims to present the applied workflow for automatic fracture plane detection and properties extraction. However, and as the second reviewer suggests also, we will work on better describe the applied methodology and compare it with other technologies in the literature (with region growth, clustering approaches, etc.). We hope that this will compensate for the absence of open code.

A third concern is that the paper is poorly organized. The geologic setting section is too long, confusing, and a mix of geologic setting and acquisition workflows. The discussion section is almost entirely composed of primary results with not enough consideration of wider implications, reference to other work, potential pitfalls of the approach, or scope for future developments. Major reorganization of the results and discussion sections are needed.

>>> As described before, we will shorten and reorganize the geological settings and separate them from the methodology, and also completely rearrange the results and discussion. The discussion will centre on comparing our fracture recognition method and approaches with others available already on the market and in published literature. In a subsequent stage, we will explore additional development steps.

Finally, there are a number of typos throughout the paper, and the discussion has a number of places where the authors intended to cite references but left them blank. This gives the overall impression of the manuscript being a bit rushed, with a lack of attention to detail.

>>> Thank you for pointing out the typos and missing references; we'll thoroughly review and address these issues for an improved manuscript.

#### **SPECIFIC COMMENTS:**

1. Section 2.1 is currently too long and a bit confusing. This paper is not focused on geologic histories, deformation conditions, fracture genesis etc. and as such I think this section could be shortened substantially. I'm not convinced the reader needs the level of detail provided in sentences such as "*magmatic association of acidic to ultramafic rocks, high pressure rocks and migmatites formed by partial melting of pelitic and quartzofeldspathic rocks*", given that this is in essence a methods paper.
2. Acquisition tools and workflows are also currently included in Section 2.1 which is confusing. I suggest that the geologic setting be shortened and the data acquisition text be put into a separate subsection (in Materials and Methods). It might be good to have a table with the outcrop name, rock type, location, scanner used, point-cloud density, outcrop area etc. This would make this information much more easily accessible to the reader without the need for a long section about the geologic setting.

>>> We agree with the comments 1. and 2, and as stated in the previous general answer, we'll condense the geological settings section and create a separate workflow description with the table you recommended.

3. Section 4.1.1 (Comparison with 1D scan lines) should be in the Results section of the paper. Primary data is presented here and therefore it is not really appropriate to have this in the Discussion section. Further, given my concerns about ground-truthing of your data, I think it is very important to present any comparisons with field data more prominently.

>>> As previously stated, we intend to enhance the comparison with field data in the results section, making it more robust and comprehensive.

4. Section 4.1.2 (Comparison with 2D maps). This section is confusing. Are you comparing your data to your own 2D maps or those already published? It is difficult to tell from your text.

>>> We will undertake a comprehensive revision of this section, incorporating 2D fracture maps of the outcrop under study. Additionally, we will delve into a more detailed and precise discussion regarding the comparison between the gathered data from automatic recognition and the observed field data.

5. Section 4.2 (Implications for DFN models). This section is full of primary results related to calculated P21 and P32 values. According to your abstract, this is one of the main objectives of your approach so I don't understand why this is not included in the results section?

>>> In response to these valuable comments, we will reposition this segment within the results section, providing greater clarity regarding the objectives and implications of our P32 calculation. Addressing the second reviewer's concerns, we will provide a more comprehensive description of our approach for calculating the 3D density of the fracture network in the results section. Furthermore, we will engage in a thorough discussion of the broader implications and limitations of this calculation in the discussion.

Specific comments and edits in the attached PDF.

Thank you for the corrections made in the PDF. We will rectify the grammar and typographical errors, as well as rephrase sentences where there is uncertainty regarding their intended meaning.

Regards.

Adam Cawood,

San Antonio, Texas

8 July 2023