How to reconstruct accurately, automatically and without bias the 3-dimension structural architecture of a geological volume based on sparse geological and structural data? Over the past two decades, the authors have developed and incrementally improved a workflow to answer this question. The paper is well structured and makes a commendable effort to guide the reader unfamiliar with the topic and place the new approach they propose within the context of earlier works.

The paper is cognitively challenging, and demands some level of mental flexibility, … I am still chewing on the finite rotation of the gradient of a vector field by the angle this vector field makes with the gradient of another but related vector field, which is perpendicular to the geological structure it represents. Fortunately, the paper includes some examples of application to document the advantage of their new approach, and a Jupyter notebook to allow readers to test and explore the proposed workflow.

The proposed new approach presents some significant advances and for this reason, the paper is definitively worthy of being published. However, the text and the figures demand some attention (see below). Given the difficulties inherent to the subject, the text must be as accurate as possible, and as easy to read as possible. I invite the authors to carefully revisit the text with the objective to improve its readability. The lack of appropriate punctuation must be corrected.

Kind regards,

Patrice

Title: In the title, consider removing "Realistic".

Line 1: … *faulted surface observations*. This is a bit confusion. Replace with "surface offsets" or "marker offsets" as my surface observations are never faulted.

Line 2: Remove "… *that are seen in all tectonic settings*" and enjoy a shorter sentence.

Line 5: Drop a full stop after "… *into geological surface modelling*", and start a new sentence with One approach …

Line 7: Since there are two approaches, replace "*Another approach builds*…" by "The second approach builds …"

Line 11: Add a coma after "*In this study*…". Add a coma after "… *implicit surface* …", add a coma after "… *restore observations*…".

Line 12-13: Replace … *prior to interpolating* … by "prior to interpolate" and consider using comas in this long sentence.

Line 13: Replace "*This approach can build* …" by " This new approach can build…".

Line 14; "… *complex fault stratigraphy* …" ??? consider " … complexly faulted stratigraphy…"

Line 15: Consider replacing *"Our approaches show …"* by "Our approach shows…"

Replace *" … the faulted surface geometry …"* by " … the faulted surface …"

Line 17: Add a coma after "(e.g., intrusions, fold series)" and a coma after "e.g.".

Line 21: Replace "… *from only field observations* …" by "… from field observations only …".

Line 23: We rarely use our biases; we fall victim of them. So, I propose: "Structural geologists typically use their knowledge and expertise to formulate a working hypothesis in a digital format, which often derives from a biased conceptual mental picture (Jessell et al., 2014)."

Line 31: Add a coma after "In this contribution". In general, can you please – when appropriate - add comas to facilitate the reading.

e.g. add a coma at the end of: *"Rather than applying the fault kinematics to the modelled surfaces …"*.

Full stop missing at the end of line 44.

Line 47 replace "e.g." by the more appropriate "e.i.*,*" and don't forget the coma after "e.i.".

Line 56: Add coma after "… *model realisations*".

Line 57: Add coma after "… *In this probabilistic framework*".

Line 62: Replace "… *to an already interpolated surface.*" By "… to a surface already interpolated.".

I am not familiar with the concept of "fault ellipsoid". Can you please briefly explain?

Line 83: Remove *"by"* in "… *previous work for modelling folds by* …".

Line 83: Add a coma after "*In this paper* …".

Line 84: Remove *"used"* in "… *for in integrating faults used in LoopStructural* …".

Line: …. *ranging in complexity from* … <u>to</u> *a thrust* …., *and* <u>to</u> *a faulted* …

Line 136 and 144: Replace *"work flow"* by workflow, here and everywhere in the text.

Line 136: Add a coma after "*In their approach* …".

Line 156: "*Trishear has been used to understand the structural evolution that has resulting* …" … replace "*resulting*" by "resulted".

This first part of the paper is certainly interesting and interesting, but the absence of illustration means that readers have only textual information to develop an understanding of the 3D geometrical meaning of each approach. Adding some figures would definitively help readers who not familiar with this topic.

Line 181: "… *when evaluated in the model domain*…" add comas at both ends.

Figure 2: A/ Simple reverse fault ???!!! am I losing my structural geology, or is it a normal fault?

Line 228: Replace all instances of "*work flow*" by "workflow".

Line 268: Replace: "… *the displacement of the fault is separated onto multiple* …" by " … the fault offset is partitioned onto multiple … "

Line 275: Add a coma after: "*To model multiple connected faults* …"

Line 290: Remove the coma (I can't believe I'm making that request) after "…*containing the intersection*…".

Line 291: Replace "*e.g.,*" by "i.e.,".

Line 291: Fix the double "*an*".

Line 294: Add a couple of comas.

For coherence, in figure 3, please use A, B and C, instead of a, b and c.

Line 311: Add a coma after, "*In the following section* …" and consider removing "*will*".

Line 313: Jupyter notebook? Excellent!

Line 321: Replace " … *500m* …" by "… 500 m …".

Figure 5: Red? To me it looks brown?

Line 336: I suggest: "Applying a constant displacement implies making the assumption that …"

Line 340: This sentence doesn't work.

Figure 7D: Can you please use different colours for the young and old faults?

Line 386: "*The fault surface (red)* …" , yet in figure 8, the fault trace is black.

Line 396: "*The fold axis can be locally defined by rotating the gradient of the fold axis direction field by the fold axis rotation angle around the gradient of the fold axial foliation.*" Who am I to argue against that … seriously this is cognitively very demanding, even with the help of figure 9. Consider replacing "*The fold axis can de locally defined …*" by "The orientation of fold axis can de locally obtained …".

Line 410: I don't see any blue curve in Fig.9, and I am not colour blind … I think.

Line 456: … *displacement of faults* … ? Doesn't sound right.

Line 456: Remove "…on other geological surfaces…".

In all figures, please capitalize the first letter of each sentence, e.g., replace " *… offset. B) shows the same …*" by "... offset. B) Shows the same …".

Figure 1: In panels C and D we can't see the fault properly.

Figure 2: Your "Simple reverse fault" looks like a simple reverse fault. Check also the figure caption, which also refers to a reverse fault.

Figure 3: Consider using plural: fixed interpolation node<u>s</u>, active interpolation node<u>s</u>, and inactive interpolation node<u>s</u>. Also, inactive interpolation nodes are represented by white circles in panel c), but the key shows a pale grey circle.

Figure 5: The caption refers to a "red surface", I see none in the figure.

Figure 6: There is a variation in the thickness of rock formations in the footwall. Is this the results of the modelling? Consider "fault vector field" instead of "fault vector". Add a full stop at the end of the figure caption.

Figure 7: In panel D using a different colour for the younger fault. Capitalize … e.g., C) Hanging wall points …

Figure 8: Be consistent … A. Geological <u>m</u>ap, yet B. Fault <u>D</u>isplacement Vectors, and C. Restored <u>m</u>ap. Either you capitalize or you don't. Same in the figure caption …

Figure 9: Be consistent, and consider replacement in the caption: "*A.*" by "A)", "*B.*" by "B)" etc. To be consistent with other figures.

Figure 10: "<u>*Block Model*</u>", yet "<u>*Stratigraphic surfaces*</u>", be consistent.