Solid Earth Discuss.,
https://doi.org/10.5194/se-2018-35-AC2, 2018

Solid Earth Discussions

Interactive comment on "Bimodal or quadrimodal? Statistical tests for the shape of fault patterns" *by* David Healy and Peter Jupp

David Healy and Peter Jupp

d.healy@abdn.ac.uk

Received and published: 9 July 2018

We thank the reviewer for their concise and constructive comments on our manuscript. We address the issues raised in sequence in the text below, complete with any explicit changes we have made to our manuscript.

1. The paper is written as a statistical manuscript and not as a tool for geologists. The methodology is presented as a black box without sufficient explanation on the rationale behind it and/or the statistical terminology. Below are few examples. a. The "eigenvalues of the 2nd and 4th rank orientation tensors" have relations to the actual distribution of the orientation data. The authors MUST give the eigenvalues AND the associated eigenvectors of the idealized cases of Figs. 1 d-f. b. The R language was

probably chosen due to its power in statistical calculations, but the link to the code (lines 85-86) does not work and the potential users MUST get a compiles code. c. The paper presents the calculations results in relative length, with almost no discussion of the geologic significance.

Reply: our methodology is definitely NOT a 'black box'! We present the underlying equations AND the source code for our software. a) The idealised cases in Figures 1d-f are just schematic, as noted in the caption; b) The link to the code has been corrected and now works, together with a new user guide; c) Our ms contains over 2 sides of Discussion of the results, centred on their geological significance.

2. It is not clear why there is a need for 16 synthetic sets (Fig. 3, 4), it appears as an exercise in statistics rather than a tool for geologists. Cut to 6 synthetic sets. This will also shorten the paper.

Reply: we disagree, strongly, on this point. The synthetic datasets have been carefully chosen to cover a range of cases to mirror the spread of natural datasets. We vary kappa, the concentration parameter in the Watson distribution, and n, the size of the dataset, for both bimodal and quadrimodal distributions. Statistical rigour demands that we test our method across the expected span of natural datasets.

3. Lines 200-216 are the key for understanding the rationale of the method, but the authors just describe Fig. 6 without explaining the PHYSICAL meaning of the eigenvalues of S1, S2 and S3 and their relations. For example, Fig. 6 is a modified Flinn diagram is a presentation of the shape of strain ellipsoid by displaying the relations between strain axes of the ellipsoid. Such links to geology will strengthen the utility of the paper.

Reply: there seems to be a misunderstanding about Figure 6. It is indeed a modified Flinn plot after Ramsay (1967), showing the ratios of the eigenvalues of the orientation tensor (or matrix). Flinn and Ramsay were concerned with the eigenvalues of the strain tensor. There may be a relationship between the strain tensor and the orientation

tensor of a faulted region but that is beyond the scope of our manuscript.

4. The paper deals only with the orientations of the fault surfaces, while the proposed method can be applied to other structural elements in geology. For example, the slip directions along faults that are essential for stress inversion and strain inversion of fault data, orientations of cross-bedding in sandstone deposits, and the orientations of joint sets (for separation of extension phases). This limitation by the authors simplifies the analysis, but restricts its utilization. It is suggested that the authors discuss the other cases of oriented data and maybe suggest possible utilization by the proposed method.

Reply: we present our new method with a focus on discriminating between bimodal and quadrimodal fault patterns. We emphatically do NOT restrict it's utilisation for other applications: in contrast, by providing an open access manuscript and open source R code we are ENABLING application to other domains. Moreover, the precise nature of the suggested application of our method to these other domains (slip directions, cross-bedding, and joint sets) remains unclear. In terms of fault patterns, we are addressing a problem in the underlying symmetry (or lack thereof) in the orientation distribution, and the implications this has for the mechanics of brittle failure.

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2018-35, 2018.