

Response to reviewer 1

Thank you for your comments. Please find our detailed responses to your comments below in red font.

The paper is interesting and generally well written. The authors present a method to successfully estimate fractures apertures and compliances using Bayesian Full Waveform Inversion of VSP tube-wave data. However, since the method can not clearly discriminate between the aperture of fractures that are relatively close to each other, do the authors think that the method could be successfully applied in complex geological settings such as in carbonates that are usually characterized by the presence of several fractures?

Based on extensive tests, we are convinced that the method presented in this paper will also be useful in even more complex geological environments than discussed in this study. However, the method is not sensitive to the complex pore space often encountered in carbonates, as these micro cracks and pores do not produce tube waves. Although, estimates of fracture apertures of individual, closely spaced fractures are not possible, the method can still provide an effective fracture aperture distribution of a package of fractures. We have added some text to the conclusions to clarify this. Furthermore, and this is in our view one of the key findings of this paper, our algorithm will not produce the illusion of being able to discern different fracture apertures as would be the case when using a deterministic inversion approach. Instead, our algorithm infers all statistical modes that are probable given the data.

Minor corrections:

- Figure 1; please consider improving the resolution so that the different phases can be followed easily.
Given that the temporal resolution of the data is quite high, we assume that you refer to depth resolution. We do indeed agree that the figure does not look great. However, these are real data that were measured with a depth resolution of one trace per 0.5 m, which is a typical value for surficial high-resolution VSP surveys. This inherently limited depth resolution is reflected in the figure and cannot be improved without heavily interpolating, and thus, biasing the original data. However, it also nicely illustrates that the proposed inversion algorithm can handle such data well, despite the seemingly low resolution with regard to depth.
- Page 6 Line 135: remove “thus”.
The only “thus” on page 6 is on line 153. We assume you refer to this one and removed it.
- Page 6 Line 158: ”A time-gated version of...” please specify the window size.
The window-length is 10 ms. We added this information to the manuscript.
- Page 8 Line 175: change ” We have run” to we ran.
Done.
- Page 9 Line 193: Please consider changing “might explain the data well too” to “might equally explain the data”.
Done.
- Page 14 Line 300: ” ... and the second fracture as small one...” replace as with a.
Done.