

Peer Review

Review of: "Annealed Stein Variational Gradient Descent for Improved Uncertainty Estimation in Full-Waveform Inversion"

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This work makes a nice contribution to the field of waveform inversion in seismic imaging, studying the application of a less commonly known algorithm, namely the Stein Variational Gradient Descent (SVGD), to the Full Waveform Inversion problem. In particular, it compares the vanilla SVGD method to an annealed variant and furthermore introduces principal component analysis (PCA) and clustering as tools to gain additional insight into the results. The numerical tests and experiments are comprehensive, and I find the detailed presentation of results (with pictures and displays) quite thorough.

In general, Section 2 needs to add more references in every subsection; especially, the discussion on PCA and clustering needs to cite well-known works/textbooks that are common references for these materials. PCA is a very old technique in Statistics, and I only see a non-standard reference [50] for this material. I would suggest the authors add some references in these sections to literature outside geosciences, where these methods originated. Similar comments apply to the discussions on clustering and other subsections in Section 2.

I think it is not very clear what the precise contributions of the paper are, and I think it would benefit if the authors could state that somewhere in the Introduction section of the paper. In particular, the authors should state what their extensive numerical tests show about the improvements provided by annealed SVGD over the non-annealed version. Does it allow one to reduce mode collapse, for example?

Overall, I think it is a well-written paper, and I recommend acceptance after a minor revision round of edits.

Declarations

Potential competing interests: No potential competing interests to declare.