

Interactive comment on “Improving quality of empirical Greens functions, obtained by cross-correlation of high-frequency ambient seismic noise” by Nikita Afonin et al.

Anonymous Referee #1

Received and published: 5 March 2019

This paper proposes an improvement to the method of Green's function retrieval from ambient noise by cross-correlation. A specific stacking method is proposed which discards partial correlation results that are not coherent with the average correlation result. After applying an iterative procedure, a correlation function is obtained with a higher signal-to-noise ratio than the ones obtained by other stacking methods. The method is illustrated with two preliminary field data examples. The authors discuss the advantages and limitations of the method.

This reviewer is familiar with the theory of Green's function retrieval but does not have a

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broad overview of the many processing methods that have been developed. Therefore it is difficult to judge the originality of the proposed method. I recommend that the paper be reviewed at least by one additional reviewer, who is more experienced with the practical aspects of Green's function retrieval.

Assuming the proposed method is original, I recommend publication after moderate revision, taking the following comments into account:

- I wonder why the authors call their method “signal-to-noise ratio (SNR) stacking”. Aren't all stacking methods aiming to improve the SNR? The proposed method stands out because it discards incoherent correlation results. Please consider a new name, which better matches the specific aspects of the proposed method. For example: “Coherent stacking”? “Coherent cross-correlation stacking”?
- On page 2 the authors mention that they want to use high-frequency surface waves to extract information about deep structures. This sounds as a contradiction. Surface waves do not penetrate deep into the subsurface, and using high frequencies makes it even more difficult to reach deep structures. Please be quantitative about the depths that need to be reached.
- Page 3, line 2. The introduction of Δt_e via the inequality is confusing. Is Δt_e the time-lag interval, or is the inequality $-t_{ds} < \Delta t_e < t_{ds}$ the time-lag interval (as actually stated in line 2)? If Δt_e is the time-lag interval (as stated in line 7), what does it mean that it can take a negative value (as stated in line 2)? Please explain.
- Explain abbreviations, such as MEMS and BB sensors.
- Mention the area of the experiments in all figure captions (Fig1: Pyhäsalmi mine area, Fig2: Kuusamo Greenstone Belt area, etc.).

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- Figure 6a: I am surprised that the time-shift of the peak appears almost at $t=0$. Why don't you show a more representative example with a time-shifted peak, corresponding to well-separated receivers?
- Figures 6b and 6c: I think these figures (or the corresponding captions) should be interchanged: the SNR in 6b looks better than that in 6c, but the captions say the opposite.
- Figure 7. The SNR of the proposed method converges to 40. However, according to the caption of fig 6a the SNR equals 71. Please explain. Are these different experiments?
- Figs 9 and 10 show only some preliminary results of the method for both regions. These figures show that Green's functions can be retrieved and the derived velocities seem to be in agreement with earlier derived results. I would have liked to see more discussion on what can be done with these results (or do we need more data before useful inferences about the area of investigation can drawn?)
- Last but not least, the paper needs significant language editing!

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2019-29>, 2019.