# Author reply to "Comment on gi-2021-28" on GI-2021-28 by Anonymous Referee 2 submitted on on 3 Feb 2022

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We thank the referee for a thoughtful review, which has helped us improve the quality of the paper. Text from "Comment on gi-2021-28" on GI-2021-28 by Anonymous Referee 2 are in grey italic font and our responses are in black normal font. Text we added to the manuscript are in emboldened font in quotation marks.

**Reply to the views proposed by reviewer 2**

*1. There are too many curves in Figure 3. it is difficult to see clearly;*

The curves represent the amplified noise and uncertainty in the reconstructed signal and it is certainly difficult to see what this signal is supposed to show due to the noise. The very noisy graph in Figure 3a looks noisy with intent, since illustrates a case where there is too much noise amplification, and it is important that this figure remains.

*2. The experimental results of the paper show that the real response signal can be extracted from the measurement signal of slow response sensor to eliminate the influence of transmembrane effect, which is in good agreement with the measurement results of DTB sensor. However, the experimental results of the algorithm are introduced in the summary. It is not understood that the correlation R has increased from 0.18 to 0.91. Because the slow response curve is very different from the fast response curve, the correlation between the two must be very low. The correlation between the fast response signal extracted from the slow response signal and the fast response signal measured directly must be very high. It doesn't feel that it can be said to be "improved", nor can it reflect the advantage of this algorithm to obtain the fast response signal;*

The reviewer brings up a good point about the applicability of the Pearson correlation coefficient (or coefficient of determination - the Pearson correlation coefficient squared, i.e. the $R^2$). The metric of comparison we used ($R^2$) has, as any such metric, drawbacks (see e.g. Barrett, 1974). One of the drawbacks are its limitations in inferring causality. We have made changes to the manuscript to clarify that the correlation coefficient only indicates that the two time series are more similar (see for instance l.284). The key requirement for using the $R^2$ in such an application is that the model is validated beforehand. We validated that the technique work (in principle) via simulations and a controlled laboratory settings. These tests are presented prior to the field application which makes the $R^2$ applicable in our case. The simulation and controlled laboratory test are documented in sections 2 and 3. We also used the Mean Absolute Error to supplement $R^2$ as a metric for comparison.

*3. This paper mainly analyzes the influence of time step on the stability of the algorithm. Are there other factors?*

We will address this view under view 4., since we believe these two points are related in both scope and content.

*4. Based on the relevant knowledge of slow response and fast response sensors, is it a good way to directly measure fast response signals? Or is it better to extract from slow response?*

These are indeed very relevant points to address (viewpoint 3 and 4). There are several factors that affect how much temporal resolution can be recovered. The two factors are the decay time, and the measurement noise variance. The slower the sensor, the more difficult it is to recover high temporal resolution fluctuations. The measurement noise also affects how well the deconvolution can be done. The purpose of the L-curve procedure is to determine how good of a time resolution can be obtained. This procedure finds a balance between how noisy the reconstruction is, and how well the reconstruction agrees with the measurements. We have made changes to the manuscript to hopefully explain these factors more clearly for instance in l.131 where we added in: **"The quality of the solution relies on an appropriate choice of regularization parameter $\Delta t$ and noise/uncertainty in the measurements, but also on the ratio between the RT of the sensor and variance in the property of interest."**

## References

Barrett, J. P.: The Coefficient of Determination—Some Limitations, The American Statistician, 28, 19–20, https://doi.org/10.1080/00031305.1974.10479056, 1974.