Internal multiple prediction in MatLab and Python

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ABSTRACT

Weglein et al., (1997) introduced a data driven method of internal multiple prediction, based on the inverse scattering series. A research area of interest is to investigate an optimal domain in which to predict internal multiples to improve the prediction and limit artifacts. We present 1D frequency and time domain predictions, 1.5D tau-p and frequency-wavenumber predictions, and an adaptive subtraction algorithm.

1D PREDICTIONS

1D internal multiple prediction algorithms expect a normal incidence trace, over 1D geology as their inputs.

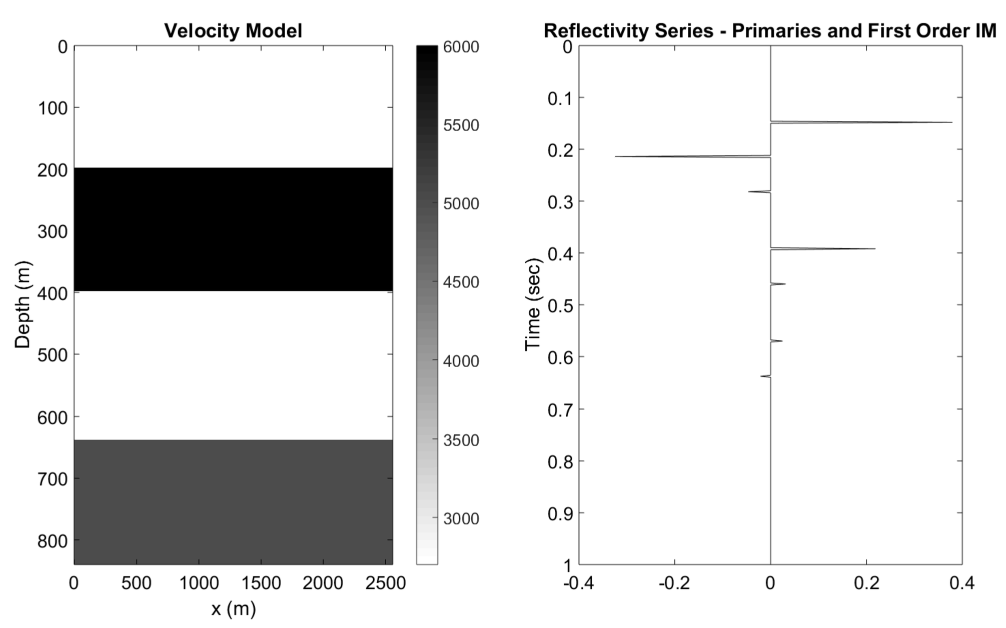

FIG. 1. Input velocity model (left), reflectivity series (right).

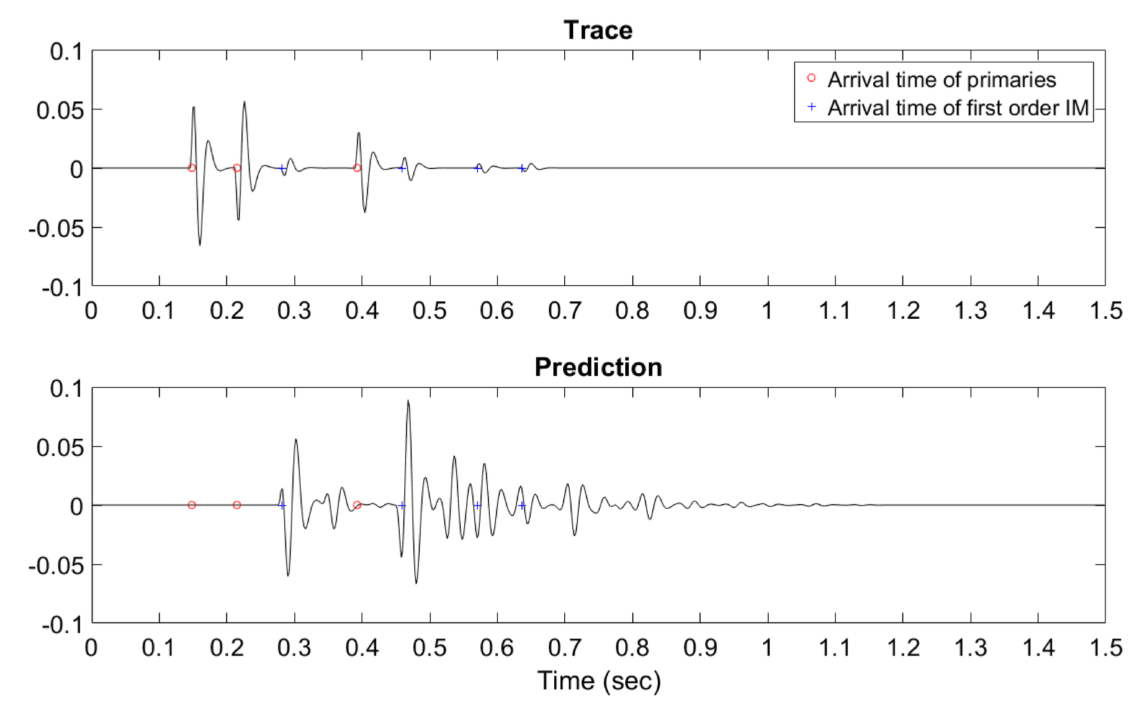

FIG. 2. Trace (top), frequency domain prediction (bottom)

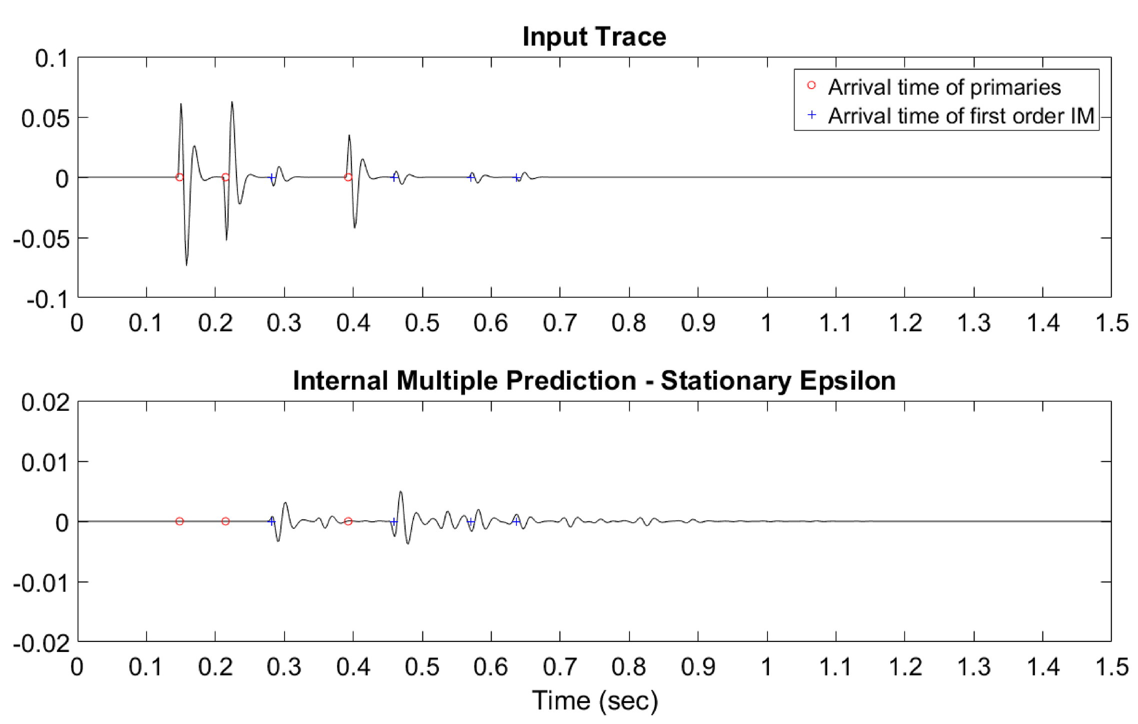

FIG. 3. Trace (top), time domain domain prediction (bottom).

1.5D PREDICTIONS

1.5D internal multiple prediction algorithms require a single shot record as their input and perform the prediction trace by trace..

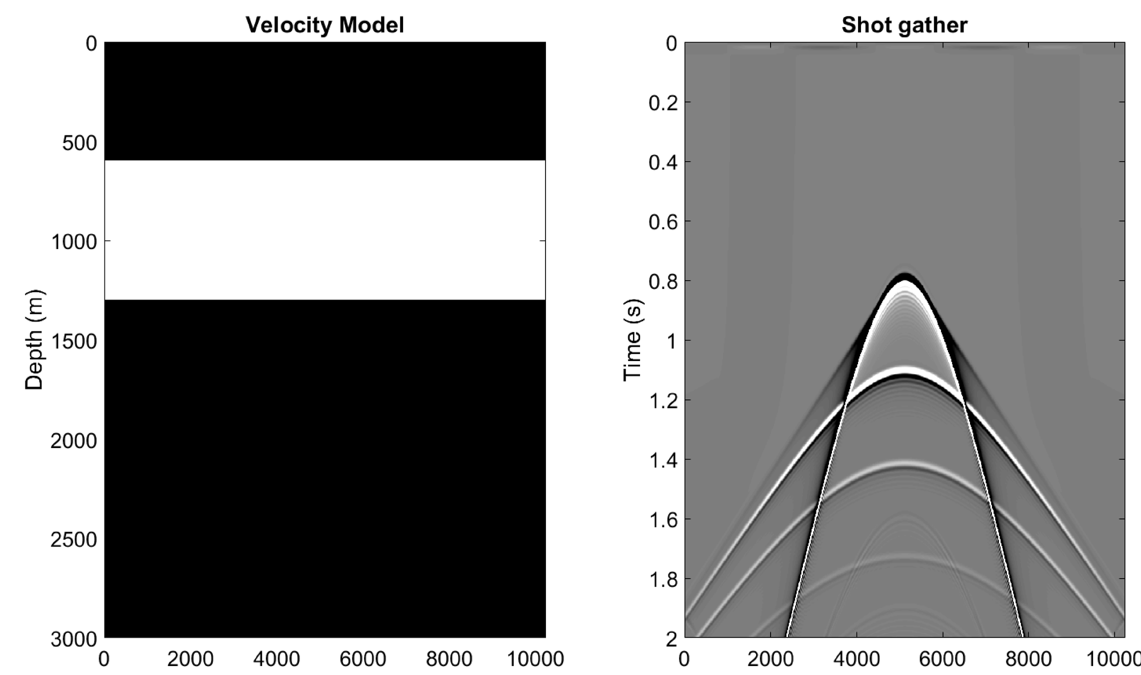

FIG. 4. Velocity model (left),shot record (right).

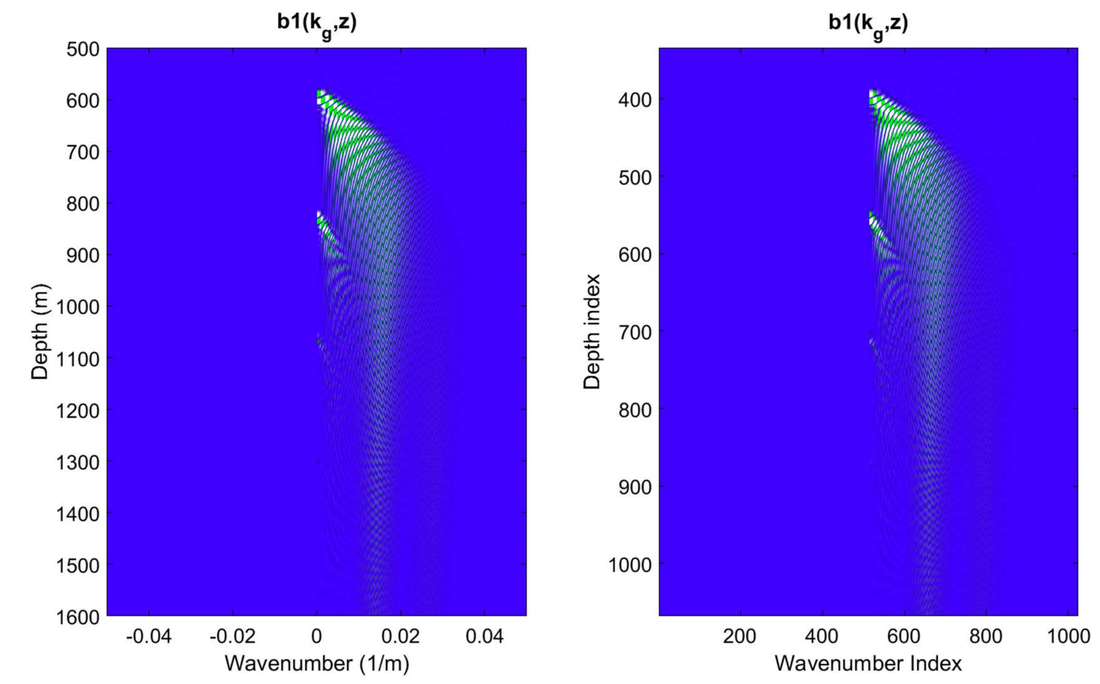

FIG. 5. Prepared frequency-wavenumber data (left), prepared data plotted against index (right).

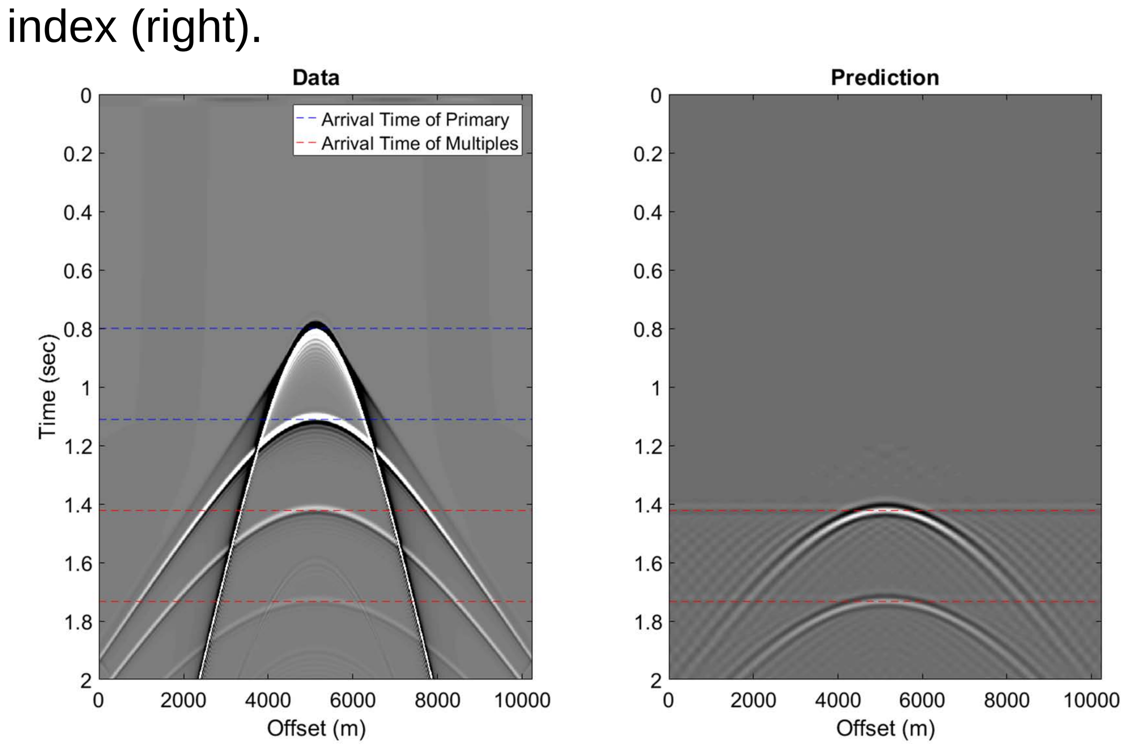

FIG. 6. Shot record (left), frequency-wavenumber prediction (right).

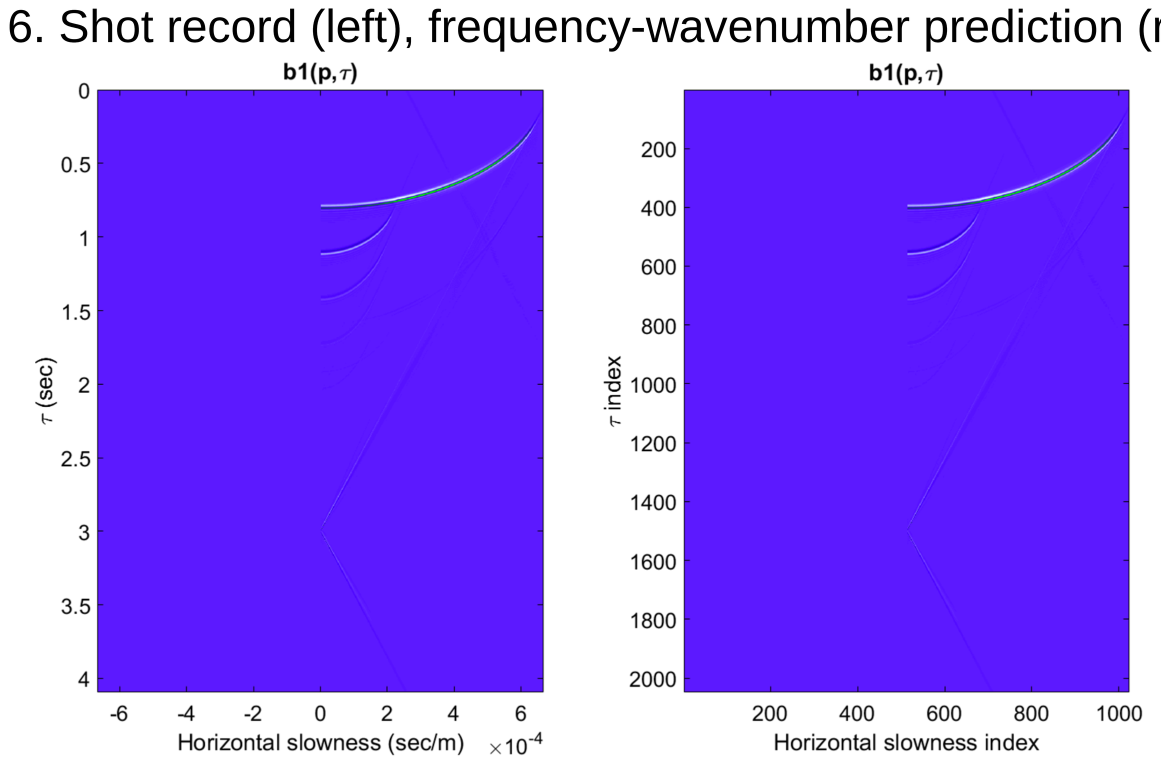

FIG. 7. Tau-p data (left), prepared data plotted against index (right).

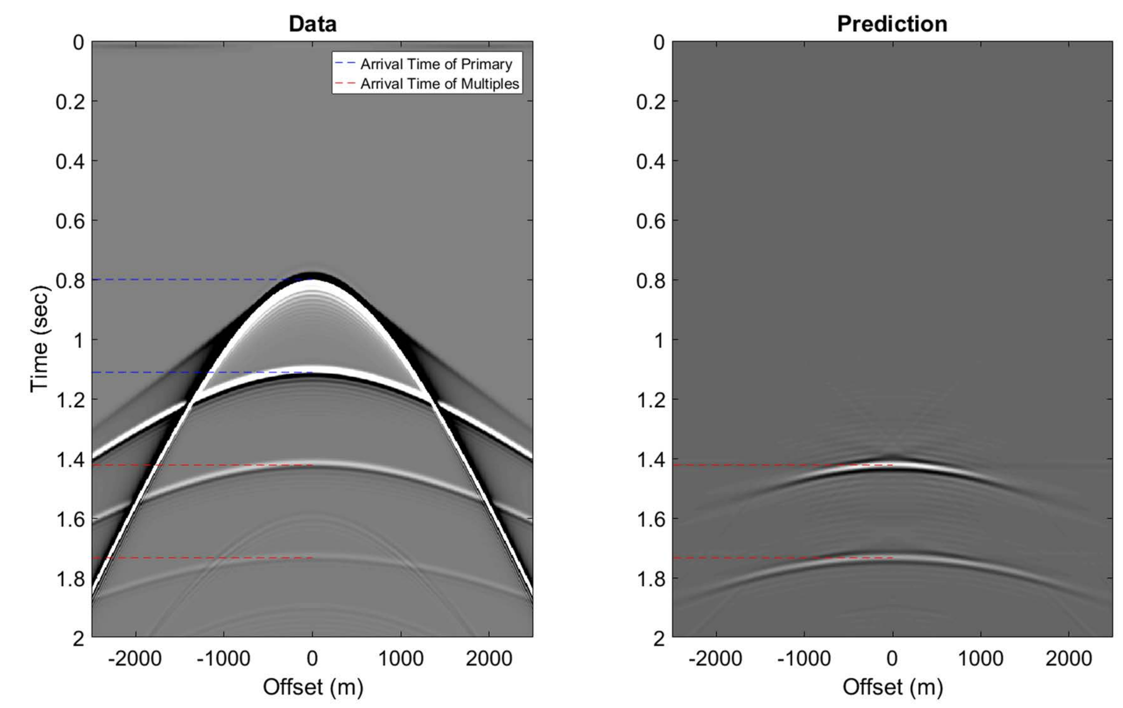

FIG. 8. Shot record (left), tau-p prediction (right).

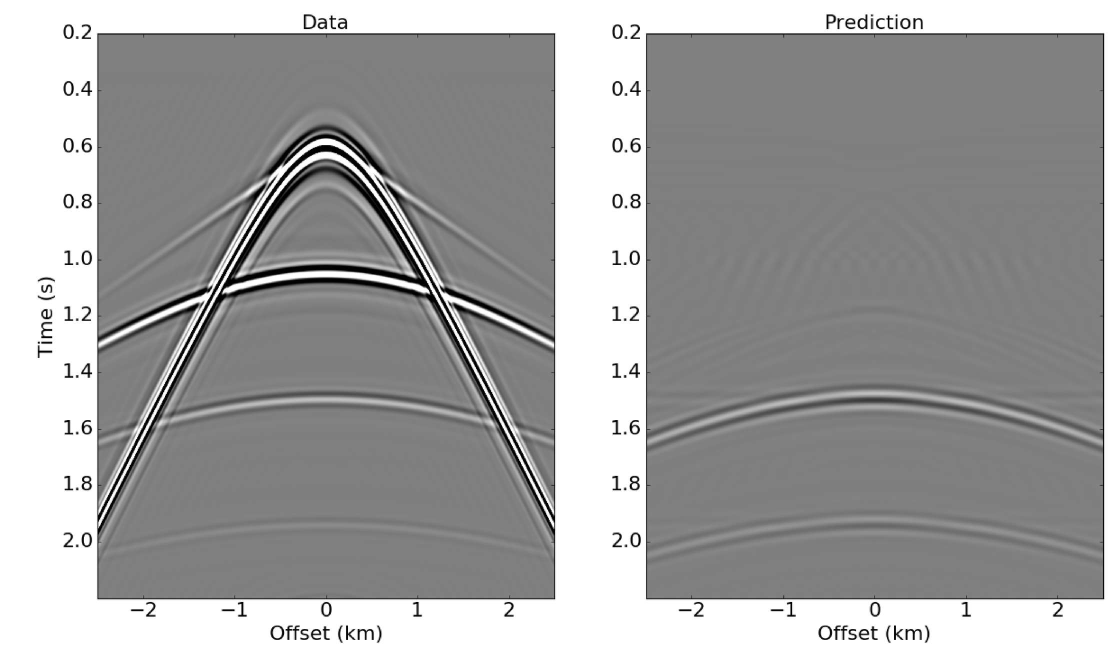

FIG. 9. Shot record (left), wavenumber-time prediction (right).

ADAPTIVE SUBTRACTION

The algorithm presented by Weglein et al., (1997) accurately predicts the traveltime of internal multiples, but only approximately predicts the amplitude. Adaptive subtraction convolves the data with a filter designed to correct for both phase and amplitude errors.

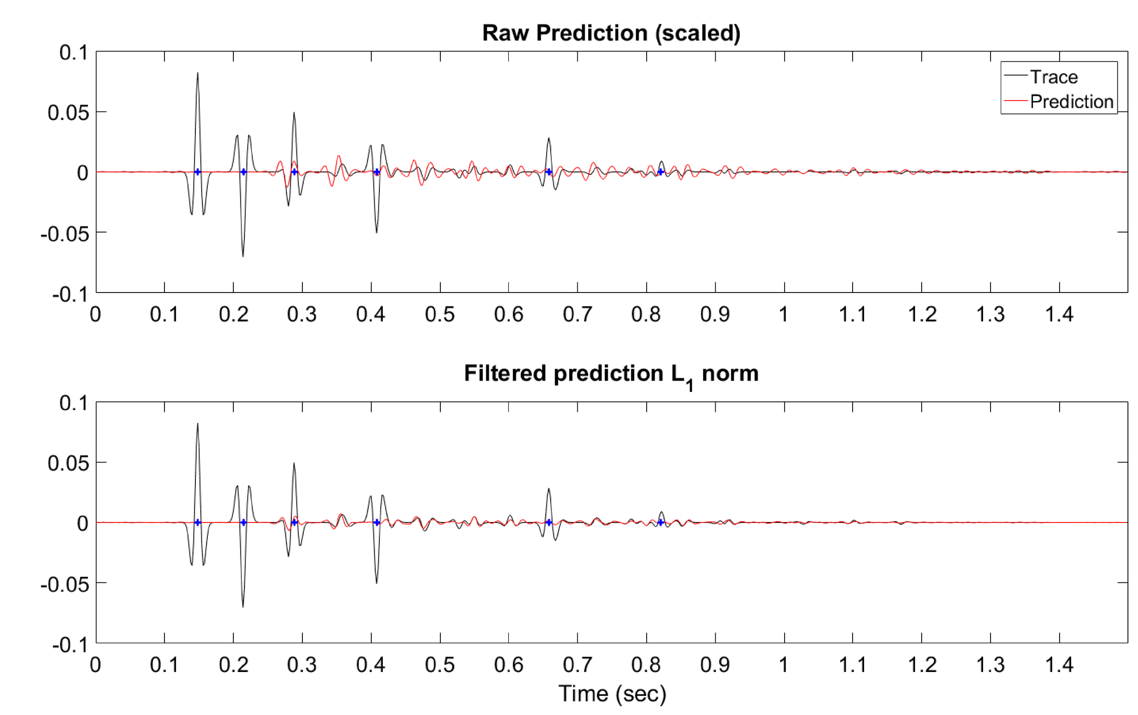

FIG. 10. Scaled raw prediction (top), filtered prediction, based on minimization of the hybrid L_1/L_2 norm (right). In this case filter is dominated by L_1 norm.

ACKNOWLEDGEMENTS

The authors thank CREWES for continued support. This work was funded through the CREWES sponsor companies and NSERC through the grant CRDPJ 461179-13.

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