APPLICATION OF PRINCIPAL COMPONENT ANALYSIS TO SIMULTANEOUS SEISMIC INVERSION

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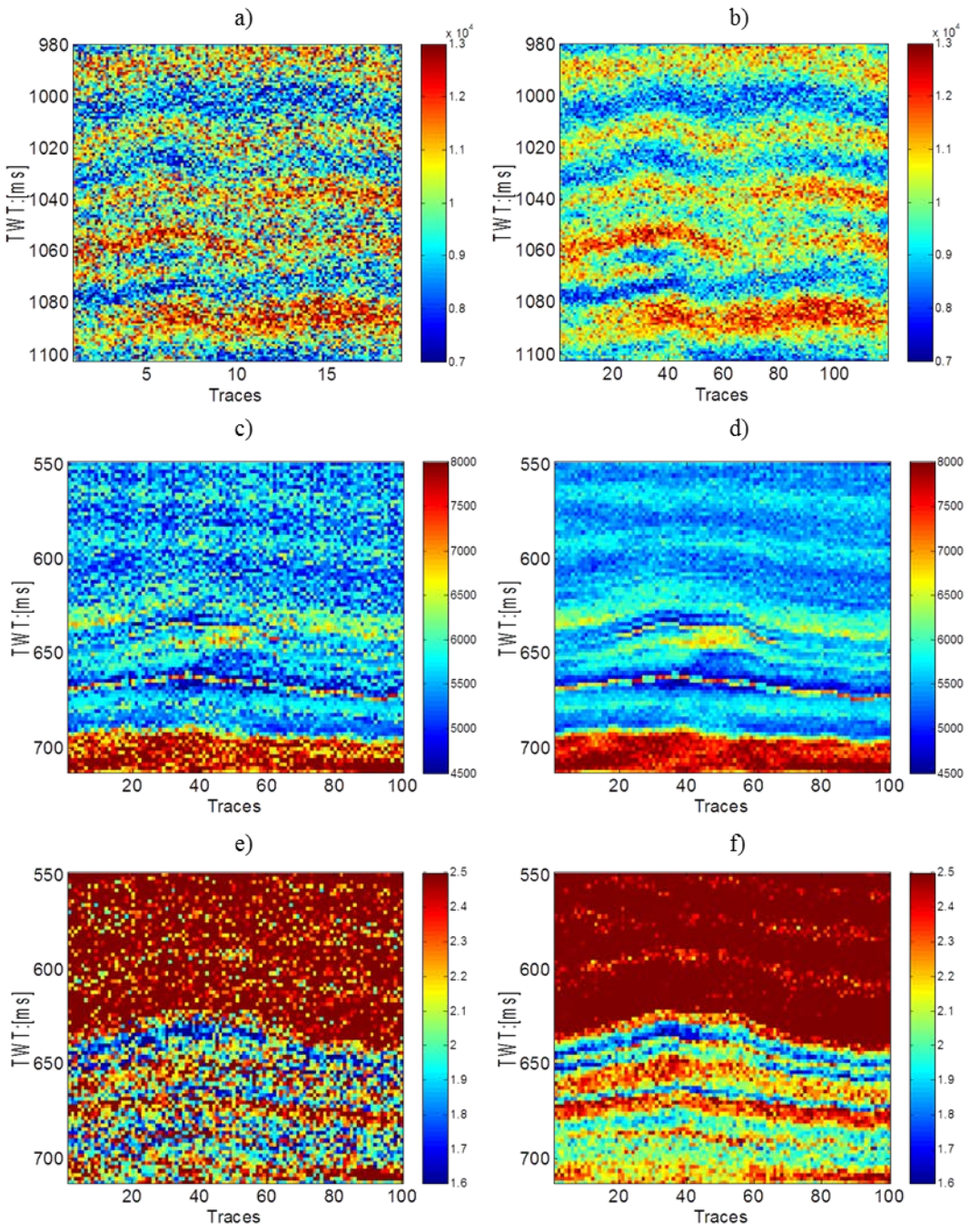
ABSTRACT

The Principal component analysis (PCA) uses an orthogonal linear transformation to project the model space with large dimensionality to a small subsurface dimension by taking advantage of strong correlation between models. In this paper, we apply PCA as an efficient parameterization tool for simultaneous seismic inversion. We start with a large number of training images sampled from the prior probability distribution. Principal components are then calculated from the covariance matrix derived from these training images. Since the number of principal components (PCs) is much smaller than the original number of model parameters, new images in posterior probability distribution can be efficiently reconstructed by only updating the weights of the PC. In this paper, we applied PCA based VFSA to both post-stack and pre-stack seismic data to invert for 2D impedance profiles. The results from simultaneous inversion demonstrate better lateral continuity than a trace-by-trace inversion using the same optimization tool. The same workflow can also be applied to 3D seismic volumes.



P-impedance profile derived from post-stack data using trace by trace inversion of VFSA a), compared with using simultaneous inversion of PCA based VFSA b); P impedance profile derived from another pre-stack data using trace by trace inversion of VFSA c), compared with using simultaneous inversion of PCA based VFSA d); Profile of P and S impedance ratio derived from pre-stack data using trace by trace inversion of VFSA e), compared with using simultaneous inversion of PCA based VFSA f).