Some applications of POCS

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POCS

- Projection onto convex sets (POCS) is a method of extrapolation.
- Data are transformed to some transform domain where the data are represented by sparse, high amplitude coefficients and the gaps by many low amplitude coefficients
- A threshold is applied, and the inverse transformed result is used to fill in missing data.
- The method is then iterated, updating the threshold.

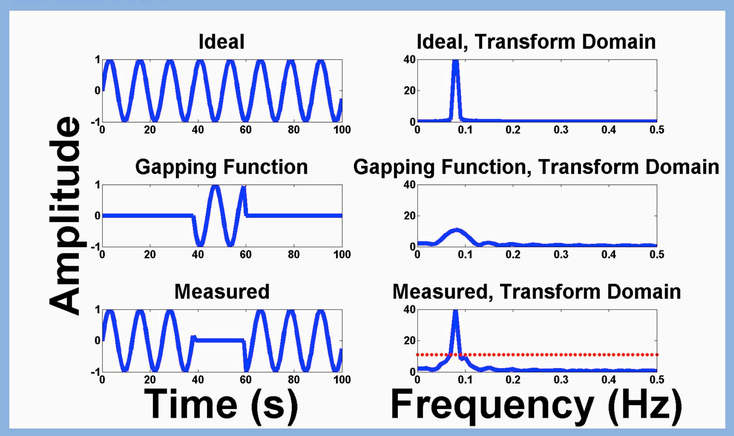

FIG. 1. The measured data is the sum of the ideal interpolated data and a 'gapping function'. Only the ideal interpolated data is represented in the transform domain by high amplitude, sparse coefficients.

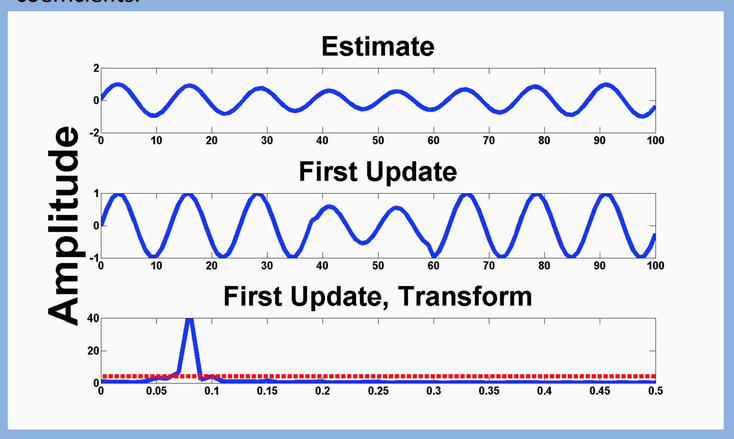

FIG. 2. After each iteration our approximation grows closer to the correct interpolation, allowing us to lower thresholds in the transform domain.

Extrapolating Low Frequencies

- Low frequencies are crucial to inversion, but are difficult to measure in real data.
- POCS can be used to recover low frequency information prior to inversion.

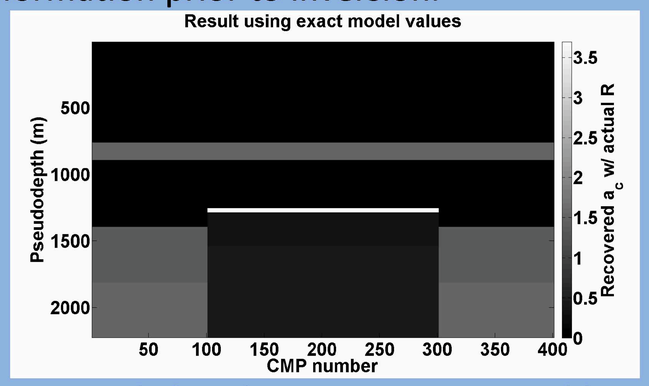

FIG. 3. Result of impedance inversion using exact model parameters. Perturbation a_c is related to impedance with a constant density assumption.

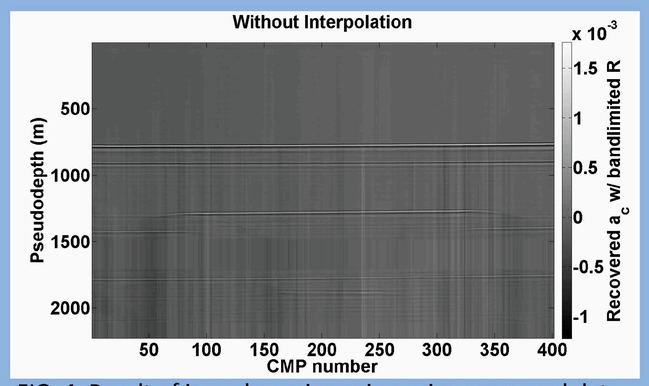

FIG. 4. Result of impedance inversion using measured data. Without low frequencies, perturbation values are not recovered.

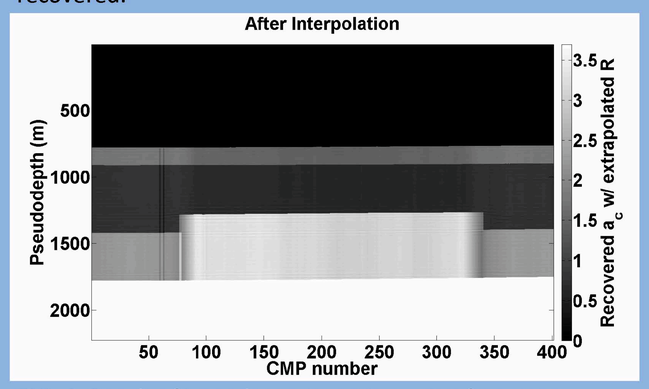

FIG. 4. Result of impedance inversion using frequency extrapolated measured data. Significant problems remain, including an inability to resolve the very thin layer, but promising improvements over Figure 4 are present.

PCA POCS

- It is important in POCS that the data in the transform domain are represented by sparse, high amplitude coefficients.
- Principal component analysis (PCA) allows us to determine principal components; vectors which each describe the maximum possible variance of the data.
- If the transform used is projection onto the principal components of the data, the sparse, high amplitude requirement should always be fulfilled.

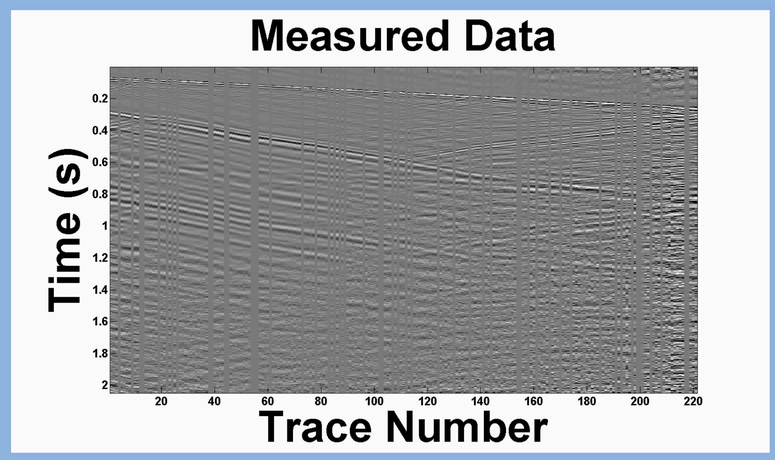

FIG. 6. Measured VSP shot gather with missing traces.

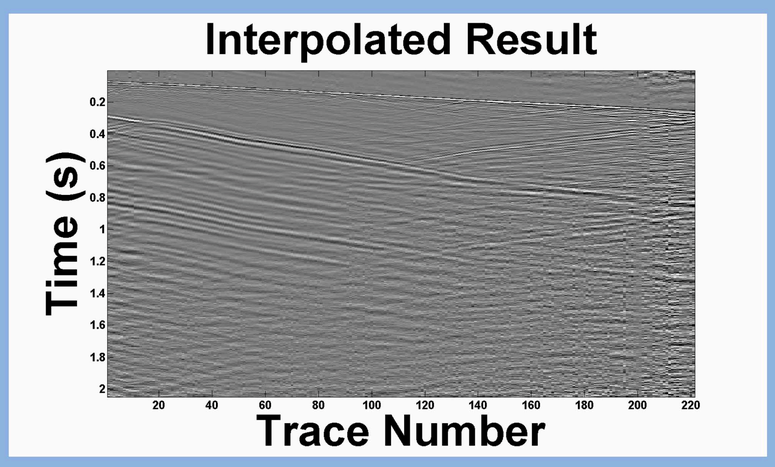

FIG. 7. Shot gather after PCA POCS interpolation.

See reports for a full list of references