
Seismic Noise Estimation and Error Propagation Applied to Post-Stack Seismic Inversion

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Inversion of post-stack surface seismic amplitudes for estimation of acoustic impedance is routine in the industry, today. Not yet routine is the assessment of uncertainty in the impedance estimate. This missing step could be critical in the Middle East, where land seismic data quality issues dominate. For example, in Saudi Arabia, impedance volumes are often used for development well location in stratigraphically controlled clastics reservoirs. The mathematical techniques for uncertainty analysis have been available for many years, but, historically, little use has been made of them in exploration geophysics. However, this is beginning to change as interest in the problem grows. Saudi Aramco is currently pursuing an internal project to assess this problem, and this presentation will review some of the progress that has been made. Some of the issues addressed are: (1) can the uncertainty analysis proceed post-inversion, or must it be included as part of the inversion process? (2) Making a clear distinction between error propagation and the estimation of errors (to be propagated). (3) Error propagation techniques – including method of moments and Bayesian methods (the latter offers the opportunity for improved impedance estimates, as well). (4) Solution methods for the Bayesian problem (5) Assumptions in the mathematical model for computational tractability, (6) Estimation of seismic noise covariance matrices (7) Wavelet covariance and start model/low frequency trend uncertainty. Both synthetic and real data examples will be shown and outstanding problems discussed. Finally, applications of inversion uncertainty analysis to porosity uncertainty estimates for reservoir model building, automatic history matching, and reserves analysis will be discussed.
