NMO, AVO and Stack

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ABSTRACT

Traditionally AVO inversion is performed on NMO corrected CMP gathers. The problem with this approach is that the way NMO is traditionally applied, it is a kinematic correction that distorts the amplitude and phase in an offset dependent fashion. This follows from the fact that the NMO inverse is ill-conditioned and unstable, so that the conjugate operator is typically applied. This paper examines a number of different methodologies to implement the inverse NMO operator and thereby get better estimates of AVO reflectivity attributes and the stack.

One way of addressing the ill-conditioned nature of the NMO inverse problem is to calculate the pseudo-inverse, using SVD and Tikhonov regularization, augmenting the problem with suitable a priori constraints. Although exact, this method is computationally expensive. More practically, this can be implemented using conjugate gradient with the number of iterations as a trade-off parameter. This results in a stretchless NMO that AVO or stacking can be subsequently be performed on.

Another approach to the problem is to combine the AVO and NMO inverse problems together, add suitable a priori constraints, and solve the joint inverse problem. The advantage of doing this is that offset dependent tuning is built into the forward model thereby excluding certain non-physical solutions that are left in the previous methodology. In a similar fashion NMO and Stack can be combined to produce a high frequency stack model.

In this presentation, these two approachs along with the traditional methodology are compared on synthetic and real data.