VELOCITY ANALYSIS BY ITERATIVE PROFILE MIGRATION

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By
Kamal Mansour Al-Yahya
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Velocity analysis by iterative profile migration

Kamal M. Al-Yahya, Ph.D.
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ABSTRACT

In conventional seismic processing, the normal moveout (NMO) equation is used for velocity analysis. The NMO equation is based on the assumption of flat, horizontal reflectors, so the NMO analysis gives erroneous velocities when the subsurface does not consist of flat and horizontal layers. Imaging by migration (either after or before stack) is done in a subsequent step using these velocities.

In this thesis, velocity analysis and imaging are combined in one step, since they are complementary processes in the first place. Velocity analysis gives low-wavenumber information about the subsurface (the velocity) while migration gives the high-wavenumber information (the reflectivity). In this scheme, migration itself is used as a velocity indicator. Because migration is not based on the flat-layer assumption and can be formulated for any velocity function, velocity analysis methods which are based on migration are capable of handling arbitrary structures.

Several schemes can be developed to do velocity analysis using migration. Here, I migrate the data with an initial velocity model and then estimate the velocity error. The initial velocity model is updated next, then the process is repeated until convergence is achieved.

I use the principle that after migration with the correct velocity model, an image in a common-receiver gather (CRG) is aligned horizontally regardless of structure. The deviation from horizontal alignment, namely the curvature, is therefore a measure of the error in velocity. If the migration velocity is lower than the velocity of the medium, events curve upward, where if the migration velocity is higher than the velocity of the medium, events curve downward. In relating the curvature to the error in velocity, kinematic arguments which approximate the error estimation are used.

The iterative method is applied to a field data set and to a synthetic data set. The field data set does not appear to have significant lateral velocity variation; however, the

example shows that prestack migration can be used for velocity analysis. The synthetic example has lateral velocity variations, caused by anticlines and a wedge. It shows that this method detects lateral velocity variation.

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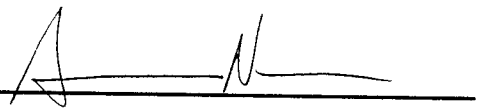
By 

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