VELOCITY ANALYSIS WITHOUT PICKING

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ABSTRACT

The conventional method of velocity analysis in reflection seismology is a three-step process. First, stacking velocities are measured by means of a series of sums through the data along trajectories that are hyperbolic in offset and time. Then, for each time, the stacking velocity corresponding to the peak value of the sum is selected. Finally, from these picked stacking velocities an interval, or true earth-velocity model is constructed. There is a basic problem with this conventional method: it requires that an interpretive step (the peak-picking of step 2) be performed without reference to an earth model. Thus a physically unfeasible set of stacking velocities may be picked. The earth model only enters later, in the third step, when the interval velocities are calculated.

The velocity-analysis method proposed in this thesis eliminates the peak-picking stage of the conventional method. This stage can be eliminated when the stacking velocities are considered from the point of view of an interval velocity model. Thus, a search for the interval-velocity model that best explains the measured stacking velocities constitutes an automatic velocity analysis algorithm that is directly subject to physical constraints.

The first part of this thesis develops the algorithm for use on a simple, one-dimensional case. Presenting this case allows the clear exposition of the basic issues of

the velocity analysis algorithm: the means by which the interval-velocity model is evaluated and the best model found. The second part of this thesis extends the automatic velocity-analysis algorithm to two dimensions. The extension requires that interval and stacking velocities be connected in a way that is valid for laterally variable media. This connection is made by use of a linear theory; a full development is contained in the final chapter of the thesis.

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