MIGRATION II

- data reduction by processing in the temporal frequency domain;
- maximum frequency reduction as a function of depth;
- model dependent extrapolation;
- multigrid extrapolation;
- use of precomputed optimized extrapolation operators;
- more than one imaging step per extrapolation step.

The computer time required for the migration of a typical shot record is less than one minute on a Convex C220.

We applied our SRM algorithms to synthetic as well as to real data. Results of both will be presented.

Delft Geophysical B.V., P.O. Box 148, 2600 AC Delft, The Netherlands.

BEAM TRACING FOR MIGRATION AND INVERSION (C-41)

J.T. FOKKEMA¹, S.R.G. KREMER² and C.P.A. WAPENAAR²

Wavefield extrapolation operators play a key role in seismic migration and inversion schemes. Both the forward and inverse extrapolation operators can be formulated in terms of one-way Kirchhoff integrals that contain forward- or backward-propagating Green's functions, defined in a geologically-oriented macromodel of the subsurface. For complicated macromodels these Green's functions must be computed numerically by a forward-modelling scheme. In this paper, we propose beam tracing as an accurate and efficient solution for generating Green's functions.

Generally speaking, a beam can be characterized by its central axis and the beamwidth. The central axis is the raypath that follows from the high-frequency acoustic approximation. The beamwidth is, in fact, given by the window function that permits the acoustic field to be decomposed into separated spatial contributions, known as beams. It will be shown that, using the boundary-integral representation for the field in a medium, the reflected and transmitted field for an arbitrary curved interface can be written as the spatial convolution of this window function and the field at the interface. The curvature of the interface determines the number of beams to evaluate. Using the Gaussian window function for the incident field, it follows directly, by the transform property of this function, that the spatial character of the window function after scattering is preserved. This class of window functions leads to Gaussian beams. From the present analysis, it is clear that the number of beams is determined by the complexity of the subsurface and
that an a priori restriction to a certain class of window function is not necessary. Furthermore, this general representation allows for a redefinition of the beam decomposition at every interface. Finally, whatever the choice of the window function, in the high-frequency approximation it converges to the conventional acoustic ray approximation.

1 Delft University of Technology, Department of Mining Engineering, Section Technical Geophysics, P.O. Box 5028, 2600 GA Delft, The Netherlands.
2 Delft University of Technology, Laboratory of Seismics and Acoustics, P.O. Box 5046, 2600 GA Delft, The Netherlands

GAUSSIAN-BEAM DEPTH MIGRATION (C-42)

N.R. HILL

Just as synthetic seismic data can be created by expressing the wavefield radiating from a seismic source as a set of Gaussian beams, so recorded data can be downward continued by expressing the recorded wavefield as a set of Gaussian beams emerging at the earth's surface. In both cases, the Gaussian-beam description of the seismic wave propagation is particularly advantageous when there are lateral variations in the seismic velocity. This paper describes a depth migration method that employs Gaussian-beam downward continuation of the recorded wavefield.

Gaussian beams offer an effective method of raypath depth migration. Unlike other raypath methods, the beams overcome the caustics and shadows that always occur where there is complex seismic velocity structure. Gaussian beams also employ parabolic approximations, which are known to be effective for seismic migration and have guaranteed regular behaviour. Moreover, Gaussian-beam migration enables wave-equation calculation of seismic energy propagation but retains the raypath description of this propagation. The contributions to the migrated image caused by energy associated with a particular raypath can be isolated and examined.

Gaussian-beam migration is competitive compared to alternative imaging methods and, in many cases, offers significant advantages. It is especially compatible with lateral velocity variations and has no dip limitations. To an extent that ensures practical usefulness, the results of Gaussian-beam migration are stable to changes in beam parameters. Gaussian-beam decomposition of recorded wavefields may be useful for other seismic