FAST WAVE-THEORY BASED ZERO-OFFSET MODELLING IN 3D (C-36)

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The quality of zero-offset data modelled by ray-tracing techniques is often not satisfactory. The wavefield near caustics is not modelled correctly, diffraction energy is usually not (correctly) included, rays may be missing, shadow zones may be present etc. The reason is that ray tracing is based on a high-frequency approximation of the wave equation. In principle, finite-difference modelling is the way to go. However, this is computationally very intensive, especially in 3D. In this paper we present an attractive compromise that is based on the one-way acoustic wave equation. Starting at the maximum depth the wavefield is forwardly extrapolated up to the surface in a recursive way, such that horizontal and vertical velocity variations can be incorporated. At each of the recursive extrapolation steps to a higher depth level, the zero-offset reflectivity information of that level is added to the data at zero-traveltime, in accordance with the exploding reflector model. The forward extrapolation is performed in a full 3D way with accurate recursive Kirchhoff operators that have been computed in advance and stored in a table. They are applied in the space domain such that lateral velocity variations can be handled correctly. The implementation yields a code that is both simple and well suited for vector processing. The 3D (and 2D) zero-offset data modelled with our method appear to be very realistic and show none of the above mentioned problems of ray tracing.

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