# Wave Equation Depth Migration with Image Gathers in Offset Domain

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## Abstract

Wave equation prestack depth migration (WEPSDM) can handle multipathing of energy in contrast to the Kirchhoff migration with first-arrival traveltimes, which does not handle mutipathing. Unlike Kirchhoff migration, after WEPSDM, offset no longer refers to the recording offset at the surface, but rather refers to the effective subsurface offset between upgoing and downgoing wavefields.

The basis of Kirchhoff migration is the summation of the contributions of many individual traces to the final image using traveltimes. These images can be generated in the offset domain as image gathers. Ehinger A. et al (1996) presented an algorithm for Green's function implementation of common-offset WEPSDM, which is equivalent to shot profile WEPSDM. Based on this algorithm and the mechanism of Kirchhoff migration, the approach presented here is to calculate Green's functions in the frequency-space domain by wavefield extrapolation. Single-trace-images based on an imaging principle related to Green's functions can be obtained and the summation over all single-trace-images and all frequencies forms image gathers in the offset domain. The image is comparable to those by shot profile WEPSDM.

The procedure contains three steps, extrapolation, imaging and summation. The imaging step is much more expensive than the one in shot profile migration, where it is negligible with respect to the extrapolation cost. Therefore this algorithm is computationally expensive. However, proper wavefield interpolation can greatly reduce the cost of extrapolation with little impact on image quality. In addition, this approach has the same flexibility as Kirchhoff migration.

References

Ehinger, A., Lailly, P., and Marfurt, K. J., 1996, Green's function implementation of common-offset wave-equation migration: Geophysics, 61, 1813-1821.