Quantitative migration in the subsurface offset domain

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Abstract: We develop a quantitative migration scheme for Common Image Gathers (CIGs) defined in the subsurface offset domain. The first step consists of modelling the data in a given extended reflectivity model under the Born approximation [Symes, 2008]. Then, the optimal reflectivity is obtained by minimizing the differences between computed and observed data, as in a classical migration scheme. We propose to modify the definition of the objective function by introducing a weight such that the associated Hessian becomes close to a Dirac distribution. The strategy is similar to the one proposed by Lambaré et al., 1992, but extended to handle subsurface offset gathers.

Micro-local analysis is performed around the image point consisting of the physical image point \( x \) and the subsurface offset \( h \). The asymptotic analysis shows that three terms contribute to quantitative migration in the subsurface offset domain [Lameloise et al., 2014]: source deconvolution, compensation for geometrical spreading and correction for uneven illumination through the Beylkin determinant. Quantitative migration helps to remove artifacts in CIGs, mainly as it automatically corrects for illumination (Fig. 1). It appears that subsequent velocity analysis is also further improved [Lameloise et al., 2014].

Fig. 1: CIGs at three different locations, obtained with the classical (top) and quantitative migration (bottom). The mean background velocity is too large.

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References

Lameloise, C.-A., Chauris, H. and Noble, M [2014] Improving the gradient of the image-domain objective function using quantitative migration for a more robust Migration Velocity Analysis, Geophysical Prospecting, in press.