Angle Gathers for Gaussian Beam Depth Migration

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Abstract

Migrated common-image-gathers (CIG's) are of central importance to prestack depth migration. They allow seismic velocity estimation by tomography and other methods, and they allow the analysis of seismic amplitudes in moderately complex structures. Historically, CIG's have usually been indexed by source-receiver offset, measured along the Earth's surface. The recent popularity of migration by wavefield extrapolation has given rise to other types of CIG's. In particular, CIG's indexed by opening angle at subsurface image locations have advantages over offset-indexed CIG's. These gathers allow the modification of tomography programs to use specular pairs of raypaths more naturally than before, and they allow amplitude analysis as a function of opening angle rather than offset (AVA vs. AVO). Another type of CIG, occurring naturally in migrations that use a synthesized linear source, is indexed by the incidence angle of the linear source at the Earth's surface.

Gaussian beam migration (GBM) can easily produce offset-indexed CIG's. Also, because commonshot GBM performs local slant stacks on shot records, the slant parameter can be used to identify data with a common emergence angle. This knowledge can be used to produce emergence-angle CIG's. Finally, knowledge of propagation direction in the subsurface allows GBM to produce, with a little extra work, CIG's indexed by subsurface opening angle. I present various ways of producing these types of CIG's, and I discuss their relative advantages.