TRUE AMPLITUDE INVERSE WAVEFIELD EXTRAPOLATION. PART I: INVERSE OPERATORS FOR PRIMARY WAVES (C-34)

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Inverse wavefield extrapolation operators can be derived by inverting the forward wavefield extrapolation operator. In the case of a homogeneous medium between two horizontal surfaces this derivation can be done straightforwardly via the wavenumber domain. By excluding the evanescent wavefield from the inversion process, a stable, band-limited 'match inverse' operator is obtained, which is identical to the complex-conjugated forward operator. For arbitrarily inhomogeneous media between arbitrarily shaped surfaces another approach must be followed. From the acoustic wave equation and the theorem of Gauss, the matched inverse Kirchhoff integral ('generalized Kirchhoff summation operator') can be derived. This integral is exact, but it assumes that the acoustic wavefield is known at a closed surface. In practical seismic situations the integral can only be evaluated at the acquisition surface; hence approximations have to be made. These approximations will always involve the negligence of the evanescent wavefield, thus limiting the maximum obtainable spatial resolution. Furthermore, multiply reflected waves are neglected. It is interesting to note, though, that the Kirchhoff summation operator, properly generalized for an arbitrarily inhomogeneous medium, correctly handles all amplitude effects, related to geometrical spreading, transmission, absorption losses, etc. In the full elastic version amplitude effects in the primary compressional wave due to wave conversion may be included as well. The generalized Kirchhoff summation operator finds its main application in (acoustic or full elastic) true amplitude redatuming schemes. In part I of this paper the underlying principles will be reviewed. Application aspects will be discussed in part II.

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