Chapter 1

MZO in 3-D

1.1 Extending the MZO theory to 3-D

Phase-shift methods are fairly easy to generalize to three dimensions, by replacing the scalar wavenumbers with orthogonal vector wavenumbers. In 3-D, the prestack migration equation (Yilmaz, 1979) is

$$p(t=0, \mathbf{k}_y, \mathbf{h}=0, z) = \int d\omega \int d^2 k_h \; e^{i k_z(\omega, \mathbf{k}_y, \mathbf{k}_h) z} p(\omega, \mathbf{k}_y, \mathbf{k}_h, z=0),$$

where $p(\omega, \mathbf{k}_y, \mathbf{k}_h, z=0)$ is the 5-D Fourier transform of the field $p(t, \mathbf{y}, \mathbf{h}, z=0)$ recorded at the surface, and the phase $k_z(\omega, \mathbf{k}_y, \mathbf{k}_h)$ is defined as

$$k_z(\omega, \mathbf{k}_y, \mathbf{k}_h) \equiv -\mathrm{sign}(\omega) \left[\sqrt{\frac{\omega^2}{v^2} - \frac{1}{4} \mid \mathbf{k}_y + \mathbf{k}_h \mid^2} + \sqrt{\frac{\omega^2}{v^2} - \frac{1}{4} \mid \mathbf{k}_y - \mathbf{k}_h \mid^2} \right]. \quad (1.1)$$

In equation (