Michael Jervis, Mrinal K. Sen and Paul L. Stoffa
The University of Texas at Austin, Institute for Geophysics

A variation of the original *Schneider et al.* [1992] approach is being used in the 3-D scheme. For the 2-D traveltime scheme, a non-linear interpolating equation is used to determine the minimum traveltime to each new point from the source in a series of eight 45 degree sectors surrounding the new point. This method thus handles rays from all directions, i.e. turning rays.

Let's have a look at the 2-D solution, since this is adapted for the 3-D case. Let z refer to depth and x_a be the lateral distance from a source location (Fig. 1). Then,

$$t^2 = s_a^2(x_a^2 + z^2)$$

is the time distance relationship. If x_a is constant then t^2 is linear with respect to z^2. Let t_1 and t_2 be known traveltimes at points (x_a,z_1) and (x_a,z_2) respectively. The first equation can be rewritten for each of these points and the results subtracted yielding

$$w = (t_2^2 - t_1^2)/ (z_2^2 - z_1^2) = s_a^2$$

For this equation the traveltime for any point between these two points can be expressed as

$$t_0^2 = w(z_0^2 + z_1^2) + t_1^2$$

This equation is the basis for both the 2-D and 3-D traveltime code. Figure 1 shows that the update time t is the time of the minimum raypath, t_0 for example, added to the time from z_0 to the update point at (x,z_2). In other words

$$t = t_0 + s\left[(z_2 - z_0)^2 + \Delta x^2\right]^{1/2}$$

To find the minimum raypath location z_0, this equation is differentiated w.r.t. z_0 giving

$$dt/dz_0 = z_0 w/t_0 - s(z_2 - z_0)\left[(z_2 - z_0)^2 + \Delta x^2\right]^{-1/2}$$