# ”SHIFTED HYPERBOLA” MOVEOUT APPROXIMATION REVISITED

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The shifted hyperbola moveout approximation (Malovichko, 1978; de Bazelaire, 1988; Castle, 1994) has long and successful history of both theoretical and practical applications. Originally defined in the group ($t-x$) domain, this approximation can also be applied in the phase ($\tau-p$) and mixed group-phase ($t-p$) domain.

The shifted hyperbola approximation is given by

$$t(x)=t_0\left[1+\frac{1}{S_2}\left(\sqrt{1+S_2\frac{x^2}{v_{nmo}^2t_0^2}}-1\right)\right], \qquad (1)$$

where $t_0$ is two-way vertical traveltime, $v_{nmo}$ is the normal moveout velocity and $S_2$ is the heterogeneity coefficient responsible for non-hyperbolicity of the traveltime curve.

Being transformed into $\tau-p$ domain, approximation (1) results in the “shifted ellipse” approximation,

$$\tau(p)=\tau_0\left[1+\frac{1}{S_2}\left(\sqrt{1-S_2p^2v_{nmo}^2}-1\right)\right], \qquad (2)$$

which is a mirror approximation to the one given in equation (1).

In the $t-p$ domain, the “shifted hyperbola” type approximation has a form

$$t(p)=\frac{t_0}{1+\frac{1}{S}\left(\sqrt{1-Sp^2v_{nmo}^2}-1\right)}, \qquad (3)$$

where $S=3S_2-2$. Equation (3) is not a mirror approximation to equations (1) and (2).

Approximations (1) and (2) have maximum horizontal slowness $p_{\max}=1/v_{nmo}\sqrt{S_2}$ with $t\to\infty$ and $x\to\infty$ at $p\to p_{\max}=1/v_{nmo}\sqrt{S_2}$, while for approximation (3), $t\to t_{\max}$ and $x\to x_{\max}$ at $p\to p_{\max}=1/v_{nmo}\sqrt{3-2S_2}$.

Comparison between the “shifted hyperbola” type approximations (1)-(3) in different domain for analytical and numerical velocity models show that the approximation (3) performs the best.

References

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