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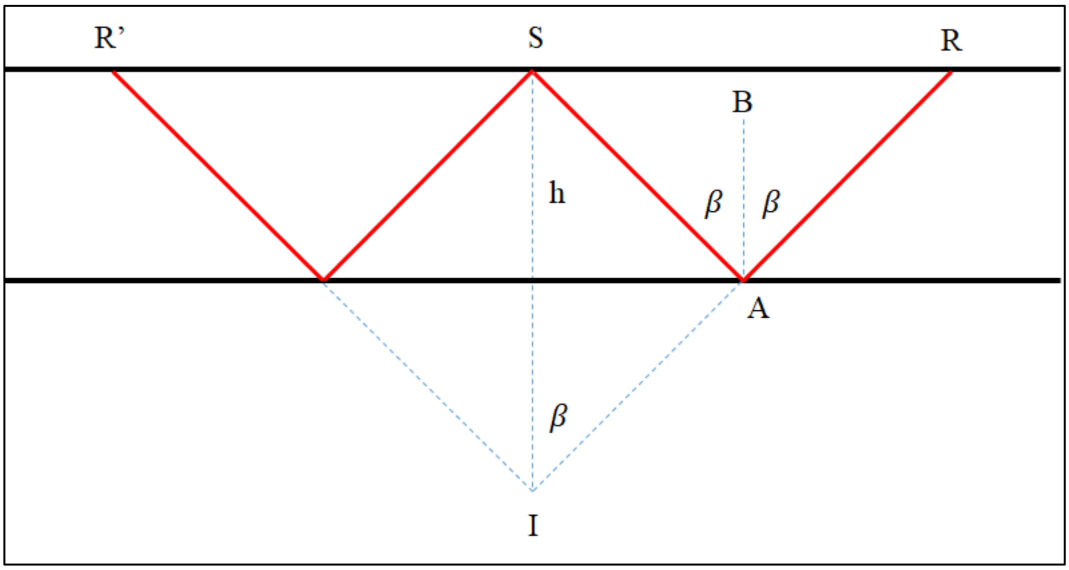
LAMPIRAN 1

PERSAMAAN WAKTU TEMPUH CMP DAN NMO



Traveltime t untuk gelombang refleksi adalah $t = \frac{SA+AR}{v}$

jika SA = AI maka panjang lintasan gelombang refleksi keseluruhan adalah IR = SAR. Sehingga dapat dituliskan persamaan matematika sebagai berikut :

$$t = \frac{IR}{v} \tag{1.1}$$

$$v^2t^2 = x^2 + 4h^2 \tag{1.2}$$

$$t^2 = \frac{x^2}{v^2} + \frac{4h^2}{v^2} \tag{1.3}$$

$$t = \sqrt{\frac{x^2}{v^2} + \frac{4h^2}{v^2}} \tag{1.4}$$

$$t = \frac{2h}{v} \sqrt{\left(\frac{x}{2h}\right)^2 + 1} \tag{1.5}$$

Jika $t_0 = \frac{2h}{v}$

Maka

$$t = t_0 \sqrt{\left(\frac{x}{2h}\right)^2 + 1} \tag{1.6}$$

$$t = t_0 \sqrt{\left(\frac{x}{vt_0}\right)^2 + 1} \tag{1.7}$$

Untuk mendapatkan beda waktu antara t dan t_0 atau t_{NMO} dapat dituliskan sebagai berikut :

$$t_{NMO} = t - t_0 \tag{1.8}$$

$$t_{NMO} = t_0 \sqrt{\left(\frac{x}{vt_0}\right)^2 + 1} - t_0 \tag{1.9}$$

$$t_{NMO} = t_0 \sqrt{\left(\frac{x}{vt_0}\right)^2 + 1} - t_0 \tag{1.10}$$

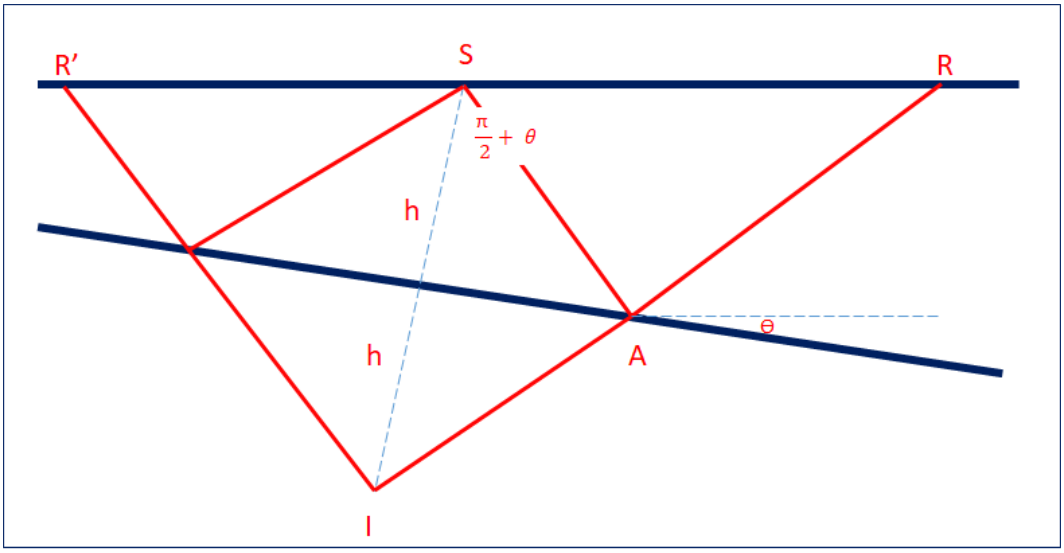
$$t_{NMO} = t_0 \left\{\left[\sqrt{\left(\frac{x}{vt_0}\right)^2 + 1}\right] - 1\right\} \tag{1.11}$$

Jika ditulis dalam domain setengah offset (r) maka

$$t_{NMO} = t_0 \left\{\left[\sqrt{\left(\frac{2r}{vt_0}\right)^2 + 1}\right] - 1\right\} \tag{1.12}$$

LAMPIRAN 2

PERSAMAAN WAKTU TEMPUH DMO



Traveltime t untuk gelombang refleksi adalah $t = \frac{SA+AR}{v}$

jika SA = AI maka panjang lintasan gelombang refleksi keseluruhan adalah IR = SAR. Sehingga dapat dituliskan persamaan matematika sebagai berikut :

$$t = \frac{IR}{v} \quad (2.1)$$

$$v^2 t^2 = x^2 + 4h^2 - 4hx \cos\left(\frac{\pi}{2} + \theta\right) \quad (2.2)$$

Dengan menggunakan aturan trigonometri $\cos\left(\frac{\pi}{2} + \theta\right) = \sin\theta\ maka$

$$v^2 t^2 = x^2 + 4h^2 + 4hx\ sin\theta$$

$$t^2 = \frac{x^2}{v^2} + \frac{4h^2}{v^2} + \frac{4hx\ sin\theta}{v^2}$$

$$\left(1 + \frac{x^2}{4h^2} + \frac{4hx\ sin\theta}{4h^2}\right)^{1/2}$$

$$t = t_0 \left(1 + \frac{x^2}{4h^2} + \frac{4hx\ sin\theta}{4h^2}\right)^{1/2} \quad (2.3)$$

Dengan menggunakan ekspansi binomial pertama maka didapatkan

$$t = t_0 \left(1 + \frac{x^2}{4h^2} + \frac{4hx\ sin\theta}{4h^2}\right)^{1/2}$$

$$t = t_0 \left(1 + \frac{x^2}{8h^2} + \frac{4hx\ sin\theta}{8h^2}\right) \quad (2.4)$$

Manfaatkan waktu tempuh dari dua receiver yang berbeda maka diperoleh

$$t_1 = t_0 \left(1 + \frac{x^2}{8h^2} + \frac{4hx\ sin\theta}{8h^2}\right)$$

$$t_2 = t_0 \left(1 + \frac{x^2}{8h^2} - \frac{4hx\ sin\theta}{8h^2}\right)$$

$$\Delta t_d = t_1 - t_2$$

$$\Delta t_d = t_0 \left(\frac{\Delta x\ sin\theta}{h}\right)$$

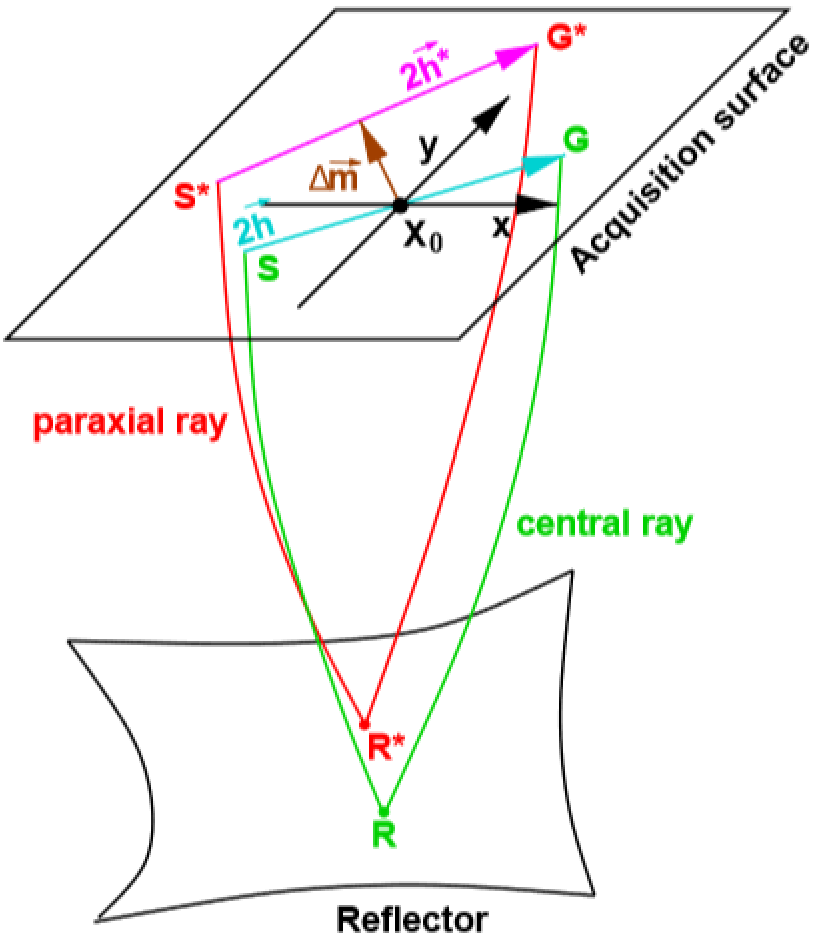
$$\Delta t_d = \frac{2\ \Delta x\ sin\theta}{h}$$

$$\frac{\Delta t_d\ v}{\Delta x\ 2} = sin\theta \quad (2.5)$$

LAMPIRAN 3

PERSAMAAN WAKTU TEMPUH CRS

Persamaan waktu tempuh CRS merupakan pendekatan teori sinar paraksial, yang mengatakan bahwa terdapat hubungan linear antara sinar utama (central ray) dan sinar sekitar (paraxial ray). Jika diasumsikan diketahui traveltime $t\ (\vec{m}\ \ \vec{h})$ sepanjang sinar utama (SRG), maka digunakan ekspansi Taylor untuk mengaproksimasi $t\ (\vec{m} + \Delta\vec{m}\ , \vec{h} + \Delta\vec{h})$ sepanjang sinar sekitar (S*R*G*).



$$t\,(\vec{m}+\Delta\vec{m}\,,\vec{h}+\Delta\vec{h})\approx$$

$$t\,(\vec{m}\,,\Delta\vec{h})+\frac{\partial t}{\partial m_x}\,\Delta m_x+\frac{\partial t}{\partial m_y}\,\Delta m_y+\frac{\partial t}{\partial h_x}\,\Delta h_x+\frac{\partial t}{\partial h_y}\,\Delta h_y$$

$$+\frac{1}{2}\left(\frac{\partial^2 t}{\partial m_x^2}\,\Delta m_x^2+\frac{\partial^2 t}{\partial m_y^2}\,\Delta m_y^2+\frac{\partial^2 t}{\partial h_x^2}\,\Delta h_x^2+\frac{\partial^2 t}{\partial h_y^2}\,\Delta h_y^2\right)$$

$$+\frac{\partial^2 t}{\partial m_x\,\partial m_y}\,\Delta m_x\,\Delta m_y+\frac{\partial^2 t}{\partial m_x\,\partial h_x}\,\Delta m_x\,\Delta h_x+\frac{\partial^2 t}{\partial m_x\,\partial h_y}\,\Delta m_x\,\Delta h_y$$
$$+\frac{\partial^2 t}{\partial m_y\,\partial h_x}\,\Delta m_y\Delta h_x+\frac{\partial^2 t}{\partial m_y\,\partial h_y}\,\Delta m_y\,\Delta h_y+\frac{\partial^2 t}{\partial h_x\,\partial h_y}\,\Delta h_x\,\Delta h_y \qquad (3.1)$$

Untuk kasus 2D

$$t\left(\vec{m}+\Delta\vec{m}\,,\vec{h}+\Delta\vec{h}\,\right)\approx\;t\left(\vec{m}\,,\Delta\vec{h}\right)+\frac{\partial t}{\partial m_x}\,\Delta m_x+\frac{\partial t}{\partial h_x}\,\Delta h_x$$

$$+\frac{1}{2}\left(\frac{\partial^2 t}{\partial m_x^2}\,\Delta m_x^2+\frac{\partial^2 t}{\partial h_x^2}\,\Delta h_x^2\right)+\frac{\partial^2 t}{\partial m_x\,\partial h_x}\,\Delta m_x\,\Delta h_x \qquad (3.2)$$

Untuk kasus Zero offset

$$t\,(\vec{m}+\Delta\vec{m}\,,\vec{h}+\Delta\vec{h})\approx$$

$$t\,(\vec{m}\,,\Delta\vec{h})+\frac{\partial t}{\partial m_x}\,\Delta m_x+\frac{\partial t}{\partial m_y}\,\Delta m_y$$

$$+\frac{1}{2}\left(\frac{\partial^2 t}{\partial m_x^2}\,\Delta m_x^2+\frac{\partial^2 t}{\partial m_y^2}\,\Delta m_y^2+\frac{\partial^2 t}{\partial h_x^2}\,\Delta h_x^2+\frac{\partial^2 t}{\partial h_y^2}\,\Delta h_y^2\right)$$

$$+\frac{\partial^2 t}{\partial m_x\,\partial m_y}\,\Delta m_x\,\Delta m_y+\frac{\partial^2 t}{\partial h_x\,\partial h_y}\,\Delta h_x\,\Delta h_y \qquad (3.3)$$

Sehingga untuk kasus 2D, Zero offset

$$t\left(\vec{m}+\Delta\vec{m}, \vec{h}+\Delta\vec{h}\right) \approx t\left(\vec{m}, \Delta\vec{h}\right) + \frac{\partial t}{\partial m_x}\Delta m_x + \frac{1}{2}\left(\frac{\partial^2 t}{\partial m_x^2}\Delta m_x^2 + \frac{\partial^2 t}{\partial h_x^2}\Delta h_x^2\right) \tag{3.4}$$

Dimana :

$$\frac{\partial t}{\partial m_x} = \frac{2\sin\alpha}{v_0} \qquad \frac{\partial^2 t}{\partial m_x^2} = \frac{2\cos^2\alpha}{v_0 R_N} \qquad \frac{\partial^2 t}{\partial h_x^2} = \frac{2\cos^2\alpha}{v_0 R_{NIP}}$$

Dengan mensubtitusi, didapatkan traveltime CRS parabolik

$$t(x,h) = t_0 + \frac{2\sin\alpha}{v_0}(x - x_0) + \frac{\cos^2\alpha}{v_0}\left[\frac{(x-x_0)^2}{R_N} + \frac{h^2}{R_{NIP}}\right] \tag{3.5}$$

Sedangkan ekspansi deret Taylor t^2 merupakan pendekatan waktu tempuh hiperbolik

$$t^2(x,h) = \left[t_0 + \frac{2\sin\alpha}{v_0}(x - x_0)\right]^2 + \frac{2\,t_0\cos^2\alpha}{v_0}\left[\frac{(x-x_0)^2}{R_N} + \frac{h^2}{R_{NIP}}\right] \tag{3.6}$$

Dengan h = r pada persamaan (2.15)

LAMPIRAN 4

PENYEDERHANAAN WAKTU TEMPUH CRS

Waktu tempuh CRS stack bila diasumsikan menggunakan zero offset ($x = x_0$) akan menjadi :

$$t^2(x,h) = \left[t_0 + \frac{2\sin\alpha}{v_0}(x - x_0)\right]^2 + \frac{2\, t_0\, cos^2\alpha}{v_0}\left[\frac{(x - x_0)^2}{R_N} + \frac{h^2}{R_{NIP}}\right] \tag{4.1}$$

$$t^2(x,h) = {t_0}^2 + \frac{2\, t_0\, cos^2\alpha}{v_0}\,\frac{h^2}{R_{NIP}} \tag{4.2}$$

Untuk kasus lapisan datar dimana $\alpha = 0$ dan $R_{NIP} = \frac{v_0\, t_0}{2}$ didapatkan waktu tempuh CMP

$$t^2(x,h) = {t_0}^2 + \frac{4\, t_0}{v_0}\,\frac{h^2}{v_0\, t_0} \tag{4.3}$$

$$t^2(x,h) = {t_0}^2 + \frac{4\, h^2}{v_0^2} \tag{4.4}$$