# Reflection from a Spherical Surface

P1 is at (y,z) = (0,s1)
P2 is at (y,z) -

Radius of curvature is R

$R := 10$

$D := \frac{R}{16}$

$Npts := 100$

$s1 := 4$

$Fnum := \frac{R}{2} \cdot \frac{1}{D}$

$ii := 1 .. Npts$

$Fnum = 8$

$h_{ii} := \frac{ii}{Npts} \cdot D$

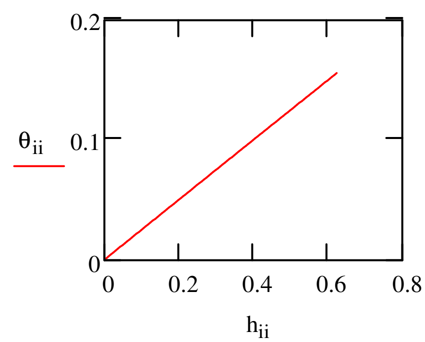
$dz(R,h) := R - \sqrt{R^2 - h^2}$

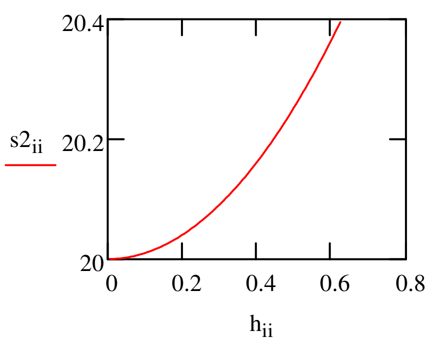
$dz(R,1) = 0.05$

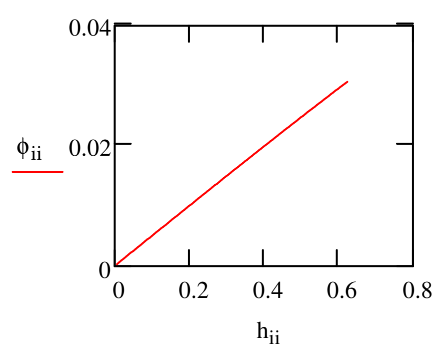
$\theta_{ii} := atan\left(\frac{h_{ii}}{s1 - dz(R,h_{ii})}\right)$

$\phi_{ii} := \left|2 \cdot atan\left(\frac{h_{ii}}{R - dz(R,h_{ii})}\right) - atan\left(\frac{h_{ii}}{s1 - dz(R,h_{ii})}\right)\right|$

$s2_{ii} := \frac{h_{ii} + dz(R,h_{ii}) \cdot \tan(\phi_{ii})}{\tan(\phi_{ii})}$




$f := \frac{R}{2}$

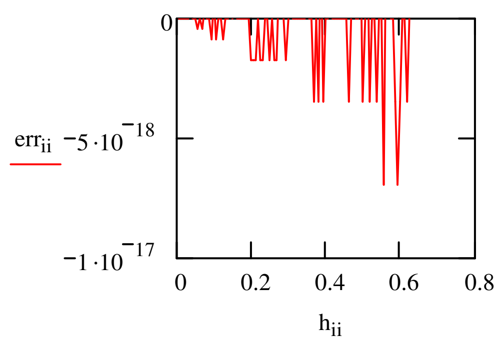
$\left(\frac{1}{f} - \frac{1}{s1}\right)^{-1} = -20$

$z_{ii} := s1 - dz(R, h_{ii})$

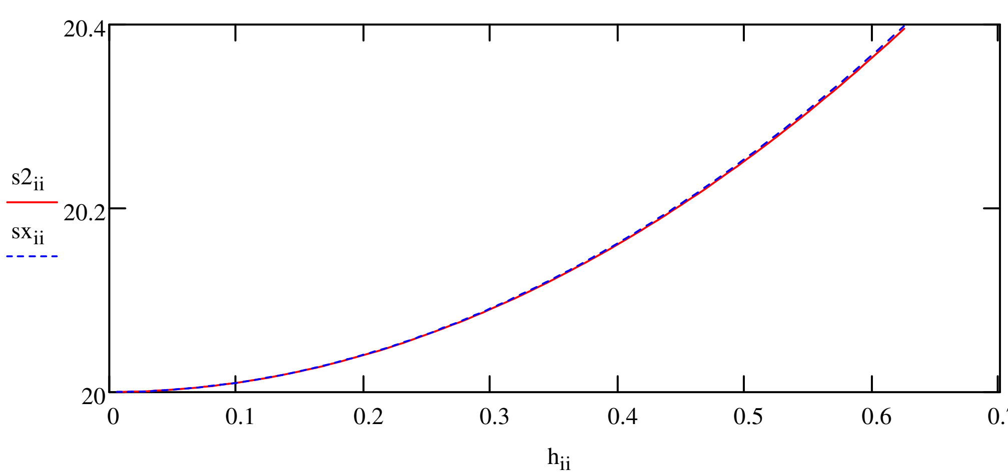
$y_{ii} := h_{ii}$

$\phi check_{ii} := \operatorname{atan}\left(\frac{h_{ii}}{s2_{ii} - dz(R, h_{ii})}\right)$

$err_{ii} := \phi_{ii} - \phi check_{ii}$




$sx_{ii} := dz(R, h_{ii}) + h_{ii} \cdot \frac{1}{\phi_{ii} + \frac{(\phi_{ii})^3}{6}}$ Approximation



## Alternate Derivation

$$y(z) := \sqrt{R^2 - z^2}$$

y>0 here

$$dydz(z) := \frac{1}{2}\cdot\left(R^2 - z^2\right)^{-0.50}\cdot(-2\cdot z)$$

$$m(z) := dydz(z)$$

Slope of the tangent to the surface

$$\delta z(h) := s1 - \sqrt{R^2 - h^2}$$

$$s2_{ii} := h_{ii}\cdot\tan\left[2\cdot\mathrm{atan}\left[\frac{1}{m\left[\sqrt{R^2 - \left(h_{ii}\right)^2}\right]}\right] - \mathrm{atan}\left(\frac{h_{ii}}{s1 - \delta z\left(h_{ii}\right)}\right)\right]^{-1} + \delta z\left(h_{ii}\right)$$