

# 1 Vorwärtsproblem

$$h_r = \sqrt{l_e^2 + h_m^2 - 2l_e h_m \cdot \cos(\phi)}$$

$$\alpha = \arcsin\left(l_e \cdot \frac{\sin(\phi)}{h_r}\right)$$

$$\beta = \pi - \alpha - \psi$$

$$h = \sin(\phi) \cdot \frac{h_b}{\sin(\beta)}$$

$$\gamma = \arcsin\left(\frac{l_r}{h_r}\right)$$

$$\delta = \pi - \beta - \gamma$$

$$b_{bottom} = \frac{\sin(\gamma)}{\sin(\delta)} \cdot h$$

$$\epsilon = \pi - \beta$$

$$\zeta = \pi - \epsilon - \gamma$$

$$b_{top} = \frac{\sin(\epsilon)}{\sin(\zeta)} \cdot h$$

$$b = b_{top} + b_{bottom}$$

$$\begin{aligned}
& b(l_r, l_e, h_m, h_b, \phi, \psi) = \\
& \left( \frac{\sin \left( \arcsin \left( \frac{l_e * \sin(\phi)}{\sqrt{l_e^2 + h_m^2 - 2 * l_e * h_m * \cos(\phi)}} \right) + \psi \right)}{\sin(-\arcsin(\frac{l_r}{\sqrt{l_e^2 + h_m^2 - 2 * l_e * h_m * \cos(\phi)}}) + \pi - \arcsin(\frac{l_e * \sin(\phi)}{\sqrt{l_e^2 + h_m^2 - 2 * l_e * h_m * \cos(\phi)}}) - \psi)} \right. \\
& \left. + \frac{\frac{l_r}{\sqrt{l_e^2 + h_m^2 - 2 * l_e * h_m * \cos(\phi)}}}{\sin(-\arcsin(\frac{l_r}{\sqrt{l_e^2 + h_m^2 - 2 * l_e * h_m * \cos(\phi)}}) + \arcsin(\frac{l_e * \sin(\phi)}{\sqrt{l_e^2 + h_m^2 - 2 * l_e * h_m * \cos(\phi)}}) + \psi)} \right) \\
& \cdot \left( \frac{\sin(\phi) * h_b}{\sin(\pi - \arcsin(\frac{l_e * \sin(\phi)}{\sqrt{l_e^2 + h_m^2 - 2 * l_e * h_m * \cos(\phi)}}) - \psi)} \right)
\end{aligned}$$

$$\begin{aligned}
& b(l_r, l_e, h_m, h_b, \phi, \psi) = \\
& \left[ \frac{1}{-sin(-arcsin(\frac{l_r}{\sqrt{l_e^2+h_m^2-2*l_e*h_m*cos(\phi)}}) - arcsin(\frac{l_e*sin(\phi)}{\sqrt{l_e^2+h_m^2-2*l_e*h_m*cos(\phi)}}) - \psi)} \right. \\
& \left. + \frac{\frac{l_r}{\sqrt{l_e^2+h_m^2-2*l_e*h_m*cos(\phi)}}}{\frac{l_r}{\sqrt{l_e^2+h_m^2-2*l_e*h_m*cos(\phi)}}} \right] \\
& \frac{1}{2} * \left( \sqrt{1 - \left( \frac{l_r}{\sqrt{l_e^2+h_m^2-2*l_e*h_m*cos(\phi)}} \right)^2} - cos(2 * arcsin(\frac{l_e*sin(\phi)}{\sqrt{l_e^2+h_m^2-2*l_e*h_m*cos(\phi)}}) + 2 * \psi - arcsin(\frac{l_r}{\sqrt{l_e^2+h_m^2-2*l_e*h_m*cos(\phi)}})) \right) \\
& \cdot \left( sin(\phi) * h_b \right)
\end{aligned}$$