$with(LinearAlgebra):$

Laser pose in robot coordinates:
x_L, y_L, θ_L

Line features in world coordiantes:
α_w, r_w

Predicted robot pose in world coordinates:
x, y, θ

World to robot:
$\alpha_r = \alpha_w - \theta:$
$r_r = r_w - x\cdot\cos(\alpha_w) - y\cdot\sin(\alpha_w):$

Robot to laser:
$\alpha_L = \alpha_r - \theta_L:$
$r_L = r_r - x_L\cdot\cos(\alpha_r) - y_L\cdot\sin(\alpha_r):$

Combining them so that $h_i = (z, p_R, p_L)$:
$\alpha_L := \alpha_w - \theta - \theta_L:$
$r_L := r_w - x\cdot\cos(\alpha_w) - y\cdot\sin(\alpha_w) - x_L\cdot\cos(\alpha_w - \theta) - y_L\cdot\sin(\alpha_w - \theta):$

On carth form:
$x_{LC} := \left(r_w - x\cdot\cos(\alpha_w) - y\cdot\sin(\alpha_w) - x_L\cdot\cos(\alpha_w - \theta) - y_L\cdot\sin(\alpha_w - \theta)\right)\cdot\cos(\alpha_w - \theta - \theta_L):$
$y_{LC} := \left(r_w - x\cdot\cos(\alpha_w) - y\cdot\sin(\alpha_w) - x_L\cdot\cos(\alpha_w - \theta) - y_L\cdot\sin(\alpha_w - \theta)\right)\cdot\sin(\alpha_w - \theta - \theta_L):$
$\theta_{LC} := \arctan\left(\frac{y_{LC}}{x_{LC}}\right)$

$$\theta_{LC} := -\arctan\left(\frac{\sin(-\alpha_w + \theta + \theta_L)}{\cos(-\alpha_w + \theta + \theta_L)}\right) \tag{1}$$

$\frac{\partial}{\partial x}(x_{LC})$

$$-\cos(\alpha_w)\cos(-\alpha_w + \theta + \theta_L) \tag{2}$$

$\frac{\partial}{\partial y}(y_{LC})$

$$\sin(\alpha_w)\sin(-\alpha_w + \theta + \theta_L) \tag{3}$$

$\frac{\partial}{\partial \theta}(\theta_{LC})$

$$-1 \tag{4}$$

We then have:

$$\nabla h = \begin{bmatrix} 1 & 0 & -\cos(\alpha_w)\cos(-\alpha_w + \theta + \theta_L) \\ 0 & 1 & \sin(\alpha_w)\sin(-\alpha_w + \theta + \theta_L) \\ 0 & 0 & -1 \end{bmatrix}:$$

$$\frac{\partial}{\partial \theta}(\alpha_L)$$

$$x_L \sin(-\alpha_w + \theta) + y_L \cos(-\alpha_w + \theta) \tag{5}$$

$$\nabla h = \begin{bmatrix} \frac{\partial}{\partial x}(\alpha_L) & \frac{\partial}{\partial y}(\alpha_L) & \frac{\partial}{\partial \theta}(\alpha_L) \\ \frac{\partial}{\partial x}(r_L) & \frac{\partial}{\partial y}(r_L) & \frac{\partial}{\partial \theta}(r_L) \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 & -1 \\ -\cos(\alpha_w) & -\sin(\alpha_w) & x_L \sin(-\alpha_w + \theta) + y_L \cos(-\alpha_w + \theta) \end{bmatrix} \tag{6}$$

$$diff(r_L, \theta)$$

$$x_L \sin(-\alpha_w + \theta) + y_L \cos(-\alpha_w + \theta) \tag{7}$$

$$(0.25, 0, 0)$$