[16-833] Homework 3 : Written Report

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Contents

1 Linear SLAM

1.1 Odometry

1.1.1 Measurement Function

Since the odometry results in a change in position, the measurement function is simply

$$h_o(\mathbf{r}^t, \mathbf{r}^{t+1}) = \mathbf{r}^{t+1} - \mathbf{r}^t$$

1.1.2 Jacobian

The Jacobian of measurement function is

$$H_o(\mathbf{r}^t, \mathbf{r}^{t+1}) = \begin{bmatrix} -1 & 0 & 1 & 0 \\ 0 & -1 & 0 & 1 \end{bmatrix}$$

1.2 Landmark

Since landmarks are measured using the relative position of the robot and landmark, the measurement function is simply

$$h_l(\mathbf{r}^t, \mathbf{l}^k) = \mathbf{l}^k - \mathbf{r}^t$$

1.2.1 Jacobian

The Jacobian of measurement function is

$$H_l(\mathbf{r}^t, \mathbf{l}^k) = \begin{bmatrix} -1 & 0 & 1 & 0 \\ 0 & -1 & 0 & 1 \end{bmatrix}$$

2 Non-Linear SLAM

2.1 Landmark

2.1.1 Jacobian

$$H_l(\mathbf{r}^t, \mathbf{l}^k) = \begin{bmatrix} \frac{l_y - r_y}{(l_x-r_x)^2+(l_y-r_y)^2} & \frac{-(l_x-r_x)}{(l_x-r_x)^2+(l_y-r_y)^2} & \frac{-(l_y-r_y)}{(l_x-r_x)^2+(l_y-r_y)^2} & \frac{l_x-r_x}{(l_x-r_x)^2+(l_y-r_y)^2} \\ \frac{-(l_x-r_x)}{\sqrt{(l_x-r_x)^2+(l_y-r_y)^2}} & \frac{-(l_y-r_y)}{\sqrt{(l_x-r_x)^2+(l_y-r_y)^2}} & \frac{l_x-r_x}{\sqrt{(l_x-r_x)^2+(l_y-r_y)^2}} & \frac{l_y-r_y}{\sqrt{(l_x-r_x)^2+(l_y-r_y)^2}} \end{bmatrix}$$