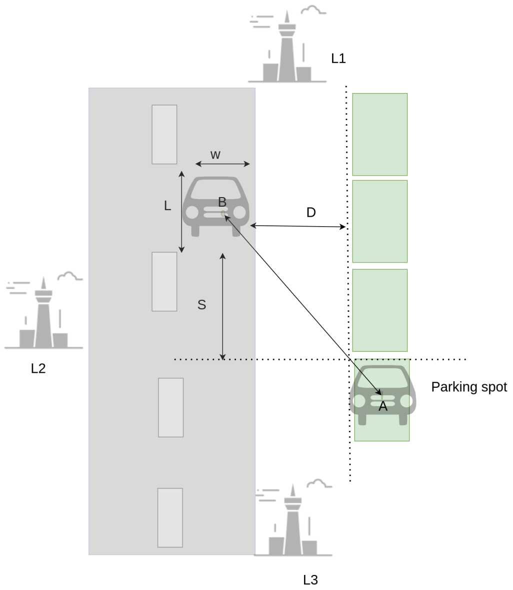
Control of Mobile Robots // Homework 03

Task: robot localization with EKF and parking



Problem Description

- There are three landmarks: L1 (5, 30), L2 (5, -30), and L3 (-5, 0), which can be seen by the sensor attached to car. Sensor reading are obtained in the following way

$$\underbrace{\begin{bmatrix} r_t^i \\ \theta_t^i \end{bmatrix}}_{z_t^i} = \underbrace{\begin{pmatrix} \sqrt{(m_{j,x} - x)^2 + (m_{j,y} - y)^2} \\ atan2(m_{j,y} - y, m_{j,x} - x) - \theta \end{pmatrix}}_{h(x_{t,j,m})} + N(0, R) \tag{1}$$

, where $m_{j,x}, m_{j,y}$ denotes the coordinates of jth landmark detection at time t. The white noise of each sensor reading , the optimal robot current location estimation, and the vehicle heading angle are given by $R = \begin{bmatrix} \sigma_r^2 & 0 \\ 0 & \sigma_r^2 \end{bmatrix}$,

$\mathbf{x}_{t,x}^- = x, \mathbf{x}_{t,y}^- = y$, and θ, respectively.

Problem Description

- The car has to incorporate sensor reading to improve its state estimation, i.e., use EKF localization, to navigate from position B (0, 0) to A. Location A has to be obtained using the given information, where lateral and longitudinal displacement is given by D and S, respectively
- You can make assumptions about this robot vehicle parameters, including width W and length L

Task Formulation

- When formulating the control strategy, you may use Dubins path planning (or you can drive the trajectory analytically)
- Derive an expression for the motion model that is based on the kinematic model you decided to use
- Derive an expression for the sensor model that is based on the problem description
- Plot the robot position uncertainty estimation over the time and the traversed trajectory
- Your submission should include **the report** and the **source code**