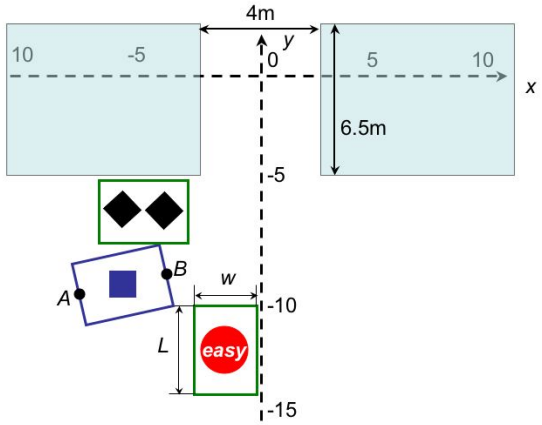
Rose-**H**ulman **I**nstitute of **T**echnology
Department of Mechanical Engineering

ME 536 — Comput Intell in Control Engr
Homework 5: — Deadline: May 8, 2020
Course Value: 100 points

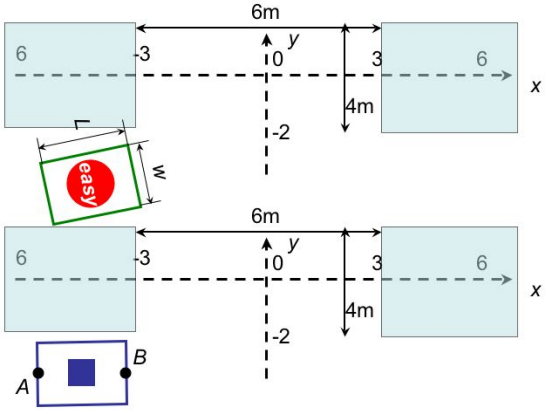
Fuzzy car parking, a la Lexus

Your task is to park the SUV in two different scenarios. You should design two separate fuzzy controllers, one for each scenario. Use the fuzzy toolbox. Implement your design on Simulink using the plant model carbackstraight.slx. In order to get the highest possible grade on this assignment, you should tune each controller to be robust to the widest range of initial conditions possible. Initial conditions and level of difficulty are illustrated in the figures below. The street / alley geometry is shown below. Note that I will test your controller by starting from a range of initial conditions. Those who achieve performance similar to mine will receive an 'A'.

1. The first scenario is backing into a parking space. The parking space is 4m wide and 6.5 m deep. Your objective is to safely move the car so the center of the rear bumper is at (0, -1.5). Try a range of initial conditions such that the easiest has $\psi = \pi / 2$ with a small offset and 5m between the rear bumper and nearest obstacle. The most difficult would have $\psi = 0$ with a small space between the passenger door and the obstacle. I'm not even sure the 'double diamond' scenario can be safely done. w = 1.572m and L = 3.0293 m.



2. The second scenario is parallel parking. The space is 6m long and 4m wide. You want to put the center of the rear bumper at (-1.5,0) ±(0.5,0.5). The easy scenario has $\psi > 0$ with a small distance from the obstacle. More challenging initial conditions have $\psi \leq 0$ with the passenger door either too close or too far from the obstacle.



Probably the easiest way to create consistent initial conditions is to choose a point for the center of the 'rear' axle (x_B,y_B), then use trig to find the A coords:

$$x_A = x_B + L\cos(\psi + \pi)$$

$$y_A = y_B + L\sin(\psi + \pi)$$

Note the car is backing into the space in every scenario, the 'blue square' shows points *A* and *B* consistent with their definitions from homework set 1. Also note that the system has only 3 degrees of freedom. That is, your fuzzy controller should work fine with three inputs--(x_B,y_B), and ψ.

You can use carplot3.m to check your controller performance. If any part of the SUV encroaches on an obstacle, the controller has failed for that attempt.