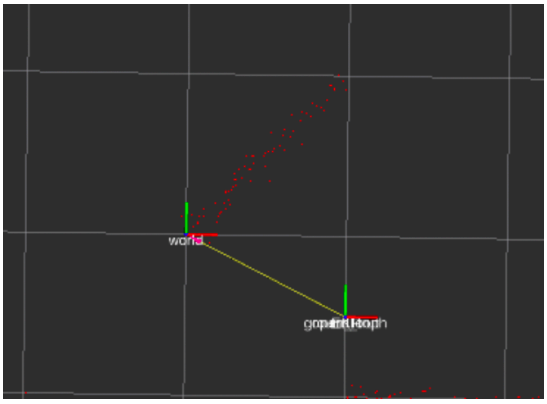
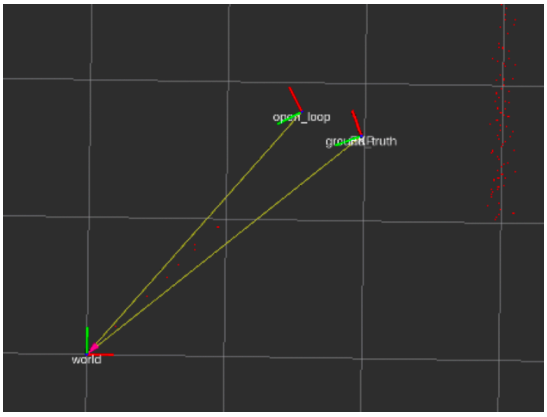
Homework 5
Problem 1 (viii)

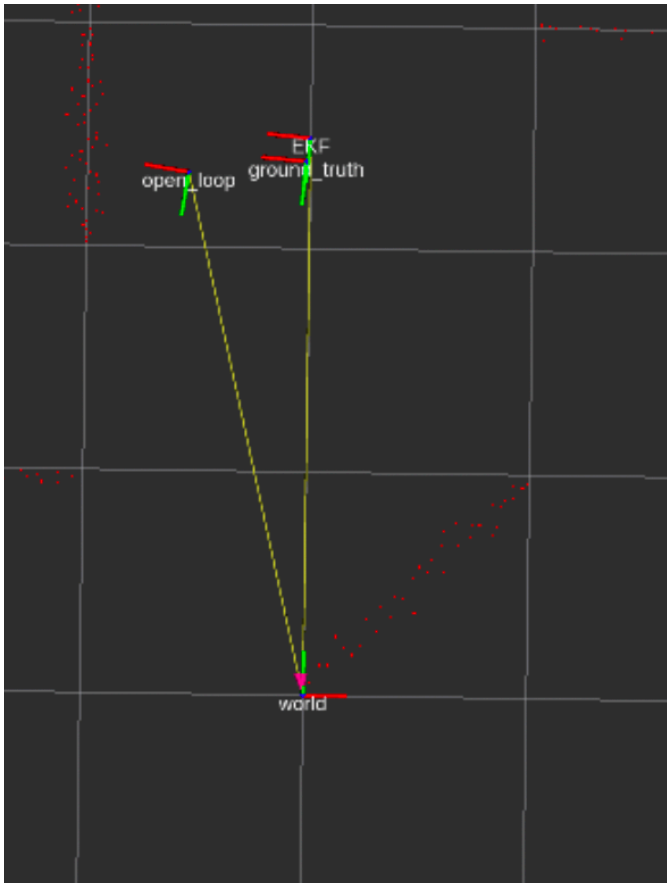
(1) initial state



(2) far from initial state

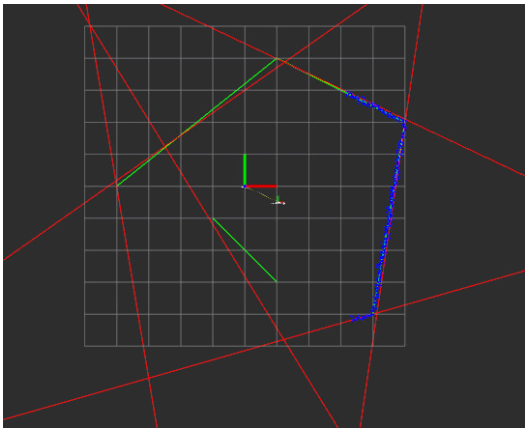


(3) state estimates diverge

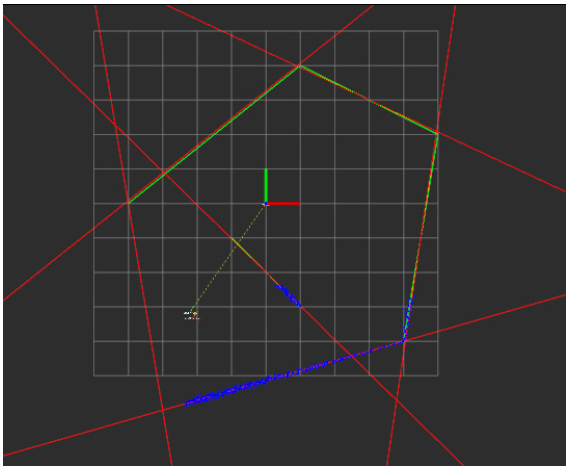


Problem 2

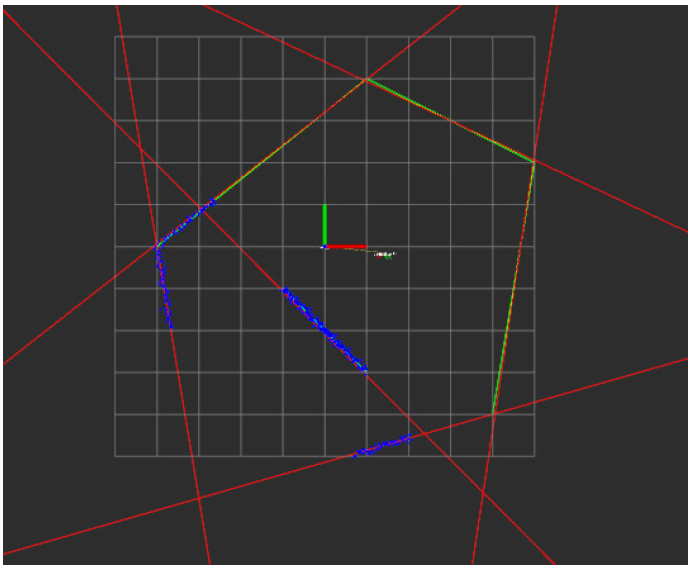
Part iii: Initial state



Part iii: Navigated away from initial state with updated map estimate



Part iii: Converged map estimate

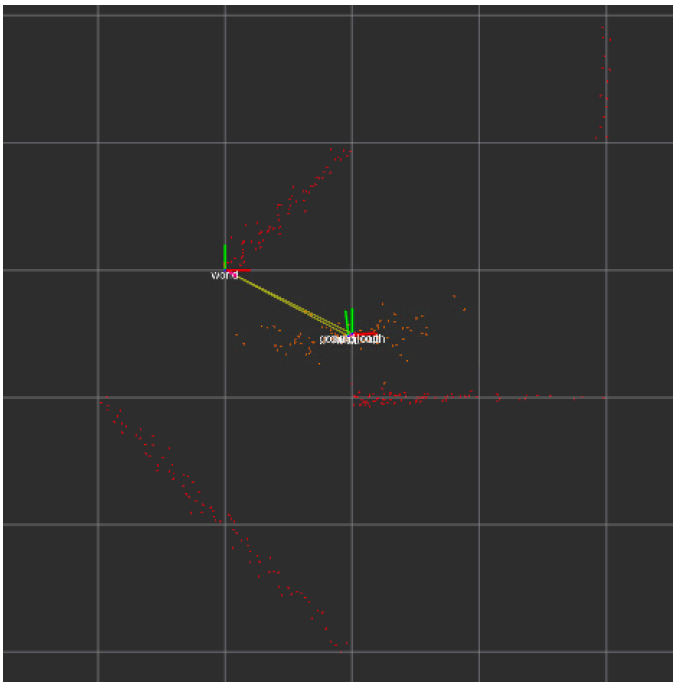


Part iii: Types of motions that cause EKF to diverge

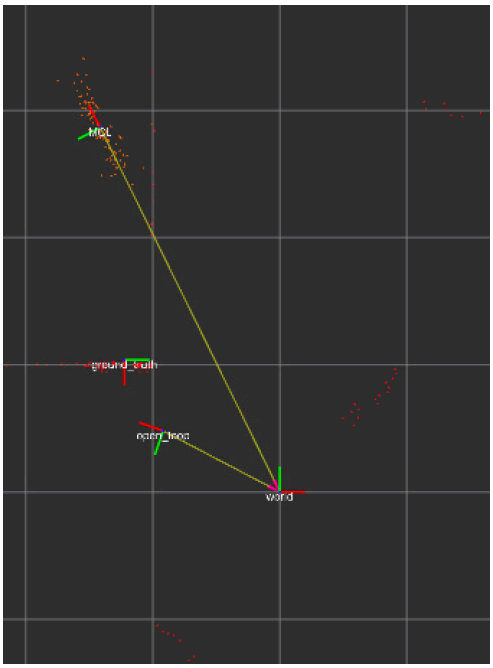
From my experience driving the simulated robot around, moving forward quickly while rotating caused the open loop prediction to drift away from the ground truth. Generally, EKF was pretty good at following the ground truth except in the case when the sensors and perception algorithm were not able to extract lines that matched map features. However, even if the robot stopped moving, the EKF algorithm was able to continuously localize the robot with ever range-finder scan, which was pretty cool.

Problem 3

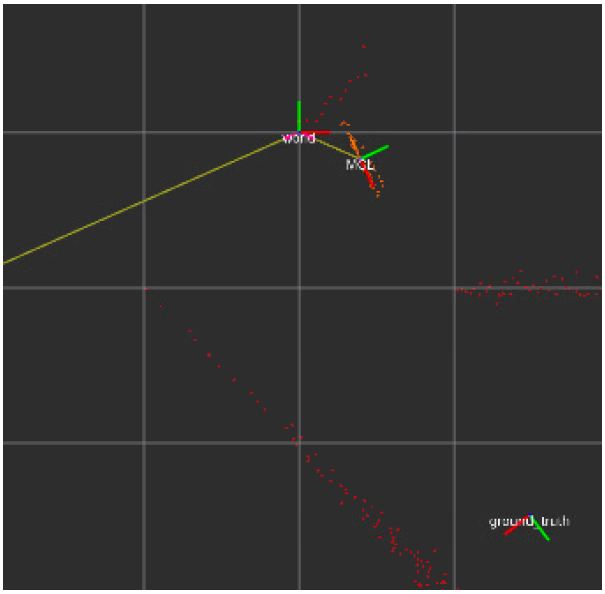
Part iv: initial state



Part iv: Navigated away with updated map estimate



Part iv: State estimation diverges



One thing that caused MCL to diverge from the ground truth a great deal was when the turtlebot was driven into a wall, so the ground truth would not move with control inputs, but both the open loop and MCL particles did. This is because the transition model for MCL did not take any collision detection into account. When the control inputs were infrequent, the MCL estimate remained accurate, but when the bot was driven into the wall very aggressively, the MCL localization measurement updates couldn't keep up.

Extra Credit

Here are the functions that I either fully or partially vectorized:

1. resample()
2. transition_model()