Final Project Report

Nakul Agarwal, Aditya Ranganath – MS, EECS

Simultaneous Localization and Mapping using the Extended Kalmann Filter

OBJECTIVE:

The main objective of the project can be divided into two:

1. Exploration
2. Exploitation

Exploration involves exploring the map without worrying much about localizing the robot into its current location. The main purpose for doing exploration is to navigate to points in the map the robot hasn't been to before. This way, it will discover interesting locations which might help localize the robot better.

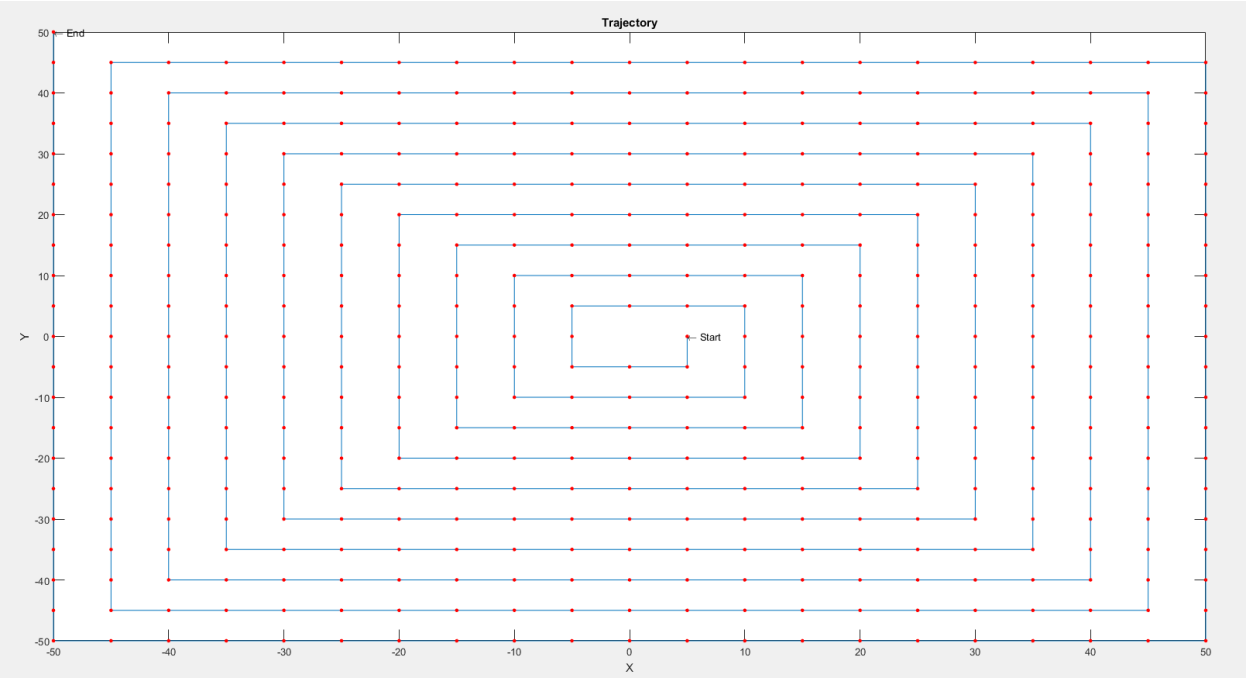
Exploitation involves exploiting information that is already available to solve problems such as localization. This is where the EKF comes into play. Both these methods and their results have been explained in the solution below.

SOLUTION:

Exploration:

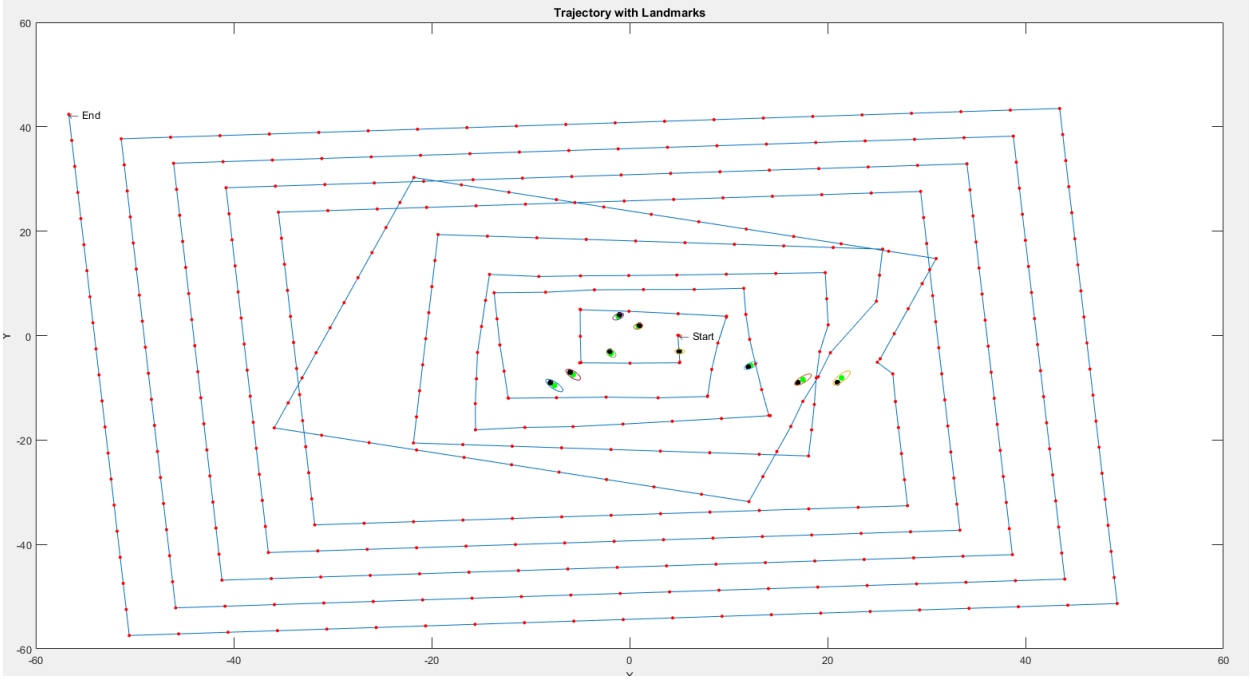
For the exploration, we implemented a spiral. The spiral is assumed to begin at the robot's beginning position, which is (0,0,0). A discrete value is taken for linear input strategy. Each linear input, in this case, is taken to be 0.5 units. This way, the exploration strategy is fool proof, and it tries to navigate to all the points in the map.

After each linear step sequence, a rotation of -pi/2 is applied. The figure below shows the ground truth trajectory of the robot



Exploitation:

For exploitation, the EKF_SLAM, with no correspondences, algorithm was implemented the new information that was added to it was the 'alpha' value, which is the motivation for the Mahalanobis distance. We had chosen the sum of eigen values for estimating new Mahalanobis distance. The motivation behind this was to calculate an optimal value to compute the new landmark encountered. The sum of the eigen values gives a very good estimate of how far the covariance has changed to. The plot for Exploitation (Prediction, Correction) is shown below:



As can be seen from the images, the error for the plots barely go out of the limits of the covariance ofeach landmark. The landmark is updated within the limits of the covariance of the landmark. The error estimation for each landmark was within 2 units of the original landmark.

Challenges faced:

One of the main challenges faced, during the project, was to find an optimal value for alpha, or the Mahalanobis distance. We had an implementation with constant value. But there were too many spurious landmarks showing up as the mahalanobis motivation was not good enough for different types of variances. Hence, we had chosen to use a function of the covariance so that the Mahlanobis distance can be computed for each type of covariance in each step.

CONCLUSION:

Thus, it can be concluded that the EKF_SLAM was computed without knowing the correspondences of the landmarks provided in the map.