Project Report – EKF SLAM with Unknown Correspondences

INTRODUCTION

The project involved simultaneous localization and mapping of the robot in a given environment. A simulator was provided that can move the robot around by applying some actions and then generates sensor readings generated from the landmarks identified. Extended Kallman Filter algorithm is used to perform SLAM. As the correspondences of the landmarks were unknown, a slight variation of the EKF ALM algorithm is used that established correspondence based on the manhalobi's distance of the current identified landmarks and the new estimated landmarks. The whole project was implemented in Matlab.

MODULES OF EKF SLAM

Following are the modules of the project implemented:

main

This is the main entry point for the project that creates provides a user interface to move the robot around the environment. The user can select for autonomous robot motion around the environment. Once an action is applied on the robot using move_robot of the simulator, sensor readings from get_landmarks which is also part of the simulator. If sensor readings are generated EKF SLAM is used to predict and update the pose of the robot along with the location of the landmarks. If no sensor readings are generated, the pose of the robot is predicted without updating. The pose of the robot and the position of the landmarks are plotted on the graph along with their error ellipsoids.

ekf_slam

This module implements the EKF SLAM with unknown correspondences for one action applied and one sensor generated. This module performs the predict and update step as the sensor values are available. As mentioned in the introduction the correspondences of the landmarks are performed using the manhalobi's distance. Each sensor reading is considered to identify whether the landmark is new or the landmark was already identified. A threshold alpha is used as a cutoff for the variance in the manhalobi's distance. If the distance is more than this threshold then it is considered as a new landmark, else the position of the old landmark is updated. Currently this threshold is a product of a constant and the sum of the eigen values.

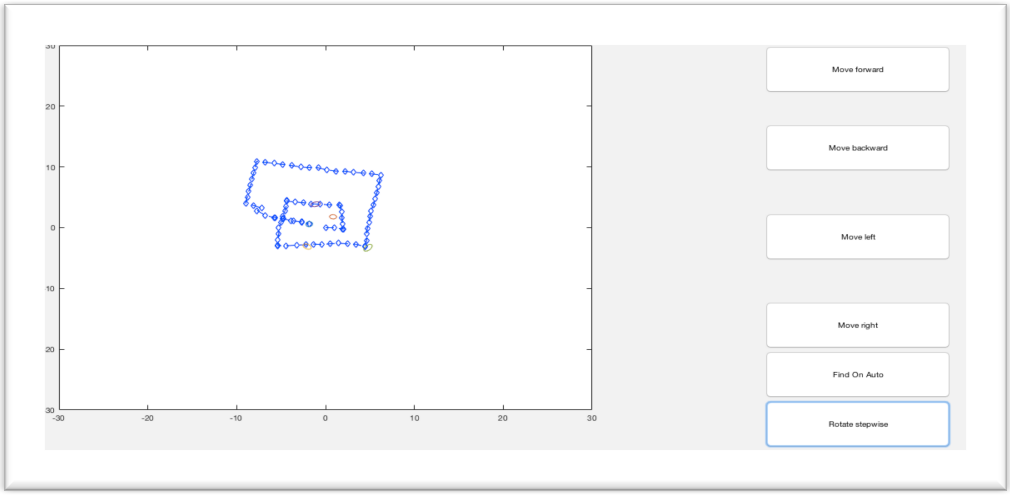
ekf_slam_wo_prediction

This module performs EKF SLAM with only prediction step. This is done as there are no sensor readings available. Hence the pose of the robot is predicted with only the available motion model and the input applied.

RESULTS

Two plans were implemented.

1. Move around in a spiral. Once the variance of the pose of the robot gets too large it tries to return to the origin and stops. This motion plan was suitable for landmarks clustered around the starting point:



2. Move in a straight path in one direction, once the variance in the pose gets too large return back to origin and move in another direction in the same way. The robot is finally moved in all the eight directions. This plan was suitable for landmarks spread out across the environment.