Khalid Arif (k.arif@massey.ac.nz)

282.758 - Simulation, Modeling and Optimization

(Localization with Light Beacons)

Navigation in a given map with AMCL and EKF (20%)

Adaptive Monte Carlo Localization (AMCL) is an algorithm that fuses laser scan matching with a source of odometry to provide an estimate of the robot's pose w.r.t a global map. The wheel odometry is also commonly fused with an IMU (or GPS, Visual Odometry) using Extended Kalman Filter (EKF) to create an improved odometry estimate (local pose estimation) for AMCL.

In this assignment a map will be provided to navigate the robot with AMCL and EKF. The results from the localization/navigation will be collected in the form of XY position plots to compare odometry and combined odometry (EKF).

Due date: 27/10/2017 by 5:00PM.

Report Requirements:

1. Not more than 15 pages in total including references and figures.
2. A brief discussion on the *robot_pose_ekf* and how it is used to fuse multi sensor information for estimation of robot states (no more than 2 pages). Append references to literature sources that describe the methods similar to those used in ROS.
3. Setup the robot similar to the assignment #2 to operate in the Gazebo environment. Modify your code to control the physical robot (see photo on the page 2) and note any differences in 1-2 pages.
4. Implement ***AMCL*** for a given map (that you can save yourself using the onboard lidar). Describe AMCL and similar methods in 1-2 pages.
5. Create a ROS catkin package to process images (using OpenCV) from the robot camera to find out pose of the robot (x, y, θ) from the light beacons (see photos on page 3). Publish this pose from the image processing over ***vo*** (visual odometry) topic for the ***robot_pose_ekf*** to compute ***odometry_combined***.
6. Record ***xy*** plots of **odometry**, ***combined_odometry*** and ***image processing odometry (vo)*** using ***rqt_multiplot_plugin***. Tweak your system to get the best possible results, discuss your results in detail and recommend in any improvements. This section can be up to 10 pages long.
7. Submit your ROS catkin package with all necessary launch files. This code will be tested with the map and depending on the working of your robot you will get marks for this part of the report.

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Fig: Nomad Scout with Hokuyo URG-04LX-UG01 laser scanner and fisheye CCD camera

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