CSci 5552
Project - Sixth Sense
Proposal

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Robot: An intelligent machine that can sense and act on the world.

1 Description

Given a robot in an static unknown environment, the goal is to

1. Create a map of the environment leaving almost no area unexplored.
2. Localize the robot in the map (with exteroceptive and interoceptive measurements).
3. Not collide with any obstacles while doing so.

The robot motion is all in 2D. We plan to be generous with visualizing our insights. We plan to compare MLE and MAP estimators in our context. We plan to compare a couple types of sensors. If time permits we plan to sense in dynamic and/or multi-robot environments.

2 Purpose

The aspects of the project span the minimal set of features required for sensing in a robot. We hope to gain crisp understanding in each of these aspects. By the end of the project we hope to be able to compose the concepts learned in the process to design and implement more sophisticated sensing techniques.

3 Simulator

We are using a self-written simulator in Java that started out a port of the simulator in class repository and therefore it has basic necessities like separate thread for robot, noise in measurements etc... We use processing as the rendering library, which is basically a thin wrapper around OpenGL. This lets us build 3D environments quickly while abstracting the unnecessarily complex OpenGL specifics. We contacted Bobby Davis for a cross-check and got a green flag.

4 Challenges

We anticipate the following challenges
Correctness: Processing sensory data correctly and handling corner cases
Performance: Processing it fast enough for it to be real-time
Safety: Ensuring no collisions in uncertainty
Measurement noise: Making reliable lifelong improving maps in uncertainty

5 Approach

The relative motion and landmark localization methods discussed in class provide a good starting point. Those solves however are for point landmarks. To handle line and circle landmarks, they have to be modified. Assuming that landmarks and measurements have a known one-to-one mapping, by iteratively getting new sensory data from landmarks and odometry, the robot pose can be calculated while updating an environment map. To handle uncertainty, we plan to use weighted MLE or MAP estimators. To maximize safety, we plan to use some conservative control scheme for the robot.