Final Exam: CMSC828F

Due 5/22/2006

1. The ER1, moving in the corridor, is equipped with a calibrated camera. That is, the position and orientation of the camera with respect to a coordinate system attached to the robot, as well as the internal camera parameters, are known. On the walls are red squares of known size, mounted at a fixed distance from the ground. Describe, how you can compute the pose of the robot (x, y, \( \theta \)) with respect to the walls.

2. The robot is moving with known translation and rotation in a corridor with textured walls, pointing camera 1 at the right wall and pointing camera 2 at the left wall. Describe a way of estimating the pose of the robot with respect to the two walls using as input normal flow or optic flow. Discuss the computational difficulties (i.e. what to do if the robot moves very fast, how to segment the walls etc.). Discuss also one technique of flow estimation.

3. Discuss your observations from the experiments with the particle filter for localization. Will it converge with the noisy IR sensor measurements? If we had more accurate depth sensors, how would you tune the various parameters to achieve faster convergence?

4. Find from the literature the current approaches to the full SLAM problem. Classify them in some way, and describe them.

5. For our SLAM solution we build a map using a topological graph representation in conjunction with occupancy grids. We have discussed difficulties in describing a location (node in the graph) uniquely. A location usually looks very different when approached from different directions. How can we deal with this problem? Describe various visual representations that may be useful in describing locations. (Think about different spatio-temporal representations).

Lastly, you have the choice of using other sensors. What sensors would you employ for the SLAM problem?