Assignment 1: Grid-based localization using histogram filters and heterogeneous sensor data

Given: Two different maps of a tiled environment which in ROS should be obtained using a map server.

The first map gives the temperature of each tile. The model for generating this map is based on a network of cold and hot water pipes that are assumed to be running under the tiles.

Based on this model it is possible to have a "cold" tile right next to a "hot tile" but we cannot have a hot tile surrounded by cold tiles.

The second map gives the texture of the tiles, each tile is either rough or smooth.

The simulated robot has a temperature sensor and a texture sensor. The sensor data has to be simulated in ROS using the true maps of the environment and the error parameters of the sensors just as I have in my program.

The temperature data has zero mean Gaussian noise, with the std deviation of the noise being a configurable parameter..

The texture sensor outputs the correct texture with some probability, again a configurable parameter.

The robot takes motion commands (up, down, left and right) to move between grids. In my implementation, I also have a command for not moving at all but this is probably not required in the ROS implementation. The robot executes the correct motion command with some probability (see my comments in the code).

Given the two maps, sensor data and motion commands, and all the probabilistic models for the sensors and robot motion, the robot has to localize itself using a histogram (Bayes) filter.

The localization program estimates a posterior distribution of the position of the robot every time it receives a new sensor data or movement command. Students have to explore how the accuracy of their localization varies when they use only one type of sensor data only versus using both.

In the ROS implementation, I am imagining different nodes for the map server, sensors and robot. Please also put in nice color-coded visualizations for the maps and the distribution of the robot pose.

Let me know what your thoughts are on the assignment and how you think stage might fit into all this.