Probabilistic Robotics
BAIPR6, Fall 2011
Lab Assignment: EKF and Particle Filter Localization
Assigned: Thursday November 10;
Due: Monday December 5, 17:00 in the afternoon

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Introduction

You are to write a particle filter and a Kalman filter for robot localization on a soccer field. The script generates motion information according to the odometry-based motion model. Observations are landmark detections. Each landmark has a unique ID. There are 6 landmarks, as described in `getfieldinfo.m`. This assignment is for a pair of programmers.

Hand-Out

Download the file http://www.cs.washington.edu/education/courses/cse571/07au/project1.tgz. This file contains the following Matlab-scripts:

Tools

- `generateScript.m` – generates data according to initial mean and noise parameters
- `generateMotion.m` – simulates simple motion commands
- `prediction.m` – move robot according to specified motion
- `sampleOdometry.m` – implements Table 5.6

- `sample.m` – samples from a covariance matrix
- `meanAndVariance.m` – returns the mean and variance for a set of non-weighted samples (illustrates handling of angles)
- `getfieldinfo.m` – gets field information
- `minimizedAngle.m` – normalizes an angle to [-pi, pi]
- `endPoint.m` – returns the location of an observation
- `matlab.el` – customization file for emacs

Tools

- `plotcircle.m` – draws a circle
- `plotcov2d.m` – draws a 2-D covariance matrix
- `plotfield.m` – draws the field with landmarks
- `plotmarker.m` – draws an 'x' at a specified point (useful for drawing samples)
- `plotrobot.m` – draws the robot
- `plotSamples.m` – plots particles from the pf

Data format

- State: [x,y,theta]
- Observation: [x,y,theta]
- Control: [drot1,trans,drot2]

Hand-In

You should implement the following scripts:

- `run.m` – Main update loop, should call ekfUpdate and pfUpdate
- `ekfUpdate.m` – EKF update

- `pfUpdate.m` – Particle filter update
- `resample.m` – particle filter resampling, called by pfUpdate

When you have completed the assignment, create an archive from your code, include your labbook_localization.pdf. and mail me (J.F.P.Kooij@uva.nl) the archive.

The body of the labbook should be to the point. Do not elaborate on the code, but show some highlights where you are proud of. Concentrate on the essence of your approach.

In case of doubt, summerize your quest for the first steps, and elaborate on the last step.

Try to design an experiment which shows the strengths of your implementation, but also design an experiment which makes clear what the limits of your implementation.

Acknowledgements

This assignment is made by Dieter Fox, Jonathan Ko and Brian Ferris from the University of Washington.

Hints *(Please read this!)*

- Get to know Matlab

  There are a lot of useful tutorials online if you don't know how to use Matlab. Dieter's first suggestion is http://www.math.ufl.edu/help/matlab-tutorial/. He is not saying that it's good (or bad) suggestion; there are many other alternatives.

  Matlab has a lot of useful functions, so don't reinvent the wheel! Need to sum a whole list of numbers (hint, hint)? Use sum! Need to know more about function function-name? Type help function-name. You will find help to be very helpful. Additionally, randn is a good one to use.

- Get to know the files

  The archive contains several files with useful utilities. You can use them, but you don't have to use them all. Some of those files have more extensive description in their header. Don't forget to read them.

- Read the book

  In principle you are implementing the algorithms described in Table 7.2 and Table 8.2.

And, if this is not enough, you can also ask for help.

Have fun!