Exercise 1 - Localisation
Intelligent Robotics
Intelligent Robotics Extended

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Aim

The goal of this exercise is for you to implement, analyse and understand the properties of the particle filter. You will program the filter for the P3 DX robot using ROS and Python. In addition it is an exercise in experimental design, and experimental write-up.

Task

Program the navigational system of your robot to use the particle filter (Monte Carlo Localisation or MCL) to localise. The algorithm will have been explained to you in the lectures. By joystick control, or autonomous control you should then gather data for experiments you have designed to characterise its behaviour. In addition to implementing the basic filter you may attempt extensions, such as adaptive MCL. You should compare the performance of your implementation to that in the ROS nav-stack. Finally you should also investigate methods for returning the best single estimate of the pose.

The aim should be to come to a clear characterisation of the properties of the filter. The experimental report should be written up and handed in using Canvas by 12 noon on Wednesday 11th October. Vivas will be conducted in the lab session on Thursday 12th October.

You should use the classical reporting style for experimental write-up. Your report should be 2 pages long, and you should use the IEEE ICRA template for the report. Do not alter the template or you will be penalised. You can find the templates here:

ras.papercept.net/conferences/support/word.php
ras.papercept.net/conferences/support/tex.php

Marking Scheme

5 marks – Performance – How well does the robot localise as evidenced by the report and the demonstration?

5 marks – Filter Implementation – Is the implementation clean? Is the code modular, well commented and structured? Is the implementation of the basic filter correct? Has a version of AMCL been attempted, and how good is it?

5 marks – Pose estimation – With respect to the return of a pose estimate, are the methods chosen well designed and principled? Do the methods deal in an appropriate way with multi-modal densities?

5 marks – Understanding – Is the ability of the team to answer technical questions about the filter good? Do they understand the trade-offs between MCL and other kinds of filter? Do they understand the basic principles of Bayesian filtering?

10 marks – Report – are the experiments to characterise and compare the filters well designed? Are they meaningful in telling us which designs are better, and in characterising the components and the whole system? Are the experiments written up properly? Is presentation good? 7 marks for experimental aspects. 3 marks for presentation (grammar, spelling, layout, clarity of writing). Full marks here will require perfection.