LAB3: Navigation by Particle Filter estimation

1 INTRODUCTION : NAVIGATION

In this lab we simulate the navigation of a Underwater Autonomous Vehicle (AUV) between south of Sardinia and Italy. The AUV measures the absolute depth (with a depth gauge) and its distance to the ground with an acoustic sensor. A bathymetric map is stored into the onboard computer.

The robot is programmed to navigate to the east in a straight line. The velocity is quite well controlled but there is lateral deviation due to unknown perturbations.

The goal of the lab is to program a particle filter in order to accurately estimate the robot position.

2 MATLAB CODE

A matlab template is given. It is made of several sections described here:

- Section 1 loads and plot the bathymetric map
- Section 2 initializes the main parameters of the simulation
- Section 3 generates the trajectory and the set of measurements
- Section 4 initializes the particle filter
- Section 5 is the particle filter

3 BOOTSTRAP FILTER

The matlab template must be completed in order to program the Bootstrap Particle Filter, mostly in section 5.

- In the predict stage a new set of particle xu must be generated from the prior xu. (In section 3 one can see how the real trajectory has been generated)
- For each particle the Importance weight q must be adapted according to the actual measurement $y(t)$ (In section 3 one can that real measurement is corrupted by a Gaussian noise (matlab function: $randn$))
- The resampling algorithm must be programmed in order to duplicate significant particles and eliminate the other ones.

4 DISCUSSION

- Does the “standard” algorithm (with no resampling) work ?
- How many particles do you suggest to use for this specific problem ?
- In the code, which part is the most sensitive to the increase of particle number?
- Why is it interesting to use a bigger measurement or process noise in the particle filter than the real one ?
- For a given particle filter compare the performance of your filter for different starting points. Explain why some departure point are better than others.