ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

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Project Summary

Dynamic Object Tracking for Mobile Robot Localization

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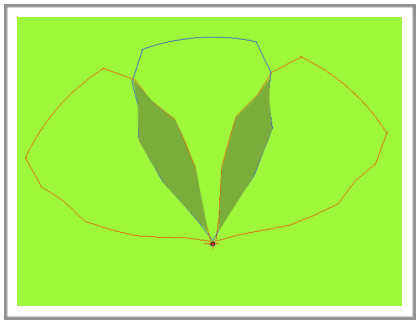
We plan to alleviate UWB weaknesses by exploiting the knowledge that a robot can gain over its immediate environment, independent from the UWB signals.
This project consists in developing algorithms which allow the robot to reliably identify and track moving objects in the environment using ultrasound sensors only.

Model of ultrasound sensor

We have used a range finder camera to modelize the ultrasound sensors of the Khepera III robot. Each pixel returns the range of the nearest object in front of it. As ultrasound sensors get back only the distance of the nearest object in all the field of view, we take into account only the smallest range of the pixels.



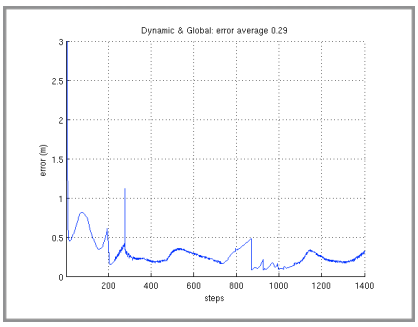
Particle filter

In order to localize, then track an object, we have used a particle filter. Particles are fictive and stand for a possible position and bearing of the object, and the weight represents the importance or the likelihood that the object is at this location. In the filter we compare the distance between the particles and the robot with the sensor's range. If these two distances are similar, so the probability that the particle is on the object is high, so the particle's weight is increased, else the weight is decreased. Then low weights are eliminate, high weights are split so the number of particles is held constant. The particles' position is updated comparing the range seen by the sensors and the previous range.

To track an object, we implement a proportional controller: the speed of the wheel is proportional to the difference between the distance object-robot and the desired distance. So for each particle we compute the distance to the robot and then we calculate the average.

Results

In order to measure the performance of our method, the robot track an moving object and we calculate the error average between particles and object position. The graph below show this error, which is constant and quite low, this shows that our algorithm works.



Limitations

Nevertheless, the main obstacle for better performance is sensors. The US-sensor has a large angle of aperture and gives only the distance of nearest object. So it is difficult to get precise angular position, velocity or direction. Moreover this method does not differentiate between the mobile object and other static obstacles, like walls.

In this work, we had to model ultrasound sensors, develop an particle filter, and implement a controller to track the localized object.