

# Homework 4: Localization

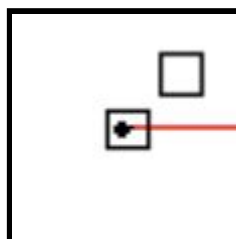
**i. Test the algorithm by running `localization.py` several times, driving around the map and seeing if the particles converge on the robot. Do they converge or not? Describe the behavior you see.**

We have tested the algorithm several times driving the robot to different positions and sequences. We can see that the particles converge correctly to the robot's center position. Sometimes they converge very fast and sometimes it takes some seconds to converge correctly. We also have seen that sometimes they converge to a certain position and they move accordingly to the motion until finally they converge to the robot's position. We also have noticed that is faster to converge by rotating the robot so the sonar detects all the walls rather than moving it to some wall or corner.

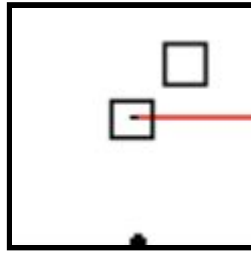
**ii. Test both increasing and decreasing the spread of the initial set of particles. How does this affect the algorithm?**

The spread of the initial set of particles affects the algorithm in the following way:

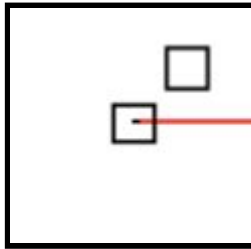
- If the spread is really small (for example 1) the algorithm finds the robot when it starts. All the particles are placed inside the robot without the need of moving or rotating it as we can see in the following image. That's happening because the initial spread center is the robot position and in this case, they are very close.



- If we increase the spread to 50, the particles are not placed inside the robot at the beginning (as we can see in the following image) but once you start moving or rotating the robot, they start going inside the robot.



- If the spread is really big (for example 100), the particles are too far from the robot (outside of the map) and they don't move inside the robot even if you move or rotate it.



### iii. Test increasing and decreasing the noise parameters $\alpha_1, \dots, \alpha_4$ . How does this affect the algorithm?

The alpha parameters are used to calculate the standard deviation of the gaussian noise we sum to the robot's motion. If we increase them the standard deviation increases too, and the noise added to the motion is bigger. So the particles motion move with more noise and takes longer to converge. Also, when they converge they are more spreaded around the robot. If we decrease the alpha parameters, it converges faster and they are closer to each other.

The first image is an example with a value of 10 and the second with a value of 0.1.

