Mobile Robots Localization – Lab 3
Localization using the y measurement only

In this new part of the lab we want to see what happens to the localization system when only the y position of the magnet in the robot frame is measured.

Preparation
Copy all the files of lab 1 into a new folder. Indeed, we are going to modify the programs at some point, and you don't want to mess up your lab 1 material.

Part 1.
We can easily check that by setting the variance of the x measurement to a very large value, by multiplying the standar deviation by a factor of at least 10. It is of course not a rigorous way to do it, but it's a quick fix to get an idea of what happens. Let all other variances to the correct values, as determined in lab 1.

Make the following tests :

- Run the program on the dataset « line1magnet ». Try to understand why there are always two red dots below the Mahalanobis distance threshold.
- Run the program on « diagonal45degrees ». Why does the previous situation not occur on this dataset.
- Run the program on « circles ». For what positions of the robot do you have red dots below the threshold ?

Give a short report on Aulaweb where you explain your understanding of this phenomenon.

Part 2.

- Run again the program on « line1magnet ». Observe the estimated localization uncertainties in the absolute reference frame. Are they satisfactory ?
- Run again with « diagonal45degrees ». Is the evolution of the uncertainties satisfactory ?

Give a short report on Aulweb where you say whether, in your opinion, the problem is related or not to the phenomenon observed in part 1 (red dots below the threshold).

Part 3.
Compare the evolution of uncertainties for « line1magnet » and « diagonal45degrees » to the evolution observed with « circles ».
Also, on « twoLoops », correlate the evolution of the uncertainties to the estimated rotation speed.
Based on these observations, when would you say the problem occurs ?

Part 4.
Conduct an observability analysis for this localization system. Prove that when both the x and y measurements are used, the state is observable. When the y measurement only is available, find out the cases when the state is not observable.

Tips :

- Remember that the tools we have seen in class to study observability are based on the continuous system, not the discrete system.
- You will consider that the positions of two magnets, say at (0,0) and (1,0) are continuously measured. In the first case both their positions, in the second only the y position.
- You can use Matlab's formal calculations to perform this study, although it is doable by hand.

Part 5.
Modify the program to actually take into account only the y measurement in the measurement vector. Make sure you identify all that must change.
Remark : For the LogData function to work properly, you still need to provide the two coordinates of the magnet in the robot frame. For example, `LogData( t , 'measurement' , X , P , [0;0] , Y ) ;` becomes : `LogData( t , 'measurement' , X , P , [0;0] , [sensorPosAlongXm;Y] ) ;` where Y is now a scalar.