

Exercise 1: Object Detection

Object detection is essential for robots to understand the world they are navigating in. In this exercise, you will build on top of today's and last week's topics and try detecting objects in images.

1. Stick the printed image of the circle on the wall at the height of the TurtleBot's camera.
2. Place TurtleBot in front of the image and orthogonal to the wall.
3. Receive the image from the TurtleBot's camera.
4. Segment the image by using thresholding to detect the circle.
5. Calculate the circle's diameter in pixels.

HINT: check <https://au.mathworks.com/help/images/ref/imfindcircles.html#d126e158801>

6. Test the robustness of your algorithm under different conditions, like variable lighting conditions, partial occlusion, color change.

Exercise 2: Distance Estimation

1. Place the TurtleBot at a known distance to the image (1m, 2m, 3m, ...).
2. Estimate the camera parameter f in the following expression:

$$\Delta p = f \frac{H}{D}$$

where Δp is the size of the circle in pixels (calculated in [Exercise 1](#)), H is the size of the circle in the real world (10 cm) and D is the distance to the image.

3. Repeat [Steps 1 and 2](#) several times to check the consistency of estimating parameter f .
4. Now, by using parameter f estimated in [Step 2](#), estimate the distance to the image live.





