# Perception

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## 1 Detection and Tracking of a moving object

### 1.1 Statement

We are interesting in detecting and tracking of a moving object in a room with a laserscanner. The laserscanner is located at a given position and is not moving. We assume that there is only one moving object in the environment. To detect it, we will use the technique of background substraction. To track it, we will determine the center of gravity of the bounding box and track it using a Kalman filter.

### 1.2 Questions

The first 4 questions are focused on detection (in DetectionObject.cpp) and the other one are focused on tracking (in TrackingObject.cpp).

1. We will first init the background by copying the data of the first scan into the background. So, you have to implement the method initBackground (in DataReader.cpp) and use the table background;

2. We will now detect the moving object by comparing for each beam the value of the background with the value of the current scan. If the difference is over a threshold, the corresponding beam will be considered as a dynamic beam. So, you have to implement the method detectMotion (in DataReader.cpp) and store the result of the detection in the table detection;

3. We will finally determine the bounding box and the center of gravity of this bounding box. The coordinates of the bounding box will be stored in xmin, xmax, ymin and ymax. The coordinates of the center of gravity will be stored in x and y;

4. Test your code with all the provided datasets. Analyze the results. Comment on the method for detection;

5. We will track the moving object while it is moving along the y axis. In Kalman.cpp, you have to implement the constructor of the class Kalman, the method prediction and the method estimation;

6. To perform the prediction, we will determine the action that has been performed between the estimation of the position at time t-2 and the estimation of the position at time t-1. Implement the code to determine the value of the action;

7. To perform the estimation, we will use the center of gravity of the bounding box as an observation. Implement the code to determine the value of the observation;

8. Test your code with all the provided datasets. Analyze the results. Comment on the method for tracking.

9. Test different values for Q, R and the initial std and comment on the effects of the tracking. What are the best values for Q, R and the initial std ?