

Exercise 1: Collision Detection

The goal of this exercise is to implement a mechanism to detect collisions with the obstacles and consequently stop the robot.

1. Drive the TurtleBot towards the wall.
2. Get x -axis IMU readings from the `/imu` topic.
3. Determine the deceleration during the impact and set the threshold T to this deceleration.
4. Implement a simple condition for collision detection. If the acceleration/deceleration is greater than threshold $T \rightarrow$ stop the TurtleBot.
5. Try to hit the wall with the TurtleBot and check whether the TurtleBot stops automatically.

Exercise 2: Obstacle Avoidance

The goal of this exercise is to implement a mechanism for detecting obstacles on the robot's path and prevent collision with them.

1. Get the lidar readings from the `/scan` topic.
2. Identify which rays correspond to the front and back of the TurtleBot.

NOTE: Instead of taking one ray for the front and one ray for the back, take several rays for the front and back. This is needed to avoid narrow passages in which the TurtleBot will not fit due to its physical size. Check the illustration below.
3. For each ray, calculate the repulsive force by fixing the influence distance of the obstacles d_0 to 1 meter.

NOTE: Repulsive forces are vectors.
4. Calculate the total repulsive force by summing up each single repulsive force.

NOTE: Be careful of the sign of each force.
5. Add the x component of the repulsive force to the commanded linear velocity before sending it to the TurtleBot.
6. [Optional] Add the y component of the repulsive force to the commanded angular velocity before sending it to the TurtleBot.
7. Test your implementation with static and dynamic obstacles.