Sensors and Control for Mechatronics Systems
Tutorial 4

Question 1: ROS sensor_msgs/LaserScan messages and MATLAB

1.1 : Load **'tutorial4.bag'** to MATLAB workspace using rosbag functions

1.2 : Select laser scan messages using select function

1.3 : Pick the first laser scan message using **readMessages** function

1.4 : Obtain the Cartesian coordinates with **readCartesian** functions

1.5 : Plot the scan using **plot** function.

1.6 : Observe how data is stored in the sensor_msgs/LaserScan message.

Question 2: Interpring laser data

2.1 : The following data array is a reading from a hypothetical 2D LiDar device. It has a field of view of 90^0 ranging from [-45^0 45^0]. Interpret the range-bearing data and convert them to Cartesian coordinates. Plot your answers in MATLAB.

Data : [1.4142 1.1547 1.0353 1.0000 1.0353 1.1547 1.4142]

Hint : Use the equations given in the tutorial slides but assume that the robot is facing the X direction.

Question 3: Laser scans and robot motion

3.1 : Figures 1 and 2 represent readings obtained by a LiDar fixed to a robot at times T1 and T2. Calculate the 2D rigid body transformation (translation and rotation) of the robot from time T1 to T2.
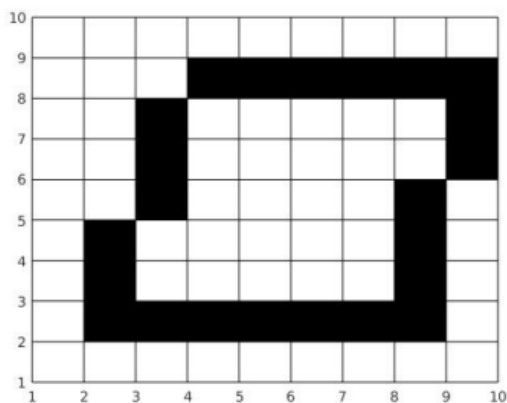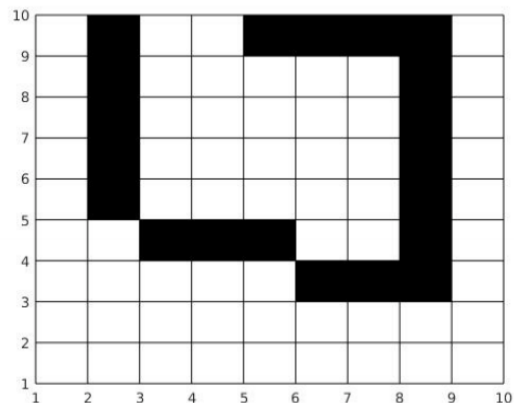

Figure 1 : Lidar reading at time T1   Figure 2 : Lidar reading at time T2

Question 4: Using ICP to compute the rigid body transformation between two point clouds.

4.1 : Load the ***intel_LASER.txt*** data to MATLAB. Make sure to load it as a 'Numeric Matrix'. Following the steps taken in question 2, convert the data in scans 1 and 32 into 3D Cartesian coordinates.

Hint : The field of view of the laser is 180^0 [-90^0 90^0] and assume the Z coordinate to be zero.

4.2 : Create two MATLAB pointCloud objects using the 3D Cartesian coordinates of scans 1 and 32.
Refer to : https://au.mathworks.com/help/vision/ref/pointcloud-class.html

4.3 : Obtain the rigid body transformation between the two point clouds using the ***pcregistericp*** function.
Refer to : https://au.mathworks.com/help/vision/ref/pcregistericp.html

Question 7: LiDars and ROS

7.1 Setup the ROS rplidar package (http://wiki.ros.org/rplidar) in your computer and take turns with the LiDar device provided and observe the measurements in Rviz (alternatively, use the already setup computer or the ***carto_cas_exp1.bag*** rosbag).