Homework 3

February 2020

1 Introduction

In this project, you will implement the structure of mapping and localization in an indoor environment using information from an IMU and range sensors. You will integrate the IMU orientation and odometry information from a walking humanoid with a 2D laser range scanner (LIDAR) in order to build a 2D occupancy grid map of the walls and obstacles in the environment. Training sets of odometry, inertial, and range measurements from a THOR-OP humanoid robot will be provided for this project.

2 Data

Once you download the code base, all training data are provided in "data/train". There are 4 training datasets differentiated by ID numbers from 0 to 3, corresponding to 4 different trajectories generated by the THOR robot in Town building at Penn. For example, dataset 0 consists of

"$data/train/train\_lidar0.mat$" and "$data/train/train\_joint0.mat$".

You are also provided a rich set of documents to guide you on this problem. To understand more about the data, go to "$docs/guidance/config\_slam.pdf$".

Each dataset contains timestamped sensor values, corresponding to the raw sensor readings. To understand more about the data, go to

"$docs/guidance/config\_slam.pdf$".

3 General guidance

A walking-through guidance for this project is provided in details at

"$docs/guidance/guidance\_slam.pdf$".

You are also provided a code structure with two unit tests to debug your code. $README.md$ details how to run the code.

Your task is to fulfill all $\#TODO$ appearing on the code. The main() function will return an array of size $3 \times N$, representing the state estimate over time, with N is the number of time steps starting when both IMU and LiDAR are launched.

There will be a long list of transformation functions need for this project. To reduce your stress, most of these functions are already provided in $transformation.py$.