

# ENGR 4200 Final Project

March 11, 2021

## 1 Introduction

In this final project you will develop software packages for the TurtleBot2 robot to be able to map and localize itself in an environment. This project must be done as a team effort (3 people in each team – you can choose your teammates), and each team is required to implement its own version of the project.

## 2 Project Description

The robot will be placed randomly in a maze. Also, randomly you will have a red brick placed in this maze. The goal is for the robot to find this red by means of Simultaneous Localization and Mapping (SLAM). You will have to demonstrate this with the TurtleBot! Simultaneous Localization and mapping is a concept that in real life is used whenever a new place is visited. What a robot does while executing a SLAM algorithm is composed of two parts: build a map and localize itself into it. A map can contain multiple types of information.

- You will have to implement your own SLAM algorithm. A template for the code is given to you that can be used in simulation (as you did in the previous labs). You should modify this as you see fit.
- You can also get inspiration from the open-source SLAM methods.
- Decisions that you will have to make:
  - What sensors you will use for localization? (laser scan/ external camera/ Kinect camera)?
  - How you will detect the brick? (image processing)
  - What type of localization will you use? Particle Filter, EKF, other methods such as UKF, PoseGraph, ....
  - What type of features will you use? (lines, Harris corners, SIFT corners, ...)

### 3 Turning in your project

The Final Project has multiple due dates. Each team must submit a single, integrated report by the team leader before the deadline. The contents required to be included in each submission are listed as follows:

- **Deliverable 1: Project Plan (March 25st, 1 : 00 pm)**
  - a. Provide a brief description of the methods you will use, evaluation of success, etc.
  - b. Include a timeline and workload breakdown (among the team members) to show your plan of finishing the project.
  - c. This has to be a one-page document and will be discussed with the instructor during the lab time.
- **Deliverable 2: Software development (April 1st, 1 : 00 pm)**
  - a. During this lab you have to show significant progress in your code. By this delivery you should have all components of your code with a basic skeleton (prediction, state augmentation, data association, update, and image processing)
- **Deliverable 3: Prototype review (April 13st, 1 : 00 pm)**
  - a. At this point you should have each of the components working independent ( 90% of your project done)
  - b. Each member of the team has to discuss their parts and present the code written for it.
- **Deliverable 4: Demo, Presentation, Code submission (April 20th, 1 : 00 pm)**
  - a. Each team has to give a 15 minutes presentation. After the presentation, a competition between all projects will take place to demonstrate your SLAM capabilities.

### 4 Grading

Your grade (100 points) will be based on:

- Deliverable 1 - 20 points
- Deliverable 2 - 10 points
- Deliverable 3 - 20 points
- Deliverable 4 - 50 points