EGH446: Autonomous Systems: Project Parts A & B
Due Date: See blackboard, 2020. **Weight:** 60 %
Overview: Major Project. Groups of 2 students.

CRICOS 00213J

Project Overview [†‡]

The aim of this group-based project is to investigate and implement control and guidance approaches for a ground or an aerial autonomous system. The goal is to design the necessary subsystems to build an autonomous vehicle that is able to navigate to goal location on an optimal path while avoiding obstacles. See appendix A and B for detailed requirements.

During this project, the group must develop the following subsystems:

- A guidance subsystem that enable the vehicle to follow waypoints.
- A path planning sub-system that construct an obstacle free trajectory to a goal.
- A collision avoidance subsystem that steer clear of walls and static obstacles.

The aim to minimise the time taken to achieve the goal, given any random location within the workspace. The group may use the following subsystems from the provided Simulink library:

- Laser/Lidar subsystem.
- Obstacle detection subsystem.

At the start of the project, the team is given:

- A high fidelity dynamic simulation environment in Matlab/Simulink in which to build their ground or aerial autonomous system.
- A getting started guide for the simulation environment.
- Basic stabilisation approach for each vehicle.
- A Simulink library with control/guidance/navigation blocks that can used to validate your implemented approach.

[‡] Please report errors within this document to luis.mejias@qut.edu.au

Submission Requirement and Assessment

The final submission must contain two reports and the final implemented solution using the simulation environment provided. Reports and software should be compressed in a **ZIP** file and submitted to blackboard. Each group will submit:

1. The group's solution implemented within the provided simulation environment in Matlab/Simulink (i.e. submit the whole Simulink file so that the solution can be simulated by the marker).
2. The data file generated by the provided competition evaluation script.
3. Two individual reports in the specified template.

Please review the CRA sheet to see how your submission will be graded.

Important Instructions and Rules

1. In this project you will be required to investigate and implement suitable algorithms for automation using concepts covered in lectures. Your learning will be at a more detailed level than covered in the teaching material.
   - It is suggested you initially attempt lower automation levels before increasing automation complexity. Initially, using the position only waypoint capture is conceptually easier, but the path planning and obstacle approaches are required for higher level performance.
2. **You may not use pre-designed navigation or guidance blocks available in the Simulink library.**
3. **You may need to tune the provided base stabilisation approaches provided (optional).**
4. Students should divide the work and take ownership for a subsystem(s) and document their work in the report.
5. These sub-systems are coupled, and design decisions in each sub-system impacts the other system (in the sense that both sub-systems need to work together). Students will need to negotiate their design decisions with each other.
6. On request the unit coordination may give permission for submission by an individual who completes all systems by themselves. They will be marked according to the same CRA.
7. Note that QUT's policy on plagiarism applies to this project:
   `https://www.library.qut.edu.au/`
   `http://studysmart.library.qut.edu.au/module6/6_5/`
   `http://www.citewrite.qut.edu.au/academichonesty/avoidplagiarism.jsp`

A (30 %) Part A Requirements: Due Week 7, 20th April.

1. Given the basic dynamics and stabilisation, design a guidance logic to navigate waypoints.
2. Report on the following:
   (a) Total mission time. (Time it takes the vehicle to visit all waypoints).
   (b) Provide a detailed explanation of your guidance subsystem. Include a block diagram of the overall design, include plots and necessary diagrams to support your explanations.
   (c) Implement and report on average cross track error.
   (d) In terms of your position controller, report on the following performance parameters: rise time (the time needed by the control system to reach the desired value after a perturbation), peak overshoot (the highest value reached by the response before reaching the desired value), settling time (the time required to reach and stay within 2% of final value) and steady-state error. Use as step function x = 10 m, y = 0 m, with initial heading $\theta_0 = 30^0$. See below.

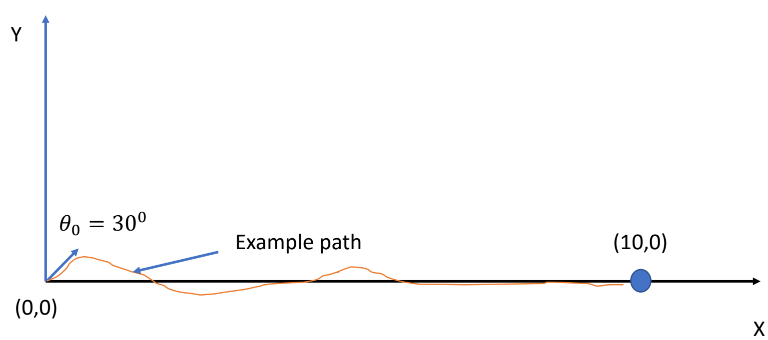

Figure 1: Example setup for position controller design

B (30%) Part B Requirements: Due Week 12

TBD