

# COMS0012 Robotic Systems

This coursework has two assessment points with the following weighting:

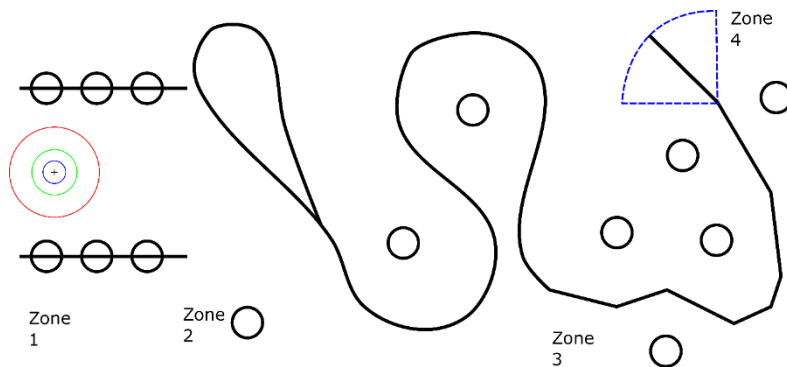
Assessment 1: [40%] Weeks 13-20 Individual Demonstration, Line Following with Romi robot.

Assessment 2: [60%] Weeks 20-24, Group Report, Report of Experiment with Robotic System.

## Assessment 1, 40%: Robot Demonstration, Line Following

### Scenario:

*"Your robot must autonomously find and track an undersea cable of unknown length and return home. Your robot will be dropped through a hole cut in an ice sheet, and no further communication will be possible."*



*\*assessment map varies.*

### Robot performance (max 100 points):

There are 3 timetabled opportunities to take Assessment 1 (all Wednesday):

**4<sup>th</sup> March (week 18), 11<sup>th</sup> March (week 19), 18<sup>th</sup> March (week 20)**

At any of the 3 Assessment Opportunities your Romi has 3 attempts at the task. Your robot will have 150 seconds per attempt. Your best scoring Assessment Opportunity will be used as the final mark. An Assessment Opportunity mean score is calculated from:

- Safe traversal from starting location Zone 1 to join the line in Zone 2 (**20 points**)
- Follow line through Zone 2-3 (**15 points**), follow line through Zone 3-4 (**25 points**)
- Detect the end of the line at Zone 4, robot must stop at the line end and *play an audible beep*. (**5 points**)
- Return to home, (**0 - 35 points**)
  - You may only take your 3 attempts at **Return to Home** during 1 of your Assessment Opportunities (4<sup>th</sup>/11<sup>th</sup>/18<sup>th</sup> March).
  - Before activating your Romi, you must declare which stopping location in reference to the coloured rings: Blue = 35 points, Green = 20 points, Red = 10 points. If you stop outside the declared ring but within the starting box, you will score a default of 5 points. Stopping outside the starting box scores 0 points. Your total score will be the mean points from your 3 attempts.
  - A plastic jig is used to measure stopping position from the centre of your Romi.

## Assessment 1, Further Specifics:

- **March 18<sup>th</sup>** is the Assessment 1 **Final** Deadline. If you have not taken an assessment opportunity prior and miss this final opportunity, you will score 0 for this component.
- Students do not get to choose or determine which map to use for assessment.
- The code your Romi is using during assessment must be uploaded to Blackboard. This will be checked by your assessor.
- You are responsible for the condition of your batteries at assessment – low batteries cannot be used to gain another attempt.
- You are responsible for the state of your Romi hardware – e.g., “the sensor wasn’t plugged in” (and similar observations) cannot be used to gain another attempt.
- If your Romi leaves the map area, difficulty getting back on to the map cannot be used to gain another attempt.
- Your Romi must start on the cross marked on the map. There is a plastic jig used to place your Romi. You will need a short delay (or button press) to allow your robot to be placed and the jig removed before it commences an attempt of the line following task.
- The time limit for the assessment starts when your Romi begins moving.
- Your Romi must leave the start location and join the Zone 2 line without crossing the black circles and lines immediately surrounding the start location (the starting box).
- Your Romi can leave the line and attempt to re-join the line. However, whilst line following, crossing a black circle on the map will count as a collision and will terminate that attempt of the task. You will score the points accrued for the attempt up to termination.
- You will not be able to score points for a zone not fully traversed.
- You may cross circles whilst completing the *(d) Return to Home* objective, such as by taking the shortest path back home.
- You can only attempt *(d) Return to home* once reaching the end of Zone 4.
- Zone 4 is the line terminus - this section of the line will vary in both length and angle, indicated by the blue dotted region, which will be set at assessment. This will be a straight-line segment. The blue dots are a visual indication only and will not be present on the assessment map.
- The final stopping position is taken from the centre of your Romi. This is assessed using the same plastic jig used to place your Romi and made in agreement with your assessor.
- You cannot add any of your own extra technology to the robot (e.g., sensors, bluetooth), but you can decorate your robot if you wish.
- You can take informal (non-marked) assessments with any of the teaching staff during any lab sessions – **however there are no practice runs during assessment.**

## Assessment 2, 60%: Group Report

Mandatory:

- Written report, 8 – 10 pages, via Blackboard, **6pm Wednesday 6<sup>th</sup> May** (week 24). Submission must be include in a zip file with a copy of all code used.
- Demonstration of developed solution **Wednesday 29<sup>th</sup> April** (week 23). *Your team will have 10 minutes to demonstrate and discuss the observable behaviour of your Romi with an examiner.*

Optional:

- [Formative] Topic/Experiment proposal hand in Thursday 26<sup>th</sup> March (week 21) via Blackboard. Feedback will be provided the following week.

In groups, you must write a report on an experiment conducted with your Romi on the theme of mapping. You can use the same map and context/scenario provided for Assessment 1 as the environment for your Romi. You must investigate an improvement to your robotic system by making a comparison between a prior and subsequent solution. You are being assessed for your ability to identify a problematic area within a robotic system, to conceive and conduct an experiment with your Romi robot, to collect and analyse meaningful results, and to communicate your work effectively with academic rigour.

You should select one aspect of your system and evaluate how it influences the general task of mapping. For example, you may wish to study motion control, a sensor configuration, state estimation, map representation, obstacle characterisation, or navigation techniques. It is important that you select *at least one appropriate metric* (measurement) to make an evaluation of your robotic system. Your metric(s) should be used to first quantify the identified problem, and then again by comparison with your hypothesised improvement.

Your Group Report should include:

- A diagram of your systems architecture in relation to the task scenario.
- A justification for your decision to focus on one particular subsystem, and how you hypothesise this will influence your overall solution within the context of mapping.
- A description of how you have experimentally optimised the subsystem. This should include:
  - A description and justification of what you have implemented.
  - A description and justification of your experiment methodology.
  - Introduction of appropriate metrics, a brief discussion of how these were decided upon, and the limitations of these metrics.
  - A summary and discussion of the experimental results, using appropriate plots and figures.
  - How the findings influenced the development of your overall solution.
- An evaluation of your improved solution applied to the mapping scenario.

Make sure to focus your efforts on selecting an interesting but concise topic to investigate, designing good experiment methodology, and performing data analysis with critical reflection. These are the aspects under assessment by way of effective communication in your report.