# Manchester Robotics / Tecnológico de Monterrey

# MR3001C Cyber-physical Systems I

# Final challenge

## Introduction

This challenge, developed by Manchester Robotics (MCR2) in conjunction with Tecnológico de Monterrey, aims to provide the student with a real-world problem to be solved using collaborative robotics in ROS.

The challenge consists of solving a day-to-day task in industry, by controlling a wheeled mobile robot in collaboration with a robotic arm, in a coordinated and sequential manner.

## Challenge Description

This challenge can be separated into two different tasks, the first one is moving the mobile to follow the designated paths by the user while avoiding obstacles along the way, and the second one involving moving the robotic arm to perform the task given by the user, both tasks should be performed in a sequential manner.

This challenge involves moving a mobile robot to different spatial positions. By using a PID (P, PI or PID) or any other type of controller to move the robot to the required positions by the challenge.

# TE3001B MR3001C Cyber-physical Systems

# Final Challenge Report Rubric

The grade consists of two parts:

* Video = 20%
* Individual Written Report = 80%

Deadline: TBD.

This is a team challenge, with an individual report.

## Teams:

* The students must form teams for this challenge.
* The teams will be the same as in other classes of this concentration.
* The teams must be multidisciplinary.
* The students must respectfully help each other to understand all the topics.
* The team must manage the project, using a project management methodology, and present it in the report.
* The methodology selected can be simple, E.g., Waterfall, Agile, Kanban, etc.

## Video (20%)

* Duration: Under **5** min. (If longer, increase speed)
* Show the team, names. Only one team member can speak at a time (not necessary for the whole team to speak in the video).
* Video on YouTube (Unlisted)
* Include the video link on the first page of the report.
* Video English

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| Task |
| Brief introduction (problem to be solved, solution strategy, team tasks, etc.) |
| Explain how the program works (launch files, libraries made, the structure of the project, etc.) |
| Show the results of the root being controlled, and the methodology followed to solve it. |
| Analysis of the behaviour of each robot and comparison of both behaviours. What is expected? Is the behaviour good? Why? Advantages/disadvantages of this type of control? Problems with this type of control? |
| A brief set of conclusions from the task. |

## Report (80%)

* Language: English
* Maximum Pages: 5 (not including front page and references)
* Min Font size: 11 pt. and Min. Line spacing: 1
* Front page: Your name, team names and id’s
* Appendix: No
* Report design: Single-column or double-column
* Format: PDF
* Details:
  + Each exercise and task in a different section
  + Results in diagrams, figures, tables, etc.
  + Include discussion, reflections, conclusions, and recommendations for each result.
  + Include references to books or publications in peer-reviewed journals (IEEE format)
* Results, tables, figures, etc., without detailed explanation/information, will be penalised.

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| **Task** |
| Introduction   * Problem statement and its importance in a real-world scenario |
| Project management strategy   * The student must show diagrams explaining how the project management strategy was implemented (planning, objectives, development, task assignment, etc.). * The student must describe concretely, why this strategy was selected and how were the task divided. |
| Control strategy   * The student must show a pseudocode/ flowchart explaining how the control strategy was implemented (the grade will depend on how detailed the diagram is. * The student must describe in a concrete manner the behaviour of the code. |
| Tuning methodology   * The student is required to explain the tuning methodology of the parameters (e.g. if done by trial and error, the student must show the different trials, constraints and conditions to select the parameters), Which tests were used to tune the parameters? Plots used? Constraints? Acceptance conditions? |
| Reflections and proposals   * The student must provide a small reflection on the behaviour of the robot (is it as expected? Good? Bad?) * What problems occur with their control algorithm in the simulated and real robot (friction due to points too close, proportional controller saturation because of points too far away, etc.) * The student must propose some solutions on how to solve these issues for the real and simulated robots. * The student is expected to present solutions to the localisation problem (mechanical: such as better friction on the wheels, less noise encoders, electronics: filtering or software: better localisation algorithms if possible) |
| References   * IEEE Format |
| Presentation and clarity   * The report must be clear for the reader, well organised and with a good presentation. |

## Rules

* This is a challenge, not a class. The students are encouraged to research, improve, tune, and explain their algorithms, designs, and manufacturing processes.
* MCR2(Manchester Robotics) Reserves the right to answer a question if it is deemed to contain partially or totally an answer.
* The students are welcome to ask only about the theoretical aspects challenge.
* For the autonomous part of the challenge, no remote control, or any other form of human interaction with the manufacturing process is allowed (except at the start).
* All the students must respect each other and abide by the previously defined rules.
* Manchester Robotics Ltd. reserves the right to provide any form of grading. Grading and grading methodology are done by the professor in charge of the unit.
* Further questions about the challenge can be asked to the professor in charge of the unit.
* Modifications to this challenge must be in accordance with the professor in charge of the unit and MCR2.
* The students are free to use any software or hardware available (within the scope of the unit) to perform the tasks previously mentioned.
* The students must act in a safe and respectful manner towards each other when using the equipment.
* The students MUST comply with the safety regulations of the laboratory and all the equipment used.
* Manchester Robotics Ltd. gives no warranty and accepts no responsibility or liability for the accuracy or completeness of the challenge presented.
* Under no circumstances will Manchester Robotics Ltd. be held responsible or liable in any way for any claims, damages, losses, expenses, costs, or liabilities whatsoever (including, without limitation, any direct or indirect damages for loss of profits, teaching interruption or loss of information) resulting or arising directly or indirectly from your use of or inability the information and material on this presented, even if the client (Tec de Monterrey) has been advised of the possibility of such damages in advance.