

Final Lab Exam

CP 275

January-April 2023

Aim

Design and Implement a Controller for a three-wheeled omnidirectional robot to satisfy a given Signal Temporal Logic Specification (STL).

Description

For the final exam, you will be asked to perform an experiment where you have to implement a Controller to satisfy an STL specification for a three-wheeled omnidirectional robot. For additional help, please refer to [1] [2] [3], Class notes and documentation/code provided to you.

State Space = $5m \times 3.3m$.

Target1 = $[3, 3.45] \times [1.5, 2]$

Target2 = $[1, 1.45] \times [2, 2.5]$

Signal Temporal Logic Specification :

$$[F_{[20,25]} Target_1] \wedge [F_{[35,50]} Target_2]$$

Kinematic Model of three-wheeled omnidirectional robot Robot to be used:-

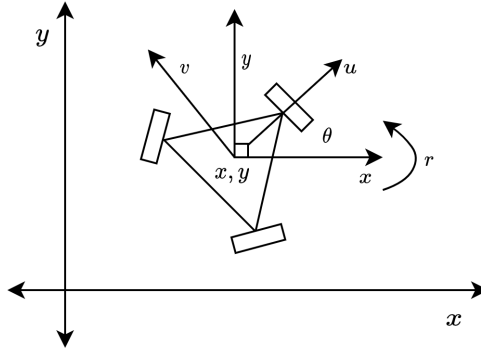


Figure 1: Omni Drive Robot

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} \cos(\theta) & -\sin(\theta) & 0 \\ \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} u \\ v \\ r \end{bmatrix}$$

Where x, y, θ indicates the robot's position, and θ indicates the robot's orientation with respect to the x axis. R is the wheel radius, and u, v, r are control inputs. Robot Specifications are - Linear Velocity Limits

= ± 0.22 m/s, Angular Velocity Limits = ± 2.84 rad/s, Wheel Radius = 0.033 m, and Centre to Wheel Distance = 0.122 m. For more information, please refer to [4].

Grading Scheme

The Final Lab Exam will be graded as follows:

- Simulation Task:- 15 Marks
- Real-World Task:- 15 Marks

For the Simulation Task, you will be given one chance if your demo/experiment doesn't work on the exam day, and for implementing in the real-world setup, you will be given approximately 30-40 mins to transfer/-experiment with code to make it work, after this your work will be graded. The exam slot will be of Around 1.5 hours for each team.

References

- [1] *Phasespace Mocap ROS Package*. 2022. URL: <https://github.com/FocasLab/phasespace-mocap-ros> (cit. on p. 1).
- [2] OpenRobotics. *ROS Answers*. 2020. URL: <https://answers.ros.org/questions/> (cit. on p. 1).
- [3] OpenRobotics. *ROS Wiki/Documentation*. 2020. URL: <http://wiki.ros.org/Documentation> (cit. on p. 1).
- [4] Yong Liu et al. “Omni-directional mobile robot controller based on trajectory linearization”. In: *Robotics and Autonomous Systems* 56 (May 2008), pp. 461–479. DOI: [10.1016/j.robot.2007.08.007](https://doi.org/10.1016/j.robot.2007.08.007) (cit. on p. 2).