Robotics workshop

For students from National Formosa University @ UTSA

Workshop Outcomes

At the end of this workshop students will be able to:

1. Learn basic usage of the robotics simulator, CoppeliaSim https://www.coppeliarobotics.com/
2. Create models of robotic systems
3. Write Lua code to control robots
4. Understand usage of vision sensors, proximity sensors, and actuators
5. Understand how to program an algorithm.
6. Implement a line following and wall following robot

Equipment list

Please download and install the education version of CoppeliaSim (it is free): https://www.coppeliarobotics.com/downloads.

1 Basics of CoppeliaSim

1. Create, modify, and move shapes https://youtu.be/qrchiEqt2ig
2. Change the viewpoint (pan/rotate/zoom/fit-to-view) https://youtu.be/98VnjXg1wBc
3. Create composite shapes https://youtu.be/v_NuNIdAo_U
4. Create a simulation https://youtu.be/H_Li3QeVM-M

Exercise: Your goal is to create a cascading effect like that in Rube Goldberg machine using geometries available in CoppeliaSim. You can also arrange by different orientation/position/size/shape to create more interesting behaviors. Use at least 4 objects. Here is one example from YouTube. https://youtu.be/OHwDf8njVfo?t=85

2 Modeling and controlling a differential drive car

1. Modeling a differential drive car https://youtu.be/uoL4J9QDZK0
2. Controlling a differential drive car https://youtu.be/IW1-4hy_yEg

Exercise: Get the car to move in a rectangular path by controlling the speed of the wheels.
Help: If you find it difficult to model the car, then you can download the model from here and proceed to control https://github.com/pab47/CoppeliaSim/blob/main/430/differential_drive.ttt

3 Line Following Robot

Download the Line Following Robot
https://github.com/pab47/CoppeliaSim/blob/main/430/line_follower_1_speed.ttt

1. Understanding how to access the vision sensors https://youtu.be/pNJh83cp1lY
2. Algorithm for line following https://youtu.be/jduuJwK8uME

Exercise: Download this scene and copy paste the code you developed.
https://github.com/pab47/CoppeliaSim/blob/main/430/line_follower_exercise.ttt
Tune the controller to complete the loop in the fastest time.

4 Wall following robot

Download the wall following robot here
https://github.com/pab47/CoppeliaSim/blob/main/430/wall_follower.ttt

1. Understanding how to access the proximity sensors https://youtu.be/iD2Dc6r7PeQ
2. Algorithm for wall following (feel free to develop your own too). https://youtu.be/oxQeojd7RTM

5 Project - Maze navigation

Exercise (submit via email): Download this scene and copy paste the code you developed for wall following robot.
https://github.com/pab47/CoppeliaSim/blob/main/430/maze_solver_exercise.ttt.
Tune the controller to move from start to goal in the fastest time without colliding into the walls.

Here is an example of the finished maze navigation: https://youtu.be/NZeG0vLbzJ0.