Mobile robotics Project

Vacuum cleaner autonomous robot

A Vacuum cleaner company has hired you. The company wants to investigate the possibility to develop a vacuum cleaner autonomous robot.

The vacuum cleaner autonomous robot that the company is planned to use is a unicycle robot (2 independent wheel located on the rear each wheel is controlled by a DC motor and a free wheel on the front). The maximum speed of the robots is 0.3m/s.

The vacuum cleaner robot is equipped with an ultrasonic sensor which gives the distance from the robot centre to any obstacle (wall, other obstacle), this distance is on the x axis coordinate frame link to the robot (the ultrasonic sensor sense only in the moving forward direction of the robot)

The robot has Proprioceptive sensor allowing to provide the X and Y position and the posture θ.

The Vacuum cleaner robot is also designed to have a better cleaning efficiency when moving forward, so the proposed control strategy should mainly use forward movement.

The company wants you to define a control strategy to perform the vacuum cleaning process. In order, to better understand the proposed process and its efficiency, the company request to perform some simulation to provide:

- visual information on the proposed control strategy and
- key indicator of the efficiency of the cleaning process.

For the simulation, the company proposed:

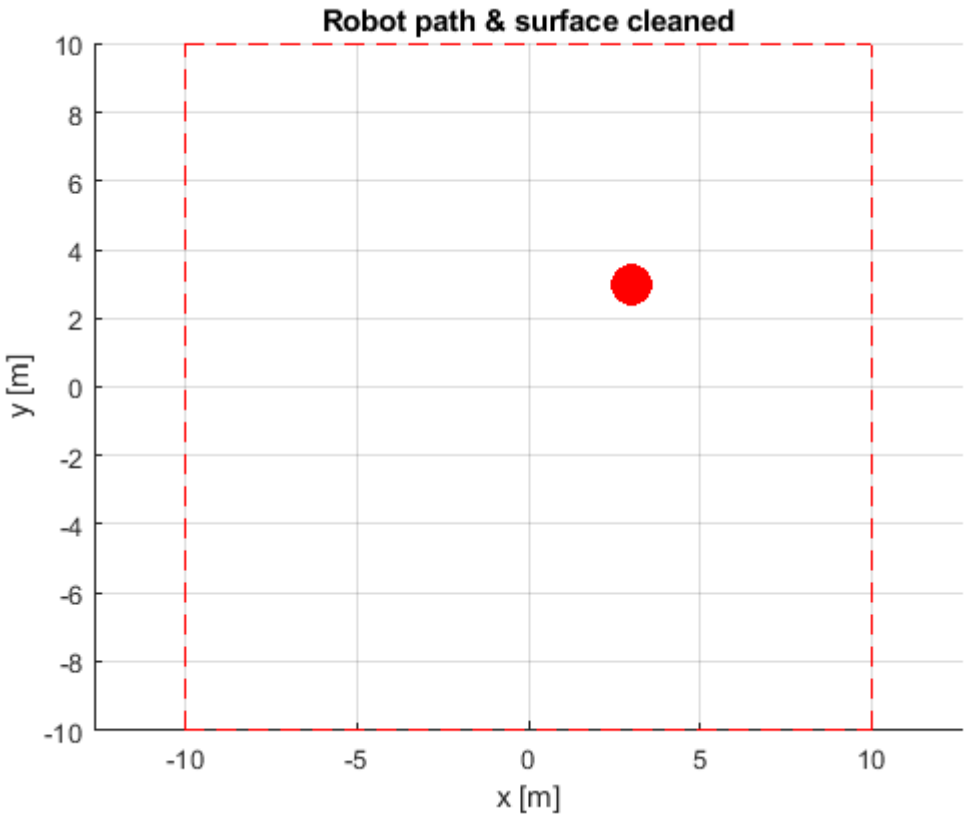
- to use a square room of 20 m length. The centre of the room is defined to be O coordinate (0,0).
- The robot is modeled as a disk with a radius of 0.2 m.
- to randomly define the initial position and pose of the robot as the robot is put in place by the person in charge of the cleaning process.
- To have on obstacle with a cylinder shape located in position (3,3) with a rayon of 0.25m
- To use the following DC motor characteristics with the following technical specification:
    - f: viscous friction
    - R: Rotor resistance
    - L: rotor inductance
    - km: motor constant
    - ke: Electric constant

- %% left motor
  - Jg = 1; fg = 1; Rg = 1; Lg = 1; Kmg = 1; Keg =1;

- %% rigth motor
  - Jd = 1; fd = 1; Rd = 1; Ld = 1; Kmd = 1; Ked =1.2;

It should be noticed that the two motor do not have the same exact characteristics.

1. Define your proposed control strategy to control the robot with the existing sensor. Even if the simulation used a square room, the strategy should work for all type of shape and size.
2. Once the control strategy is defined, provide a model of the vacuum cleaner robot, this model should show at least:
   a. The unicycle robot model
   b. The DC motor model for each motor
   c. The control strategy
   d. The block to simulate the measurement from the ultrasonic sensor.
   e. The block which computes the key indicator
3. Use the model to perform simulation and compute the following key indicator:
   a. The % of the room vacuumed as a function of time.
   b. the part of the room cleaned on a map and the robot path (see below the example of the map)



Project deliverables:

- one document to present **(format .doc, .ppt, .pdf only)**
  - the proposed control strategy (with the explanation)
  - your approach for the simulation
  - the result of your simulation with the key indicator (this could also include different simulation to check the influence of certain parameter on the Key indicator).
  - Indication on how to use your simulation model.
- Your Simulink/Matlab code that could be run to check the result provided in the document (instruction to run the code have to be provided in the document), the code should be provided under a ZIP file with the folder with the code **(file .m and .slx).**
- File naming convention : file name should start by your family name and surname : <Name_Surname_xxxx.yyy>