Assignment 6: Problem Statement

SC635-2020

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You are provided with a template file with that simulates sixteen unicycle robots in an empty world environment. Forward speed is assumed constant (and equal) for all the agents. The heading is updated by the control law:

$$\theta_i(t+1) = \frac{K_p}{1+|\mathcal{N}_i(t)|}(\theta_i(t) + \sum_{j \in \mathcal{N}_i(t)} \theta_j(t))$$

K_p has to be nominally chosen as 1.**Wrap every angle that you measure from (0 to 2π radians**]

Consider the underlying graphs for the definition of $N_i(t)$ as :

1. completely connected ,
2. ring,
3. directed spanning tree, and
4. all robots within a radius r centered at robot i are considered as the neighbours of robot i. Try the studies for atleast 2 values of r ..say r=1unit and r =3units

Perform the following:

1. Observe how the robots move in ROS-Gazebo simulation for each case individually and record your observations and the tuning parameters.

2. Now, add zero mean noise in each of the heading measurements for each of the cases, and observe the behaviour. Note the value of the variance of the noise that you have chosen.
3. Comment on your observations.
4. Record the variation of all the headings in a single graph (i.e. θ_i v/s N_samples for i=0,...,15)
5. Plot the variation of the average of the headings vs Number of samples. The experiments should be run long enough to see that the consensus has indeed been reached.
6. Comment on the performance in each case(in terms on time required to reach consensus). Note the eigen values of the system in each case. If heading-consensus is not reached in any of the cases, give appropriate justifications for the same.
7. Prepare a report compiling these results in the form of a presentation as done for the earlier assignments

Note- The control law here does not gurantee collision avoidance for robots. In the event that the robots collide, adhoc measures can be used to prevent the collision. One is to allow K_p to deviate from its nominal value of 1. The other could be reducing the value of linear velocity when the robots are in an ϵ neighbourhood of eachother. You may chose to use any other measure, provided you report the same.