ME-GY 7943
Network Robotic Systems, Cooperative Control and Swarming

Exercise Series 3 Solution

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Exercise 1

a)

Given:
Framework = (G,p(v))
G = (V,E)
V = {v_1,v_2,v_3,v_4,v_5}
E = {(v_1,v_4),(v_1,v_5),(v_2,v_3),(v_2,v_5),(v_3,v_5),(v_4,v_5),(v_4,v_3),}
p(v) = {$v_1 \to (0,2), v_2 \to (1,1), v_3 \to (0,0), v_4 \to (-1,1), v_5 \to (0,1)$}

Constraint vector is as follows:

$$\mathbf{g}_d = \begin{bmatrix} \|v_1 - v_4\|^2 \\ \|v_1 - v_5\|^2 \\ \|v_2 - v_3\|^2 \\ \|v_2 - v_5\|^2 \\ \|v_3 - v_5\|^2 \\ \|v_4 - v_5\|^2 \\ \|v_4 - v_3\|^2 \end{bmatrix}$$

$$\implies \mathbf{g}_d = \begin{bmatrix} (v_{1x} - v_{4x})^2 + (v_{1y} - v_{4y})^2 \\ (v_{1x} - v_{5x})^2 + (v_{1y} - v_{5y})^2 \\ (v_{2x} - v_{3x})^2 + (v_{2y} - v_{3y})^2 \\ (v_{2x} - v_{5x})^2 + (v_{2y} - v_{5y})^2 \\ (v_{3x} - v_{5x})^2 + (v_{3y} - v_{5y})^2 \\ (v_{4x} - v_{5x})^2 + (v_{4y} - v_{5y})^2 \\ (v_{4x} - v_{3x})^2 + (v_{4y} - v_{3y})^2 \end{bmatrix}$$

$$\implies \mathbf{g}_d = \begin{bmatrix} 2 \\ 1 \\ 2 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

b)

Please refer to *"getConstraints.py"*.

c)

Please refer to *"getRigidityMat.py"*.

d)

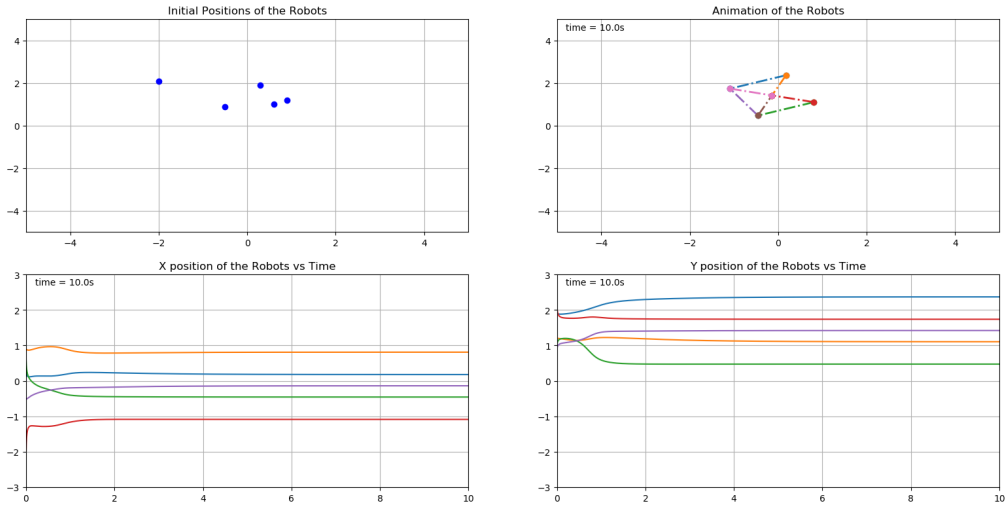

Figure 1: Formation and X,Y vs Time Plot.

Exercise 2

a)

Please refer to *"formationControlObs.py"*.

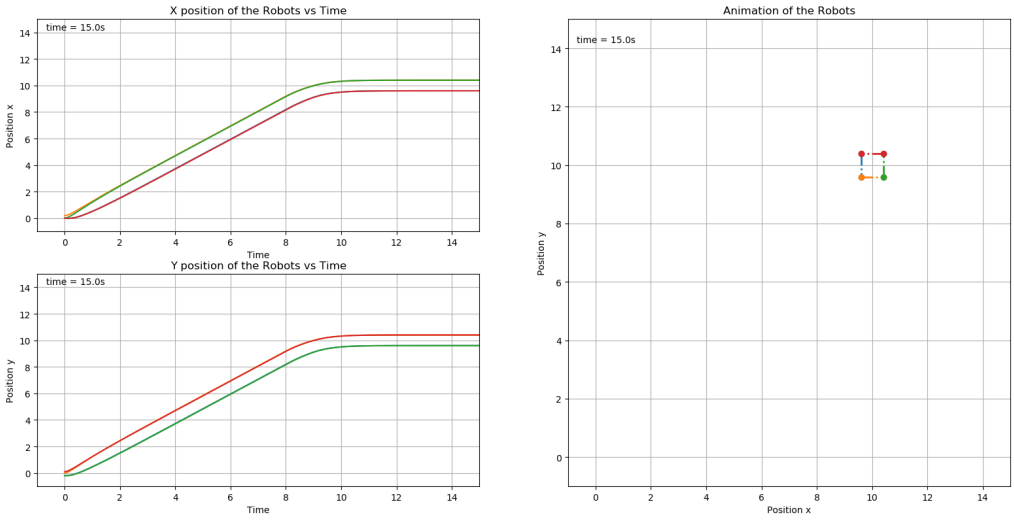

Figure 2: Formation and X,Y vs Time Plot.

b)

Please refer to *"formationControlObs.py"*.

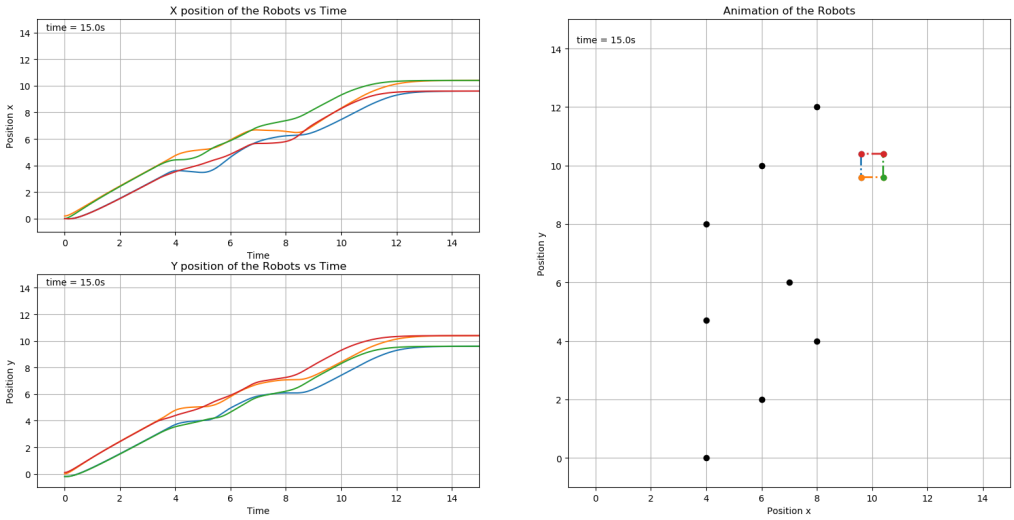

Figure 3: Formation and X,Y vs Time Plot.

c)

Please refer to *"formationControlObs.py"*.

In this case even after adding the 9^{th} obstacle, the formation is able to reach the goal position (10,10).

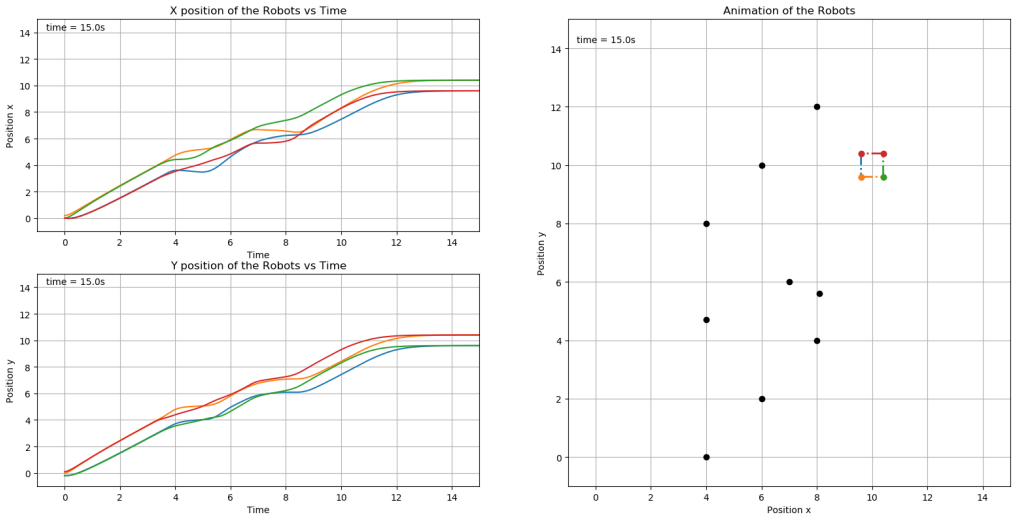

Figure 4: Formation and X,Y vs Time Plot.