CS455/655. Spring 2018

Project 1. MSN Flocking Formation Control

Project Deadline: March 15th 2018. Each student has to submit both **hard copy** and **electronic copy** of the project report.

1. **Hard copy submission in the class:** Return the hardcopy of your project report and **DO NOT** include source code in your hardcopy submission.

2. **Electronic copy submission: Include source code in your electronic submission.**
   Name/Zip your files as: "PR1-First_Lastname" then email your project report to Bravehung@yahoo.com: Before 11.30pm March 15th.

Project parameters:

Number of sensor nodes: n =100

Space dimensions: m = 2

Desired distance among sensor node: d = 15

Scaling factor: k = 1.2 and interaction range $r = k*d$

Epsilon = 0.1 and *Delta_t = 0.009* (These two parameters are optional and you can change them)

Case 1. Implement Algorithm 1 (MSN Fragmentation)

(Grade: UG 25point and G20point)

Randomly generate a connected network of **100** nodes in the area of 50x50. Then implement the Algorithm 1 to show the fragmentation behavior of the MSN.

1. Plot the initial deployment of the MSN of 100 nodes. Link neighboring nodes together by a line (prefer: blue line). See you Homework 1.

2. Plot/show the 6 snapshots of the MSN to show how it is fragmenting.

3. Plot the trajectory of the all sensor nodes in the *xy* coordinate.

4. Plot the velocity of the all sensor nodes in the *xy* coordinate.

5. Check and plot the connectivity of the MSN. Use this to check

```
Connectivity(t)= (1/(num_nodes))*rank(A); %A is Adjacency matrix
If Connectivity(t) = 1 the MSN is connected; Else not connected
```

Case 2. Implement Algorithm 2 (MSN Quasi-Lattice Formation) with static target

(Grade: UG 25point and G20point)

Randomly generate a connected network of **100** nodes in the area of 50x50. In this case you can set up a target (gamma agent) as static point with its coordinate (x = 150, y =150). Then implement the Algorithm 2 to show the flocking behavior of the MSN.

1. Plot the initial deployment of the MSN of **100** nodes. Link neighboring nodes together by a line (prefer: blue line)
2. Plot/show the 6 snapshots of the MSN to show how it is flocking and moving to the target location while avoiding collision with each other.
3. Plot the trajectory of the all sensor nodes in the *xy* coordinate.
4. Plot the velocity of the all sensor nodes in the *xy* coordinate.
5. Check and plot the connectivity of the MSN

Case 3. Implement Algorithm 2 (MSN Quasi-Lattice Formation) with dynamic target

(Grade: UG 25point and G20point)

Randomly generate a connected network of **100** nodes in the area of 150x150. In this case you plan a target (gamma agent) moving in a **sine wave trajectory**. Then implement the Algorithm 2 to show the flocking behavior of the MSN.

1. Plot the initial deployment of the MSN of 100 nodes. Link neighboring nodes together by a line (prefer: blue line)
2. Plot/show the 6 snapshots of the MSN to show how it is flocking and tracking a moving target.
3. Plot the trajectory of the all sensor nodes in the *xy* coordinate.
4. Plot the velocity of the all sensor nodes in the *xy* coordinate.

5. Plot the Center of Mass (COM) of the MSN and plot the trajectory of the target on the same figure to show how the MSN follows the moving target.

6. Check and plot the connectivity of the MSN

<u>Case 4. Implement Algorithm 2 (MSN Quasi-Lattice Formation) with dynamic target</u>

<u>(Grade: UG 25point and G20point)</u>

Randomly generate a connected network of **100** nodes in the area of 150x150. In this case you plan a target (gamma agent) moving in a **circular trajectory**. Then implement the Algorithm 2 to show the flocking behavior of the MSN.

1. Plot the initial deployment of the MSN of 100 nodes. Link neighboring nodes together by a line (prefer: blue line).

2. Plot/show the 6 snapshots of the MSN to show how it is flocking.

3. Plot the trajectory of the all sensor nodes in the *xy* coordinate.

4. Plot the velocity of the all sensor nodes in the *xy* coordinate.

5. Plot the Center of Mass (COM) of the MSN and plot the trajectory of the target on the same figure to show how the MSN follows the moving target.

6. Check and plot the connectivity of the MSN

<u>Case 5. Implement Algorithm 3 (MSN Quasi-Lattice Formation) with obstacle avoidance:</u>

<u>(Grade: UG 10point and G20point)</u>

- This CASE 5 is required for Graduate Students
- Optional for undergraduate student with **10 Bonus Point:**

Randomly generate a connected network of **100** nodes in the area of 50x50. In this case you plan a target (gamma agent) at the location of (200, 25). The obstacle is circular shape with radius of 15 and its center location is (100,25). Then implement the Algorithm 3 to show the flocking behavior of the MSN.

1. Plot the initial deployment of the MSN of 100 nodes. Link neighboring nodes together by a line (prefer: blue line). Plot the obstacle (circular shape) on this figure also.

2. Plot/show the 6 snapshots of the MSN to show how it is flocking and avoiding obstacles.

3. Plot the trajectory of the all sensor nodes in the *xy* coordinate.

4. Plot the velocity of the all sensor nodes in the *xy* coordinate.

5. Plot the Center of Mass (COM) of the MSN and plot the trajectory of the target on the same figure to show how the MSN follows the moving target.

6. Check and plot the connectivity of the MSN

(Note: Students are very encouraged to implement the Algorithm 3 with multiple obstacles)
Sample Result of MSN formation control and obstacle avoidance.