Report File

Shashwat Shukla

213234001

Assignment- 4

Balancing

Scenario:

- In the given scenario here, two extreme bots are positioned at stationary points and 6 bots in between adjust position to balance.
- All 6 bots in the between follow the same algorithm, hence a general algorithm is written for each of them.

Algorithm:

- All bots try to position themselves geometrically in between the two adjacent bots to the left and the right.
- Since extreme bots are fixed all the bots in between ultimately settle in a balanced position, where they are equidistant from each other.
- The algorithm the individual bots follow is shown in the flow chart in Figure 1.
- The velocity determined by the algorithm was in terms of the velocities in the x and y directions.
- However, since the robot models we use are differential drive bots, which take inputs as unicycle model, appropriate conversions were made to the velocities.
- The velocities provided to the robot were in terms of linear and angular velocities.
- The *'velocity_convert'* function was to check the maximum velocities and turning angles, and also to convert x-y velocities to linear and angular velocities.

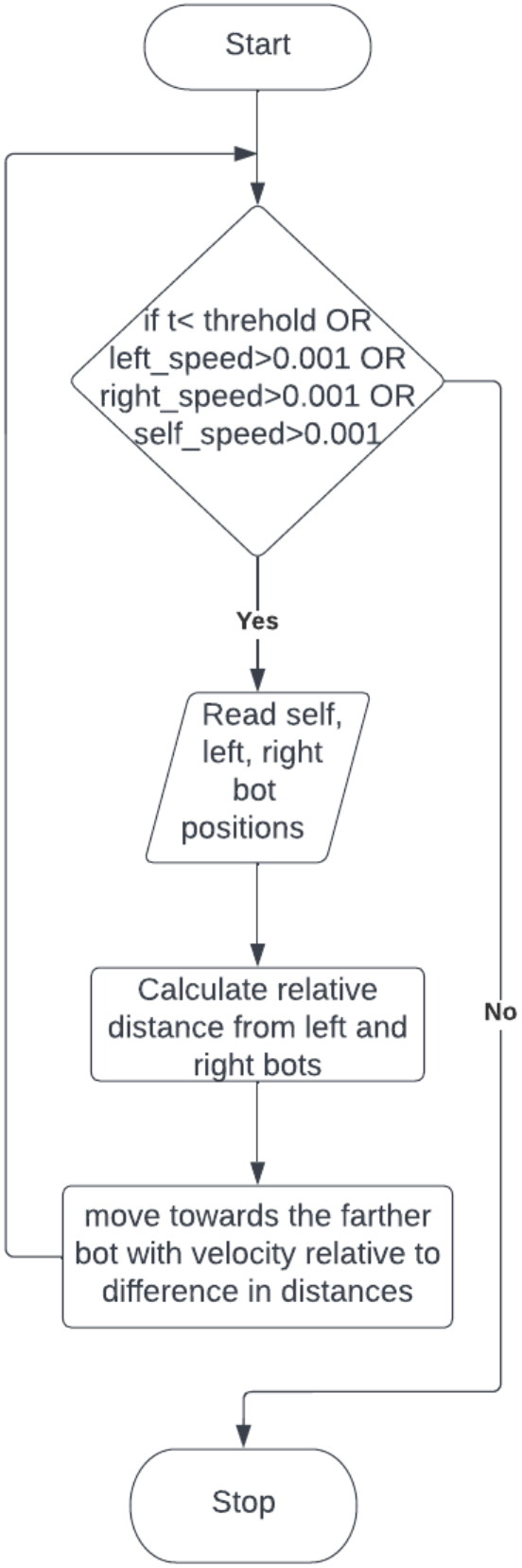

Fig 1: Flowchart of algorithm followed by individual bots

Changes in Existing code:

The skeletal code provided needed some tweaks to work in the given objective.

- The function to convert velocities in the skeleton code works well if the robot orientation and the desired direction of movement differ by less than ± 90°.
- However, when the difference is more than that, ideally the robot should not completely turn in the desired direction as, the robot can move in the reverse direction as well.
- E.g., With the existing function if the robot had to move in the direction exactly opposite to its orientation, it would move in a circle to take a turn. This is due to the limits put on the angle error. Whereas, the robot could have simply moved in the opposite direction with negative linear velocity, without turning.
- Since a few robots needed to move in the opposite direction, necessary changes were made.

Results:

The following images show the robot movements that resulted in the balancing of the robots:

- Fig 2 shows the start and end points of all robots, along with the path taken by them.
- Fig 3 shows the same for each individual robot.
- Fig 4 shows the combined x-axis positions with respect to time,
- While fig 5 shows the same for individual bots.
- The same images are also attached in the submission folder.

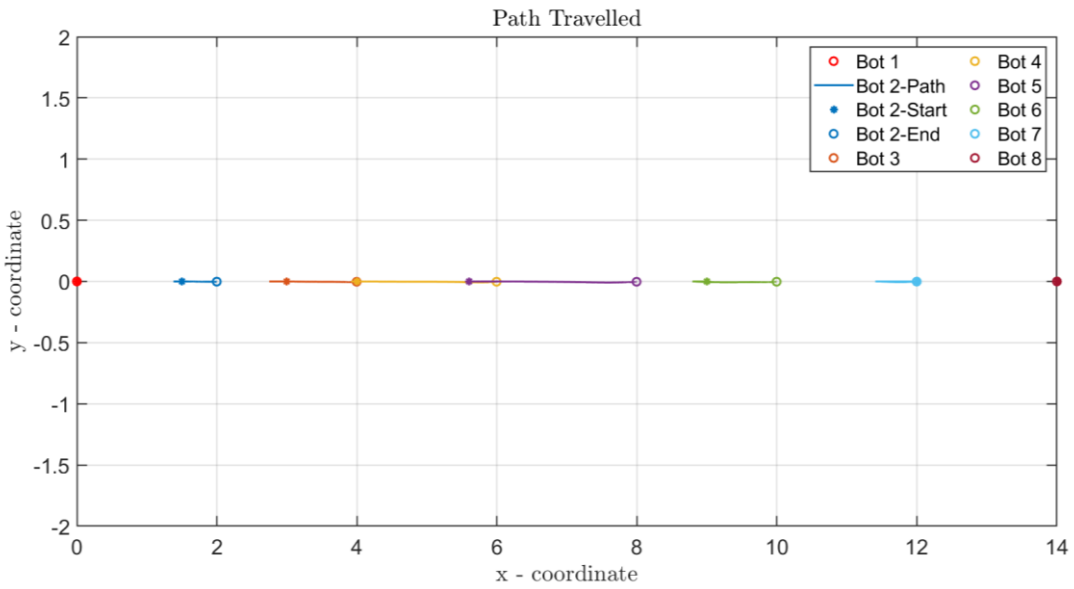

Fig 2: Path travelled by all bots

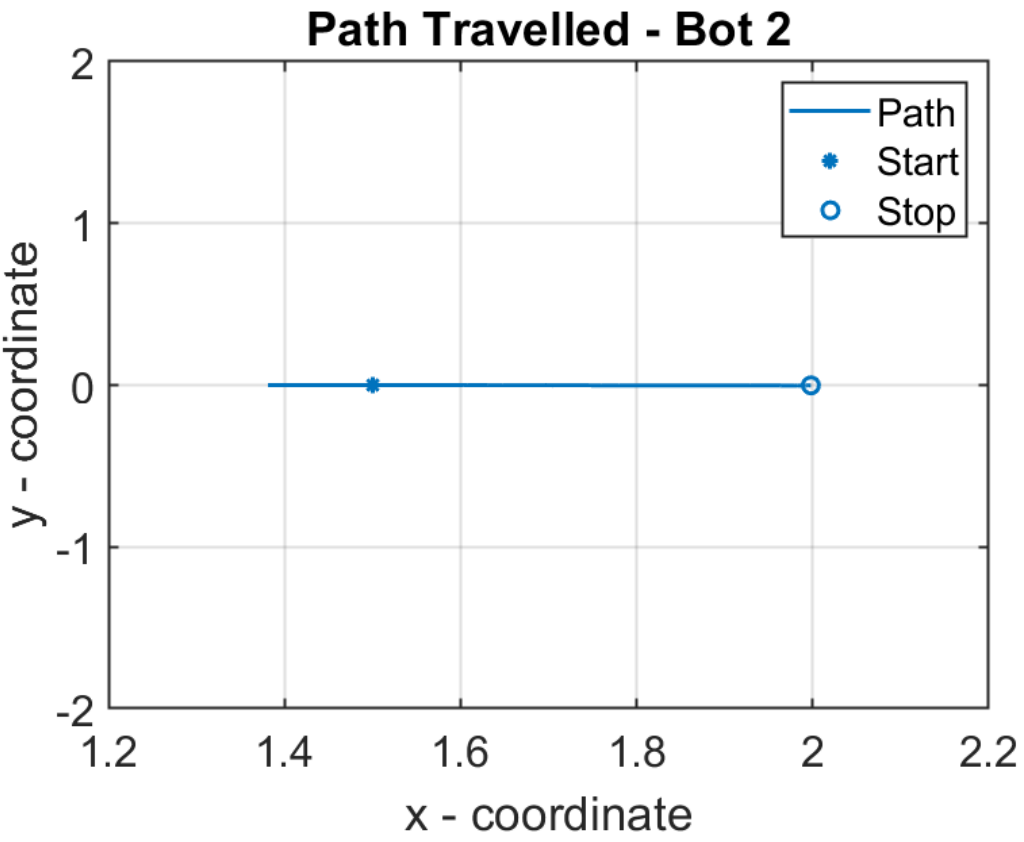
Path Travelled - Bot 2
Path
Start
Stop
y - coordinate
x - coordinate
2
1
0
-1
-2
1.2
1.4
1.6
1.8
2
2.2

Fig 3a

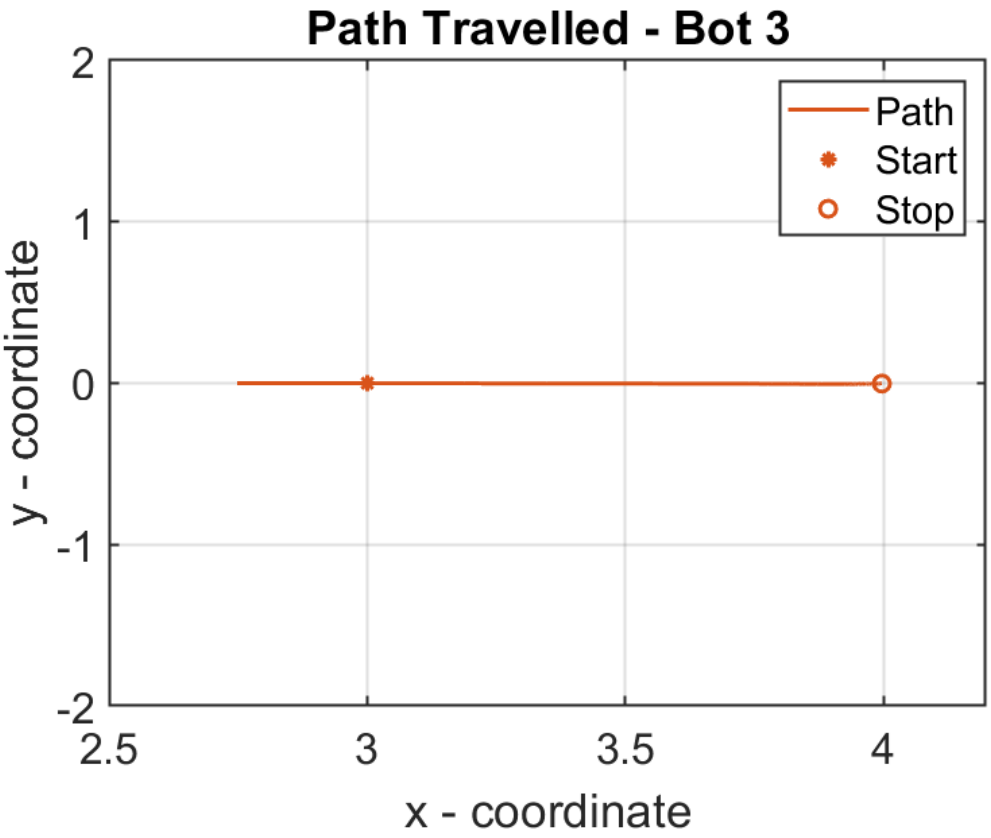
Path Travelled - Bot 3
Path
Start
Stop
y - coordinate
x - coordinate
2
1
0
-1
-2
2.5
3
3.5
4

Fig 3b

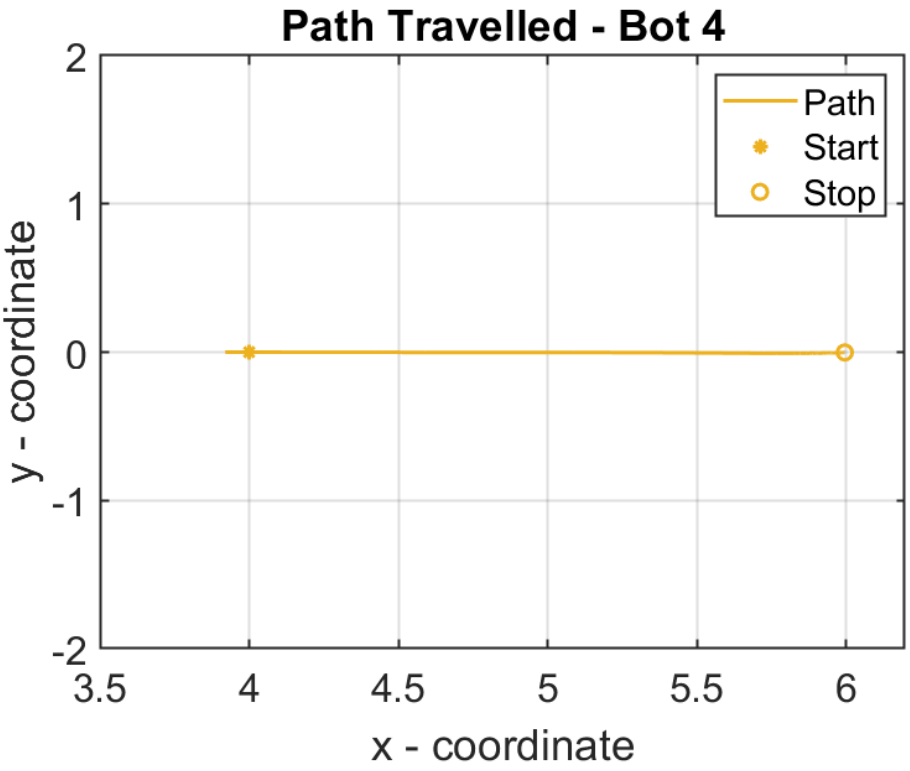
Path Travelled - Bot 4
Path
Start
Stop
y - coordinate
x - coordinate
2
1
0
-1
-2
3.5
4
4.5
5
5.5
6

Fig 3c

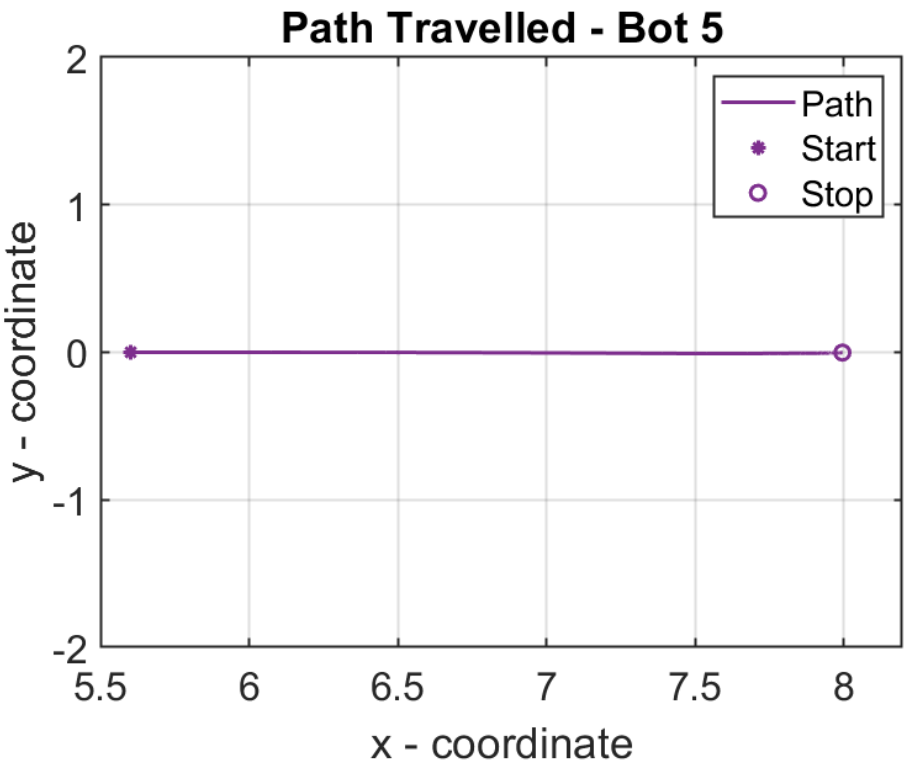
Path Travelled - Bot 5
Path
Start
Stop
y - coordinate
x - coordinate
2
1
0
-1
-2
5.5
6
6.5
7
7.5
8

Fig 3d

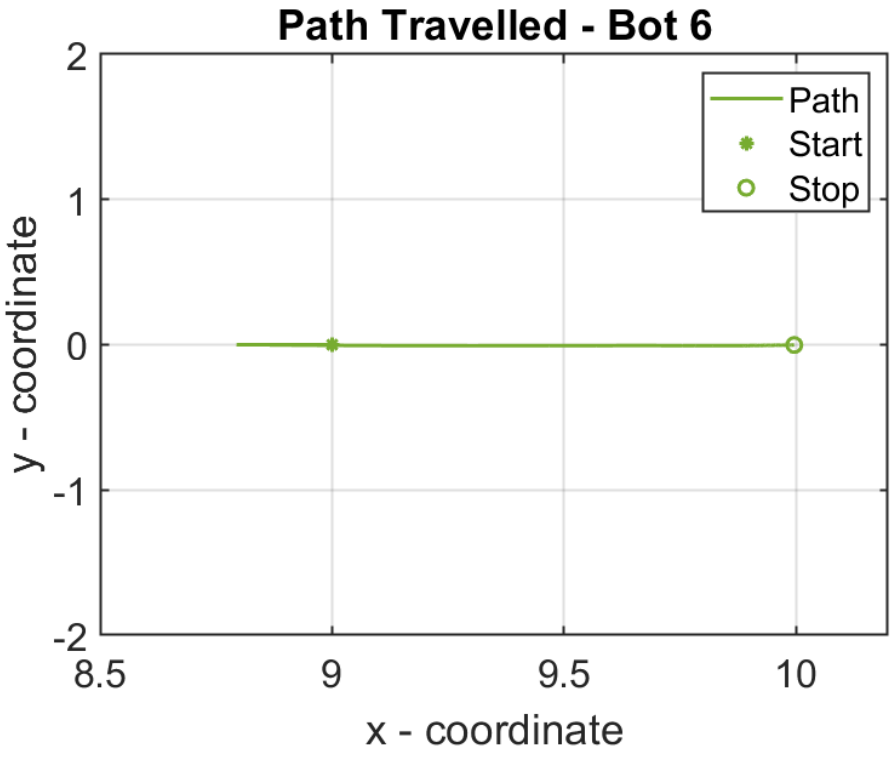

Fig 3e

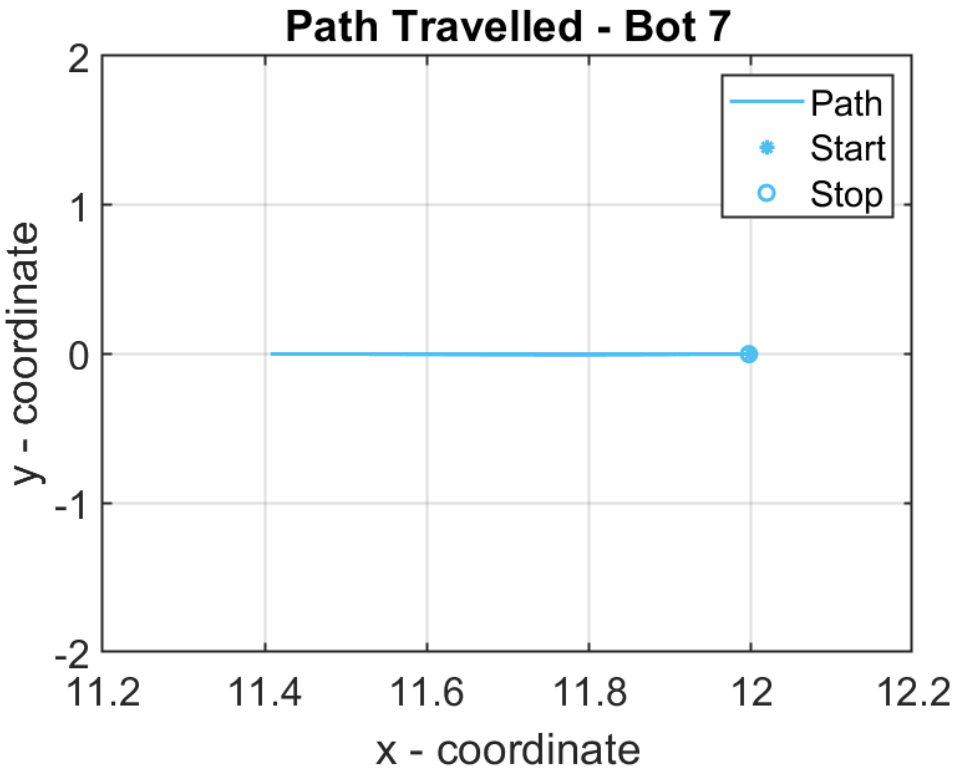

Fig 3f

Fig 3: Path, starting and end points of individual robots.

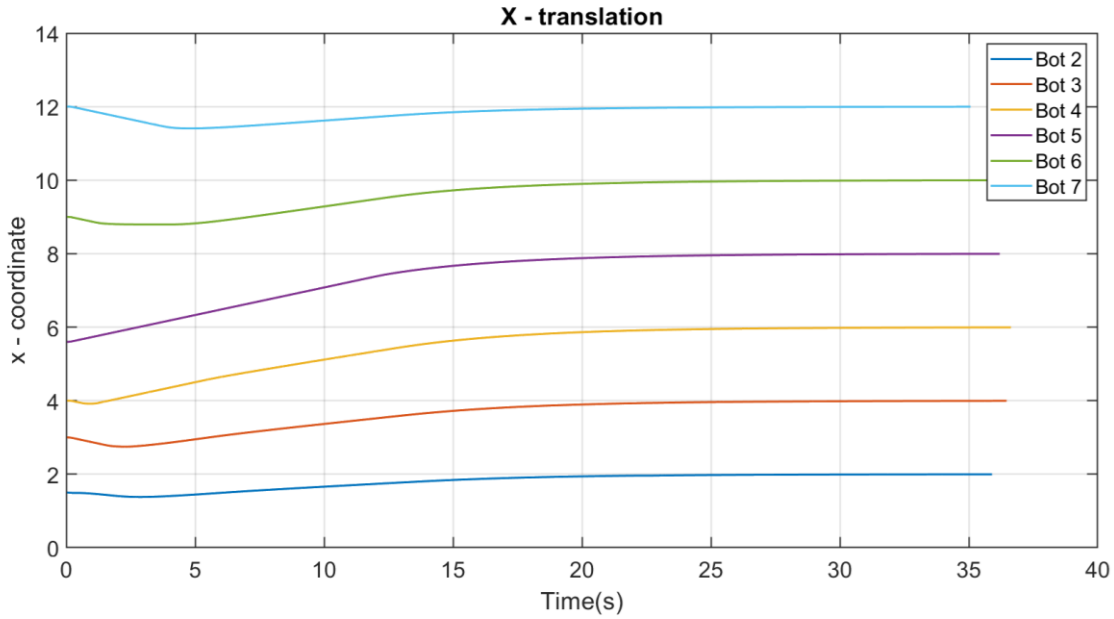

Fig 4: X axis translation of all bots with respect to time.

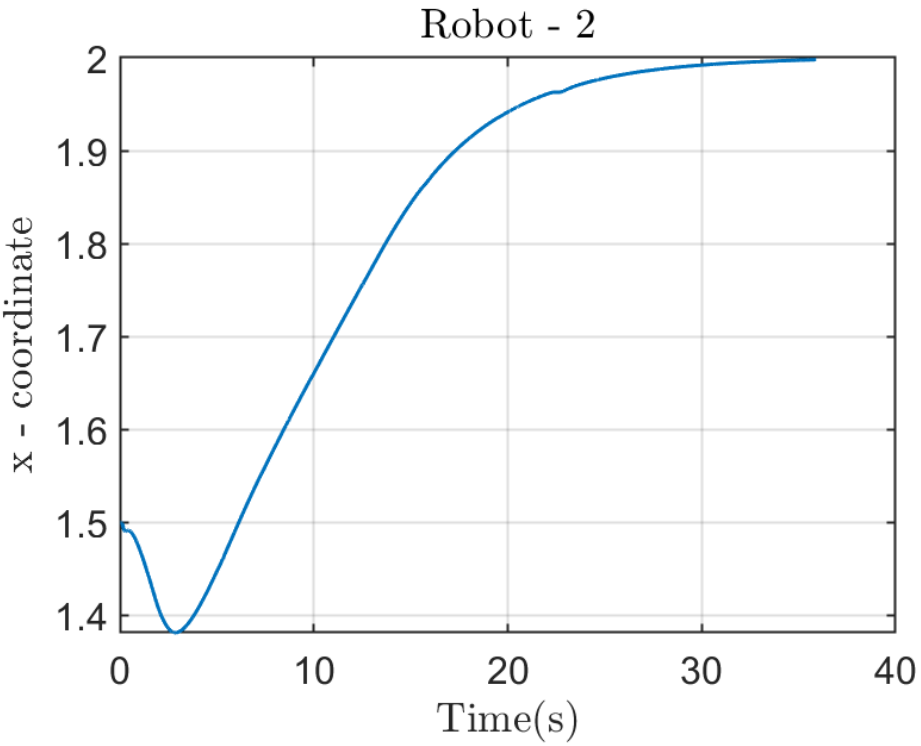

Fig 4a

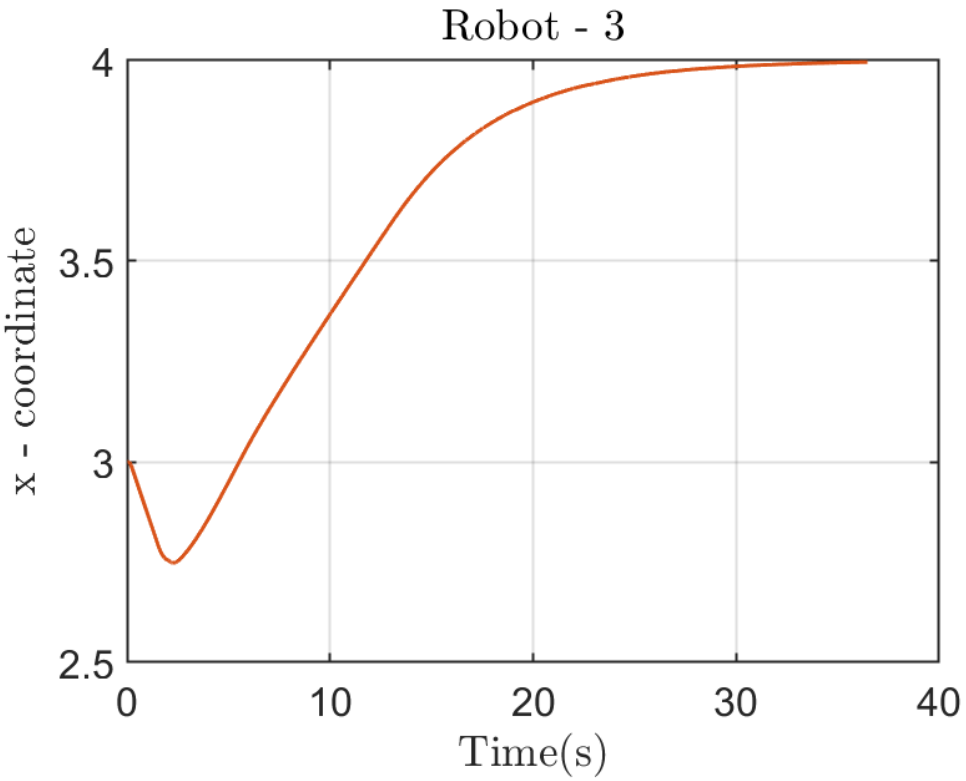
Robot - 3
x - coordinate
Time(s)
4
3.5
3
2.5
0
10
20
30
40

Fig 4b

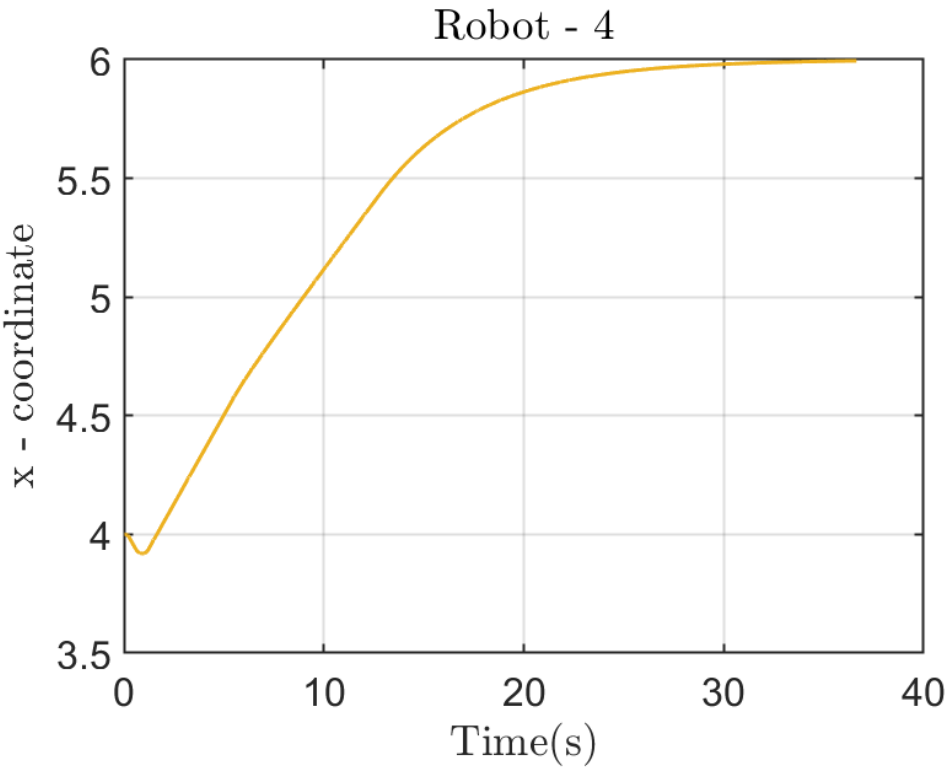
Robot - 4
x - coordinate
Time(s)
6
5.5
5
4.5
4
3.5
0
10
20
30
40

Fig 4c

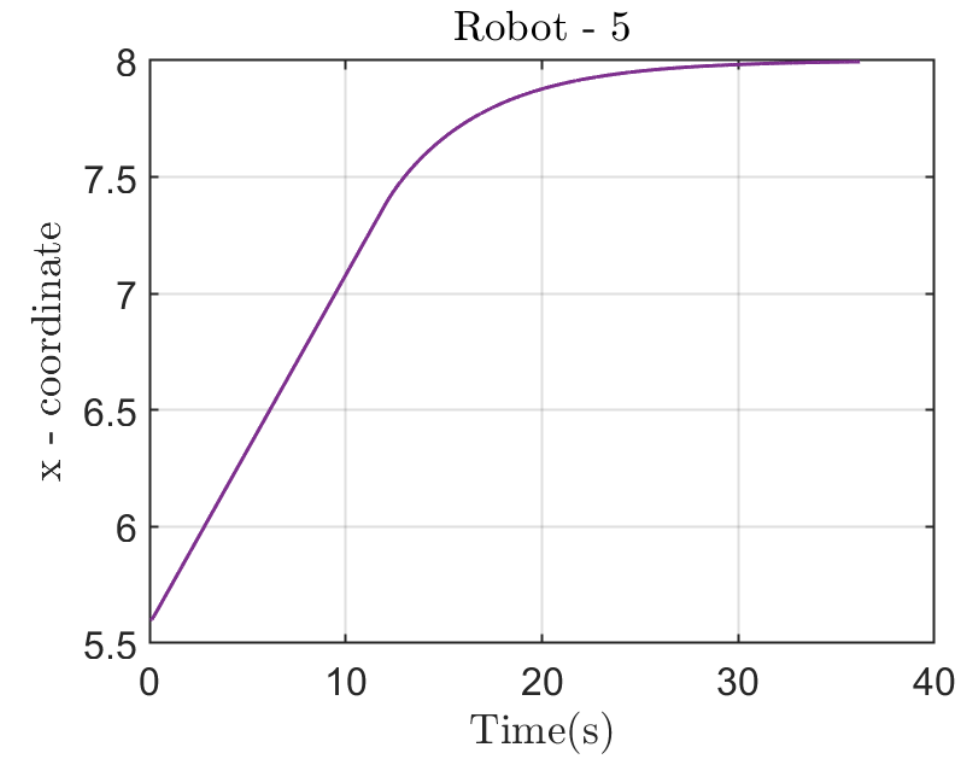
Robot - 5
x - coordinate
Time(s)
8
7.5
7
6.5
6
5.5
0
10
20
30
40

Fig 4d

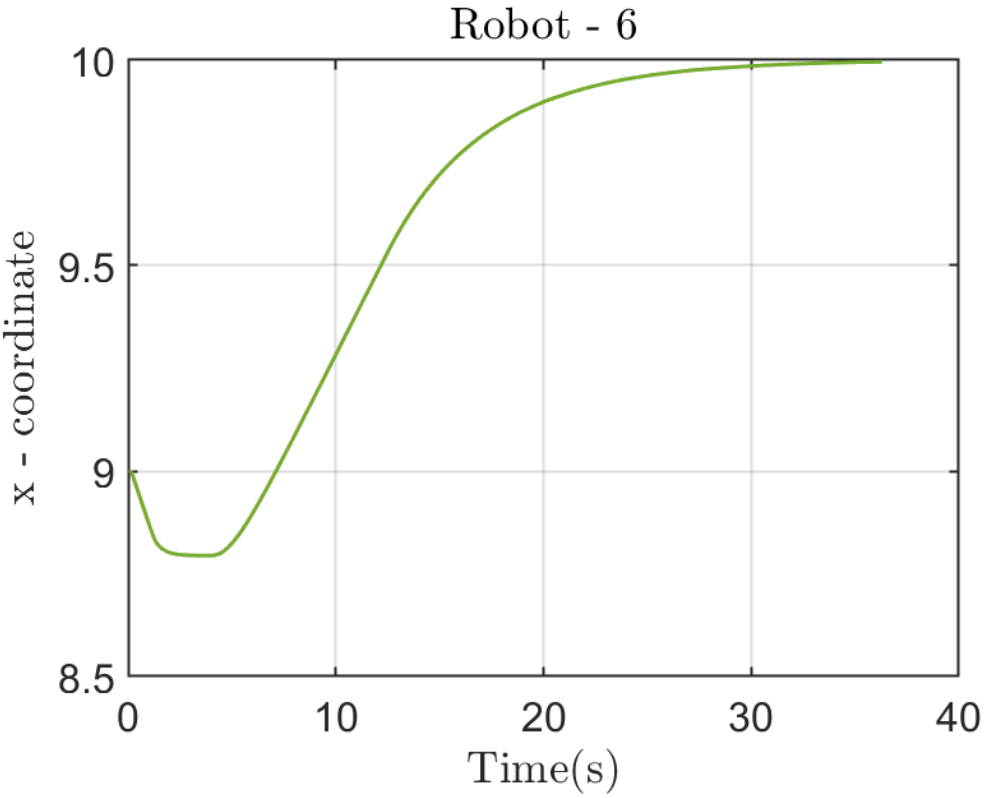
Robot - 6
x - coordinate
Time(s)
10
9.5
9
8.5
0
10
20
30
40

Fig 4e

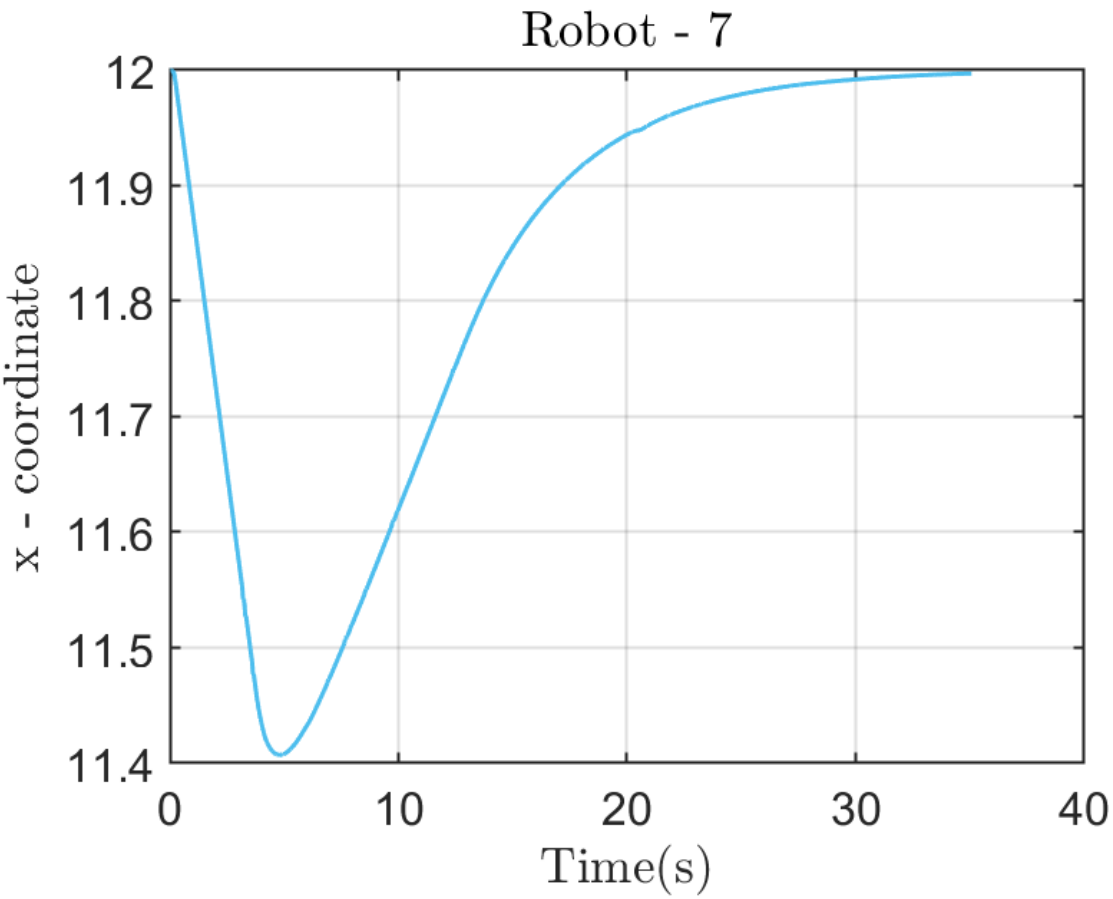

Fig 4a

Fig 4: X translation of individual bots.