CS5331: Aerial Computing

Summer II 2023

Project #2: Random Waypoint andPrivacy-Preserving Drone Mobility

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Project-2 report

Project to Implement:

I. Simulate two simple mobility models: (i) Random Waypoint (RWP) and Privacy-Preserving Random (PPR).

In RWP, a drone chooses a random destination within a 1,000 x 1,000 (m2) network, 2-dimensional network. The drone flies toward the destination. Upon arrival, the drone stays during a pausing time. Then the drone chooses another random destination within the network and flies toward the destination. The drone repeats the same procedure.

In PPR, a drone chooses a random destination within the network. Rather than flying straight to the destination, the drone builds a virtual rectangle with a diagonal starting from its current location to the destination and generates several dummy locations (k) located with the rectangle. Then the drone flies toward the destination through all the dummy locations, e.g., from the closest located dummy location first.

For visualization, use a solid line for the drone path, and mark the drone location every one second interval. For RWP and PPR, mark the drone as '*' (start) and 'o' (empty circle), respectively.

2. Input parameters

- Mobility model: 0 for RWP and 1 for PPR
- Velocity: 1 to 5 m/sec
- Pausing time: 0 to 10 secs
- Number of dummy location (k): 2 or 3

3. Run at least twice for each mobility model by changing input parameters. For example, type the following in the command window. For PPR, show the results when k is 2 or 3.

- >> mobility(0, 2, 5, 0) % RWP, 2 m/s, 5 secs pausing time, zero dummy location
- >> mobility(1, 3, 10, 2) % PPR, 3 m/s, 10 secs pausing time, two dummy locations

4. Measure the performance for each mobility model.

- Total flying distance from the base, left and bottom of the network (0, 0)
- Total flying time

Steps to execute the code:

- Launch the MABLAB
- Open the source code file with the name - "pro2_muchchunoor_subhashchandra.m"
- Run the code by passing the input parameters as mentioned below

Input parameters:

1. Mobility model: 0 for RWP and 1 for PPR
2. Velocity: 1 to 5 m/sec
3. Pausing time: 0 to 10 secs
4. Number of dummy location (k): 2 or 3

Results and Graphs:

For Model 0: Random Way Point(RWP) Mobility

1) pro2_muchchunoor_subhashchandra(0,2,5,0);

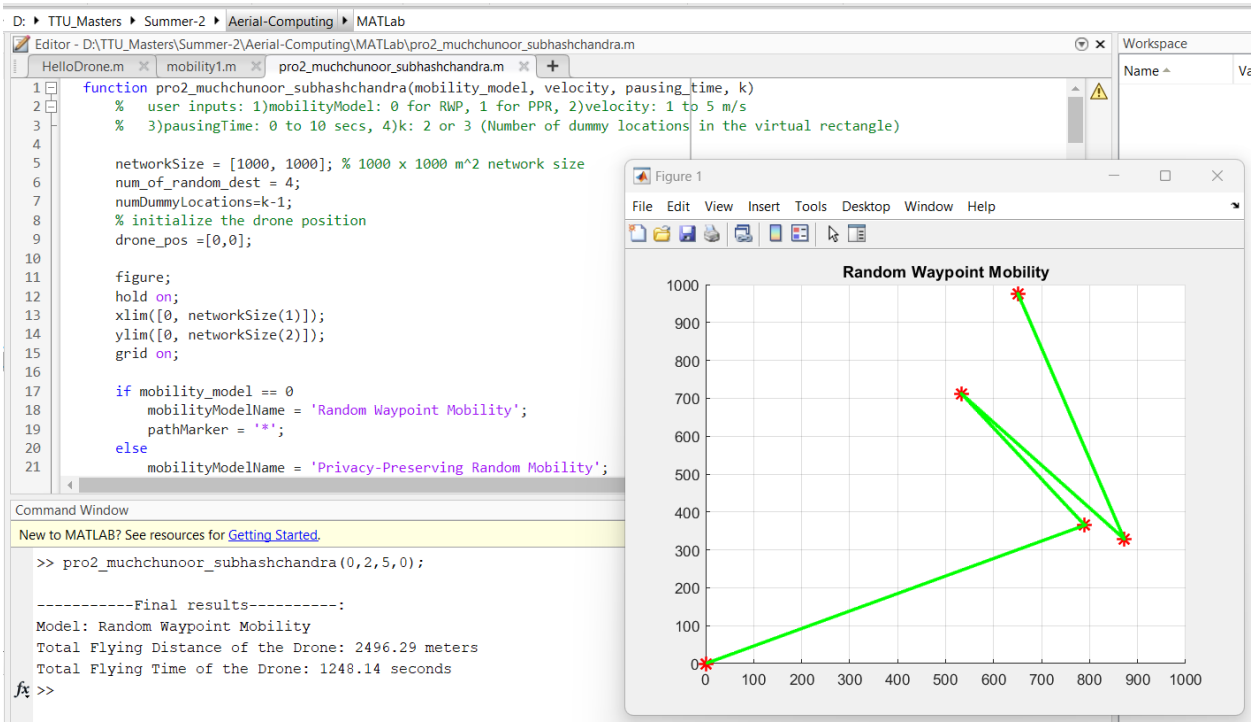
Results analysis:

The code is executed by passing input parameter, model=0, velocity=2, pausing time=5, and number of dummy locations=0.

Then below is the output graph for the model RWP and

total flying distance of the drone=2496.29 meters

total flying time of the drone through all the random locations =1248 seconds

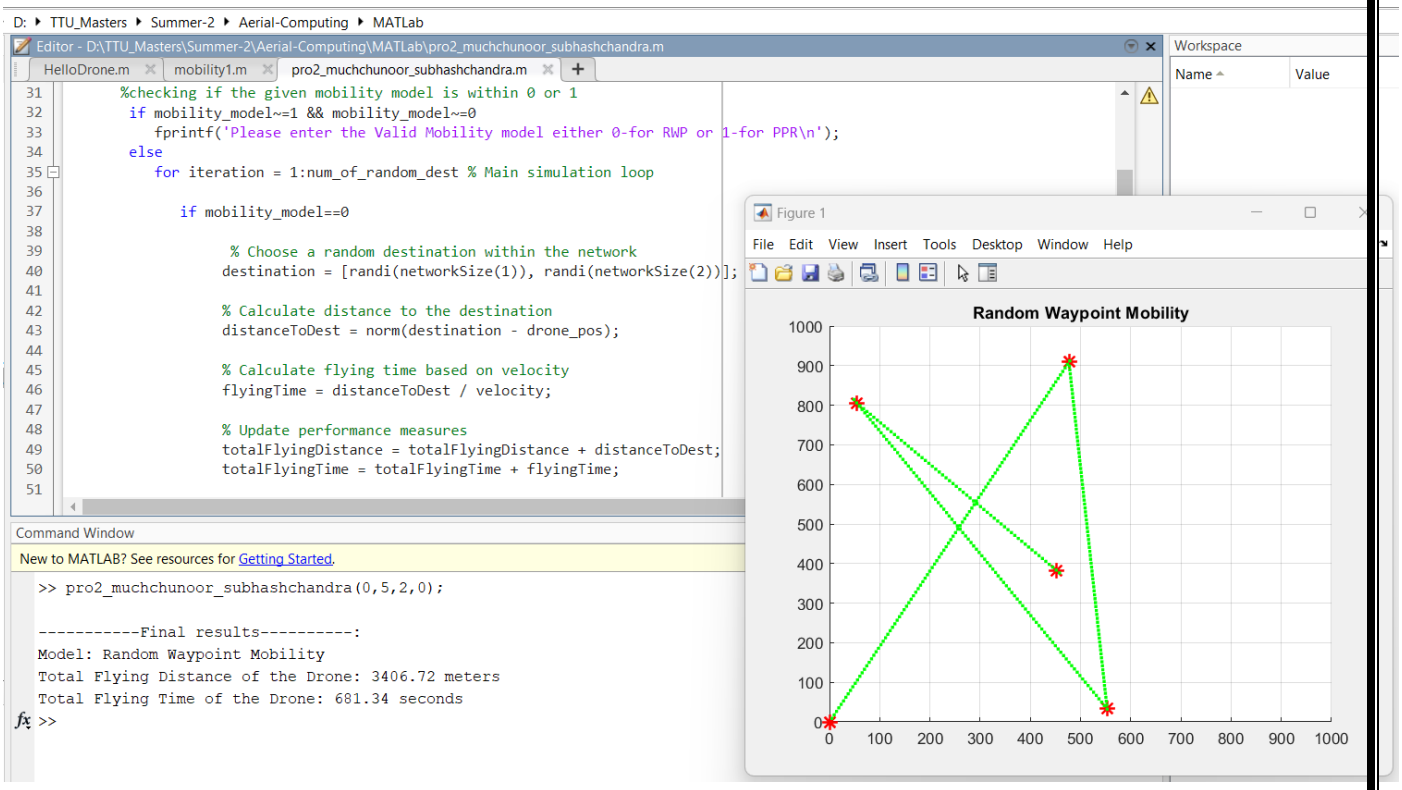


2) **pro2_muchchunoor_subhashchandra(0,5,2,0);**

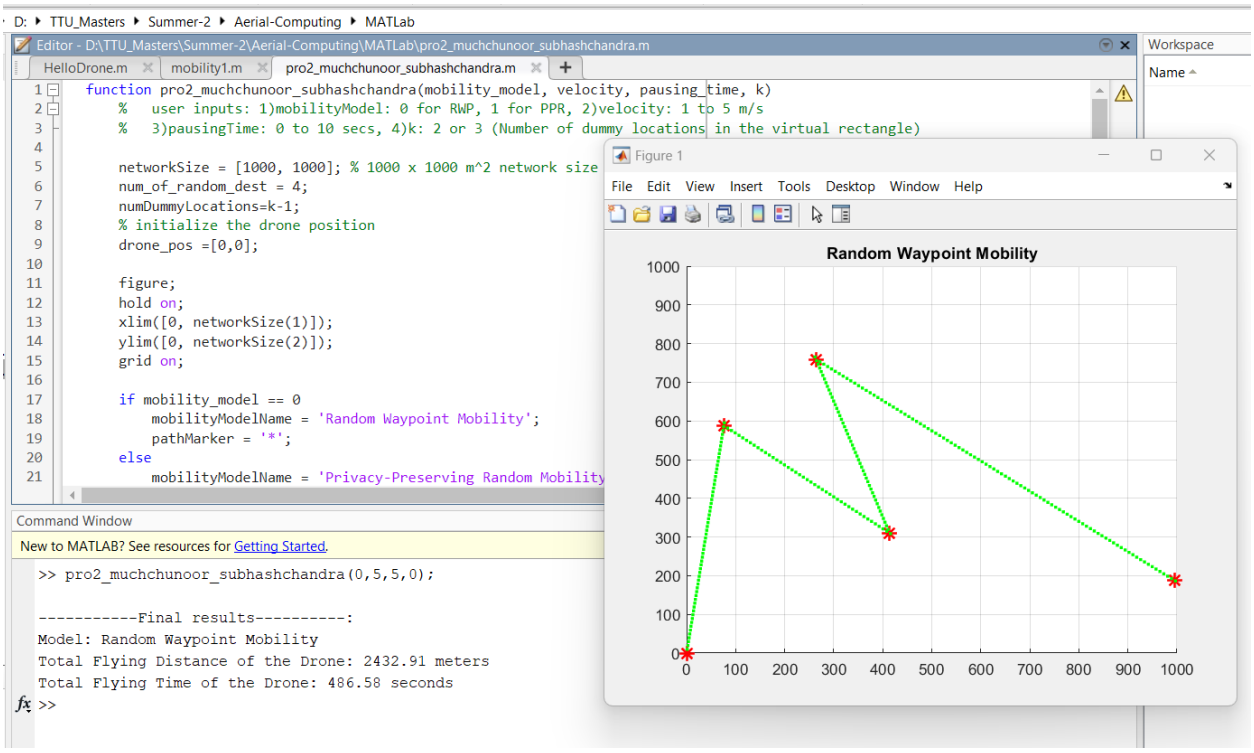
Same way for the above given inputs, it drawn RWP model and calculated the

total flying distance of the drone=3406.72 meters

total flying time of the drone through all the random locations =681.34 seconds



3) **pro2_muchchunoor_subhashchandra(0,5,5,0);**



For Model 1: Privacy-Preserving Random (PPR) Mobility

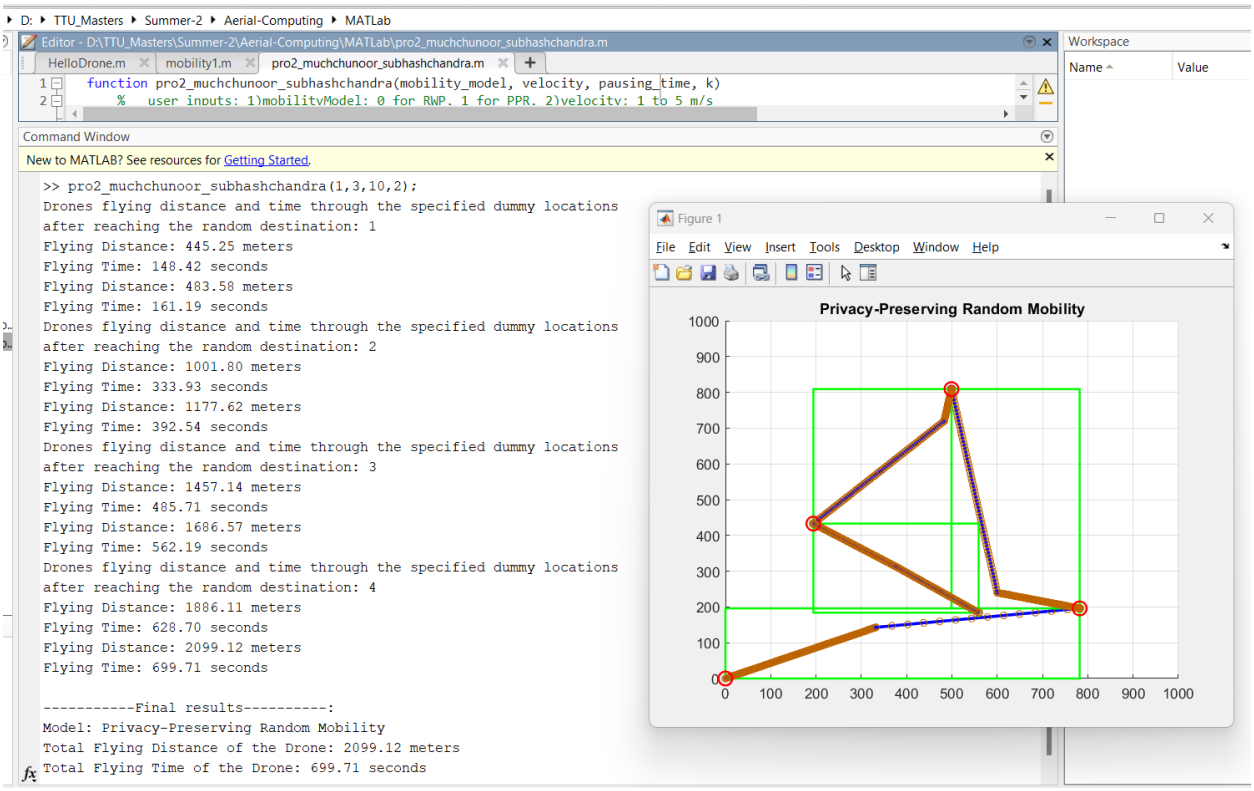
1) **pro2_muchchunoor_subhashchandra(1,3,10,2);**

The code is executed by passing input parameter, model=1 is PPR mobility, velocity=3, pausing time=10, and number of dummy locations=2.

Then below is the output graph for the model PPR and

total flying distance of the drone through all the dummy locations=2099.12 meters

total flying time of the drone through all the dummy locations =699.71 seconds

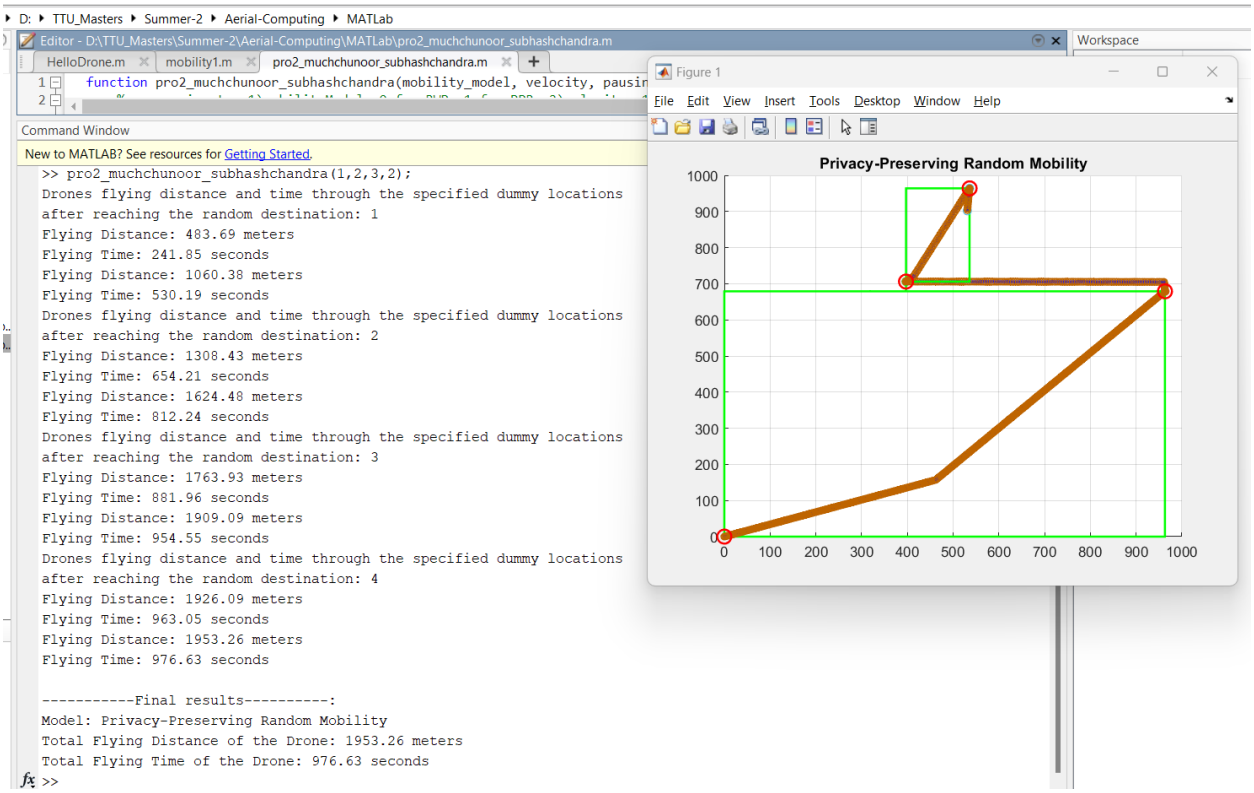


2) pro2_muchchunoor_subhashchandra(1,2,3,2);

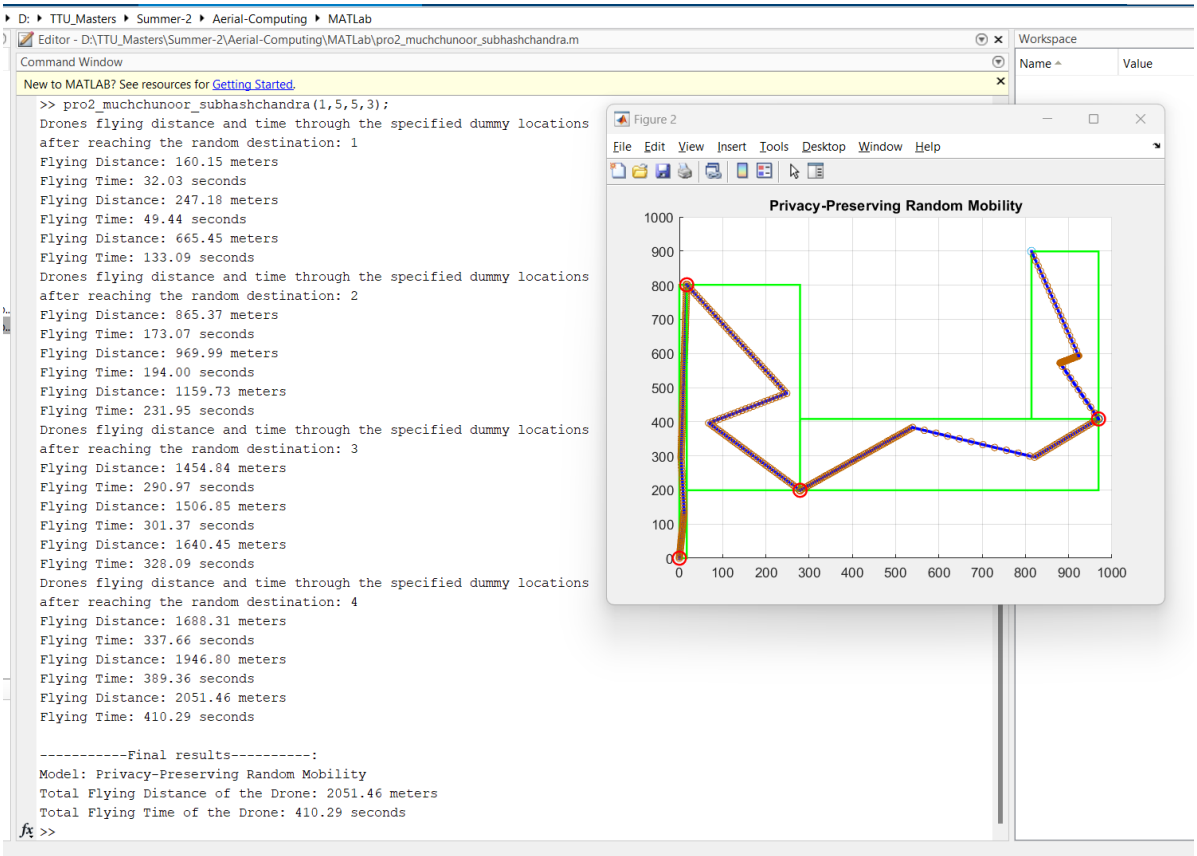
Then below is the output graph for the model PPR and

total flying distance of the drone through all the dummy locations=1953.26 meters

total flying time of the drone through all the dummy locations =976.63 seconds



3) pro2_muchchunoor_subhashchandra(1,5,5,3);



Explanation:

Random Waypoint (RWP) Mobility Model:

The Random Waypoint (RWP) model is a simple mobility model widely used in wireless communication simulations. In this model, mobile nodes move randomly within the given network area.

It works as below-

- The drone starts at a random position within the specified network area (1000x1000 m^2 in this project).
- It then selects a random destination within the network area.
- The drone calculates the distance to the destination and determines the time required to reach it based on its velocity.
- The drone moves towards the destination in a straight line at a constant speed.
- During its movement, the drone's position is interpolated to show its location at 1-second intervals.
- The drone reaches the destination, pauses there for a specified time, and then repeats the process by selecting another random destination and moving towards it.

Privacy-Preserving Random (PPR) Mobility:

In this model, the drone moves towards a random destination while deliberately avoiding straight paths. Instead, it flies through randomly created dummy locations within a virtual rectangle. This approach makes it harder for anyone observing the drone to predict its exact path and destination, thus enhancing privacy and security in wireless communication scenarios.

It works as below-

- Like RWP, the drone starts at a random position within the network area.
- It then selects a random destination within the network area, just like in RWP.
- The drone calculates the distance to the destination and determines the time required to reach it based on its velocity.
- A virtual rectangle is formed diagonally from the current drone position to the destination.
- The drone generates dummy locations within this rectangle, including the starting and ending points.
- The drone then flies through these dummy locations in a zigzag pattern (reaching the nearest dummy location first, then the next nearest, and so on), rather than taking a direct path to the destination.
- During its movement, the drone's position is interpolated to show its location at 1-second intervals.
- Once the drone reaches the destination, it pauses there for a specified time, and then repeats the process by selecting another random destination and moving towards it through dummy locations.