UESTC4020: Wireless Sensor Networks

Laboratory Session 1 & 2

[Note: It may happen that you may not be able to finish the tasks during the lab sessions. That is fine. Try to solve as much problem as you can during the lab session, and you can do the rest in your own time.]

In this lab, first you will familiarise yourself with simple Matlab coding techniques to solve some problems predominantly related to physical layer. Then you will also tackle some challenging problems too.

Task 1: (10% marks)

Load the given file 'labdata.txt' in Matlab workspace. It contains file with location of 50 sensor within 1 square kilometre area. (hint: use 'load' function).

Plot them as shown in the figure 1 below.

Once you have the data, **find** the WSN located closest to the centre, i.e. location (0,0). Assign that as a sync (which collects all the data in the networks).

In the plot, **mark** it in a different colour with a different marker (it is shown in red in the given figure 1).

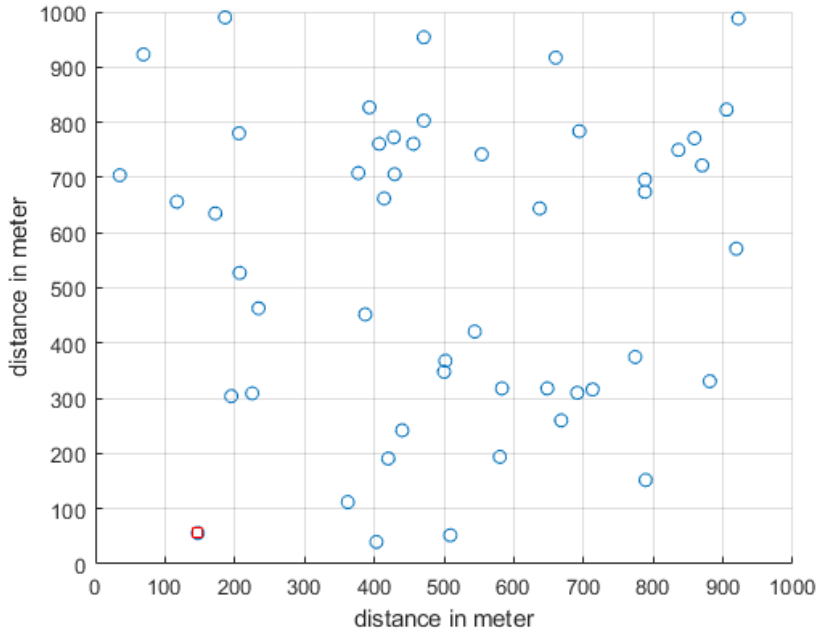

Figure 1: Random WSN node deployment.

Task 2: [25%]

Unit disk model of coverage only considers distance. Assume that the maximum distance covered by the node transmitters are 10m.

Write Matlab code to find how many nodes doesn't have another node within 10m coverage.

Now, **increase** the coverage by 5m to 15m. Take a note of how many users remains out of coverage.

Repeat the process until you find the minimum coverage distance required to ensure that all the nodes have at least another node within the coverage.

Plot the relation between coverage distance and number of nodes remains out of coverage range (i.e. 0 neighbours within coverage range).

Task 3 [25% marks]

Implement the following deterministic formula in Matlab to calculate Transmit power requirement when received power requirement is 0dBm.

$$P_r = P_t \times G_t G_r \left(\frac{\lambda}{4\pi d}\right)^2$$

Note that the symbols have their usual meanings. Your code should take a certain frequency as input and should provide required power as output.

You should demonstrate results for the following frequency values: [430 MHz, 900 MHz, 2.4 GHz]

(You can consider plotting a bar chart to show relative variation in the requirement).

Now **write code** to use Shanon's capacity formula to find the expected bit rate for a given bandwidth. Assume that the bandwidth is 500KHz.

$$C = Blog_2(1 + SNR)$$

How much bit rate you can expect to achieve for the given scenario? In order to increase bit rate by 10%, what will be the required increase in transmit power? Your code should provide result for a given frequency. Demonstrate your results for the three spectrum bands used in Task 3.

Task 4 (40% marks)

The final task involves writing code for finding average number of hops required by each node to reach the sync (using the minimum distance found in task 2). Now this problem will have many solutions depending on how you are selecting the next hop to eventually reach the sync. Try to come up with an innovative solution to minimise the hop count **[the group with lowest average hop count will receive 5% bonus (not exceeding 100% score)**].

Explain the working principle of your code/algorithm.

[Can you show a plot highlighting the path taken by the farthest node from the sync to reach the sync? How many hops does it require?]

Critically analyse your solution and comment on the advantages and drawbacks of your solution (energy cost, overloading possibility, etc).

Marking Criteria:

Elements	**F-E** **20-39**	**D** **40-49**	**C** **50-59**	**B** **60-69**	**A** **70-100**
Presentation, clarity and communication of ideas (25%)	Poor presentation without meaning and lot of irrelevant material	Elementary presentation with some mistakes and some irrelevant material	Satisfactory presentation with meaning and almost no irrelevant material	Good presentation with clear meaning and no irrelevant material	Excellent presentation with very clear meaning and precisely relevant material
Theoretical/ Mathematical /Technical Content (35%)	Poor or no technical content and analysis without referencing	Elementary technical content and analysis with limited referencing	Satisfactory technical content and analysis with some referencing	Good technical content and analysis with relevant referencing	Excellent technical content and analysis with precisely relevant referencing
Results (40%)	Poor or no results	Elementary results with limited discussion and comparisons	Satisfactory results with some discussion and comparisons	Good results with critical discussion and comparisons	Excellent results with thorough critical discussion and comparisons