Homework 2 Report

Question 1-1

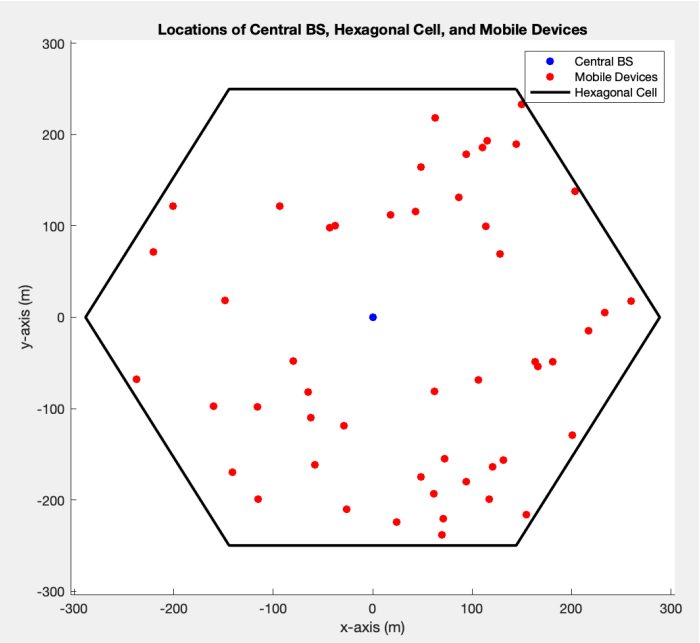

Figure 1: Hexagonal Cell with 50 randomly distributed mobile and a Central BS

My code uses hex vertices to store the vertices, which depend on the radius of the cell. While so, my code uses mobile_device_positions to store randomly generated placements within the hexagon, by filtering out placements generated that are outside the hexagon. We also record the distances into a vector used in other questions. Red dots are mobile devices, and blue dots are base stations. Also, plot the hex vertices to show the hexagon region.

Question 1-2:

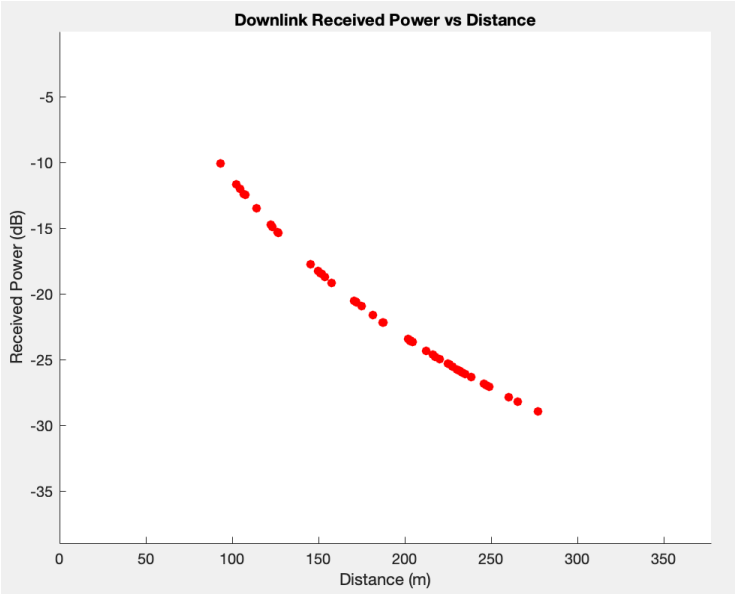

Figure 2: Received Power vs Distance during Downlink

My code first convert every thing into W or W/W, then use the formula of

Received power = pathloss * BS Power * Transmitter Gain * Receiver Gain …**1**

Path loss = ((hb*hm)^2)/(distances^4) …**2**

Using equations 1 and 2, transform to dB then graph out the relationship between distance and received power

Question 1-3:

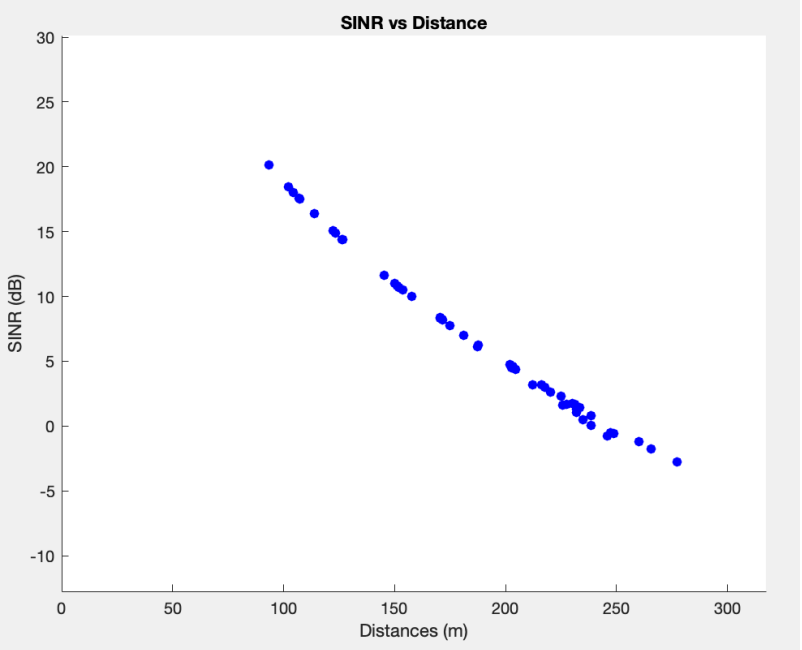

Figure 3: SINR vs Distance during Downlink

SINR is calculated by Signal Power divided by Interference Power added with Noise Power. In this case, I use thermal noise power for the calculation of Noise Power(N=kTB where k = Boltzmann constant, T = temperature, B = Bandwidth). Since the case is downlinked, the interference for a specific mobile device comes from other BSs. The interference is calculated by adding all the received power from the other 18 BSs to the specific mobile device. Then, just use the formula of SINR = S/(I+N).

Question 2-1

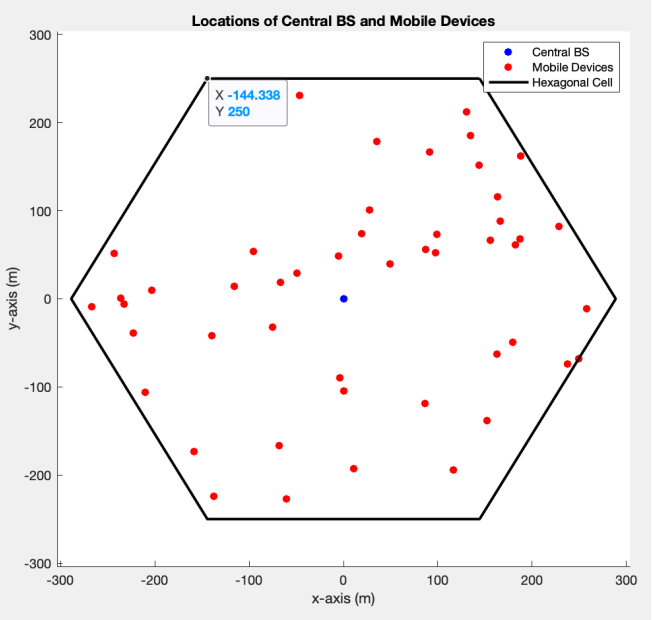

Figure 4: Hexagonal Cell with 50 randomly distributed mobile and a Central BS

Similar to question 1-1, the method used is the same, according to the code above. I just used the same values as above to draw out the graph. The current Figure 4 is another run of simulation so that it will show another random distribution.

Question 2-2:

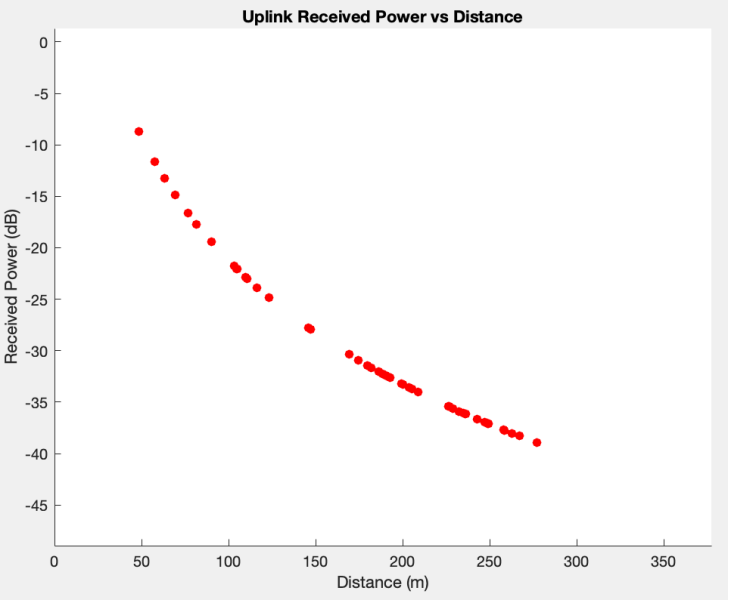

Figure 5: Received Power vs Distance during Uplink

The method used is the same, but in this case, I consider uplink received power, which uses mobile device power instead of BS power in equation 1.

Question 2-3:

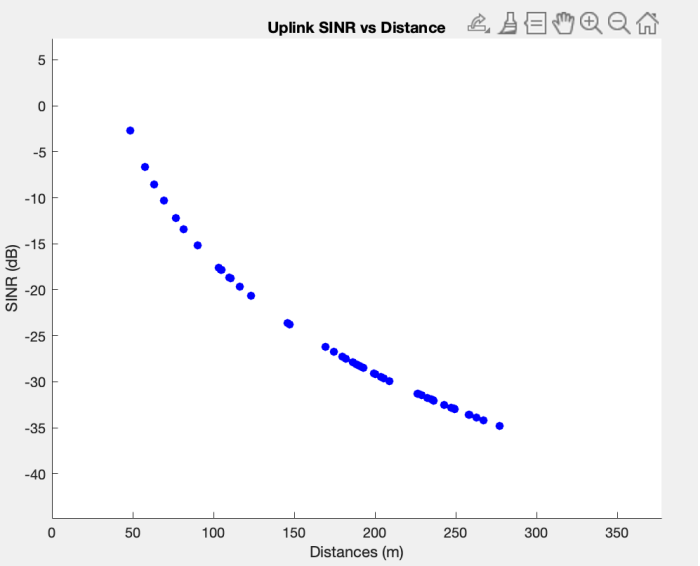

Figure 6: SINR vs Distance during Uplink

SINR is calculated by Signal Power divided by Interference Power added with Noise Power. In this case, I use thermal noise power for the calculation of Noise Power(N=kTB where k = Boltzmann constant, T = temperature, B = Bandwidth). Since this case is uplinked, so for a specific mobile device happens at the BS side due to the concurrent uplink transmission of the other mobile device within the cell, so that received power will be added all together except the specific mobile device as the Interference I. Then, use the formula of SINR = S/(I+N).

Bonus Question

B-1

In this part, the code is written by setting each set on center positions, then using the same plotting method as Q1-1 and Q2-1 to plot all the hexagons. For generating the mobile devices, I generate 50 mobile devices and then translate them by the center positions of each of the 19 cells. This can easily be written with iterative and basic geometry knowledge.

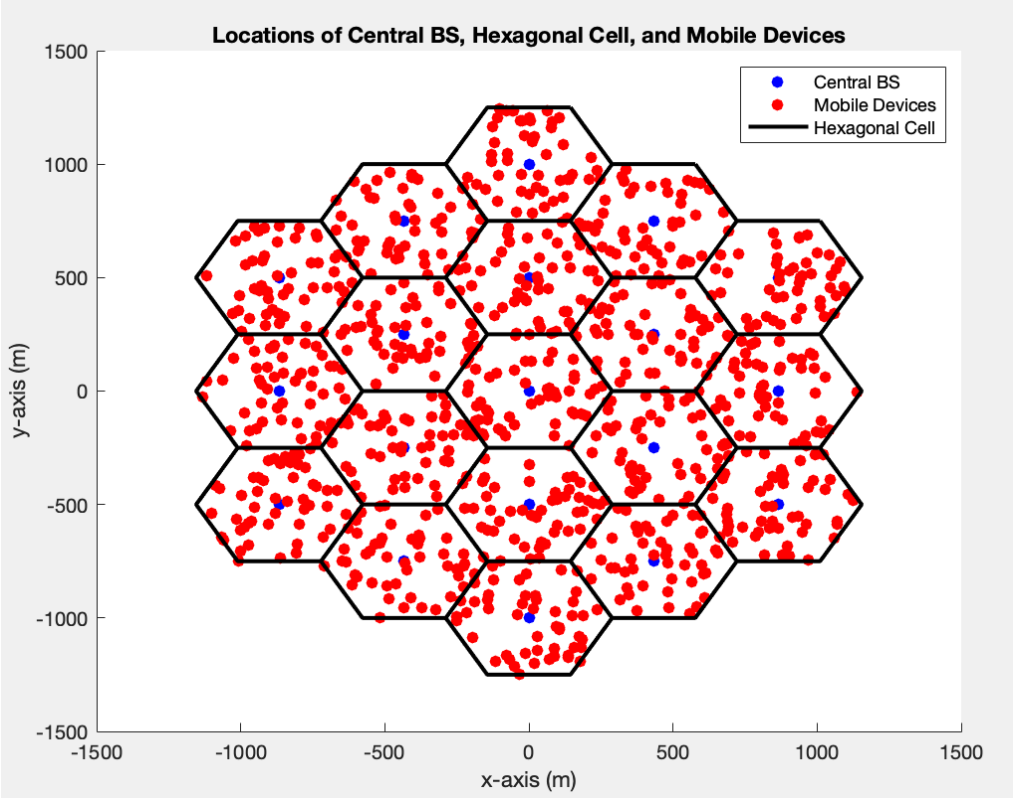

Figure 7: 19-Cell(Randomly Distributed, 50 mobile device in each cell)

B-2

In this part, the received power is calculated using the distance to the corresponding center base station of each cell. Referring to questions 1-2, the method used is the same. The equations that are used is the same, please refer to Q1-2 for equation 1 and 2. The difference between this graph in Q1-2 and Q2-2 is that there are more points, but the distribution of the points is still following the same line.

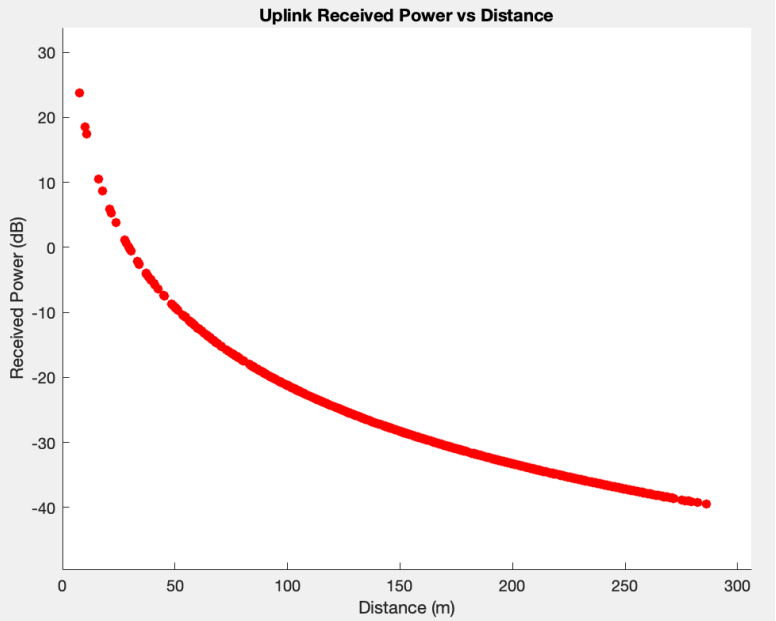

Figure 8: Received Power vs Distance during Uplink

B-3

SINR is calculated by Signal Power divided by Interference Power added with Noise Power. In this case, I use thermal noise power for the calculation of Noise Power(N=kTB where k = Boltzmann constant, T = temperature, B = Bandwidth). For calculating the Interference, I added up all the Power Received by every other mobile device inside and outside of the base station minus the power received by the one mobile device transmission we are focusing on.

The difference between this graph in Q1-3 and Q2-3 is that there are more points, but the distribution of the points is still following the same line with a lower SINR dB due to interference.

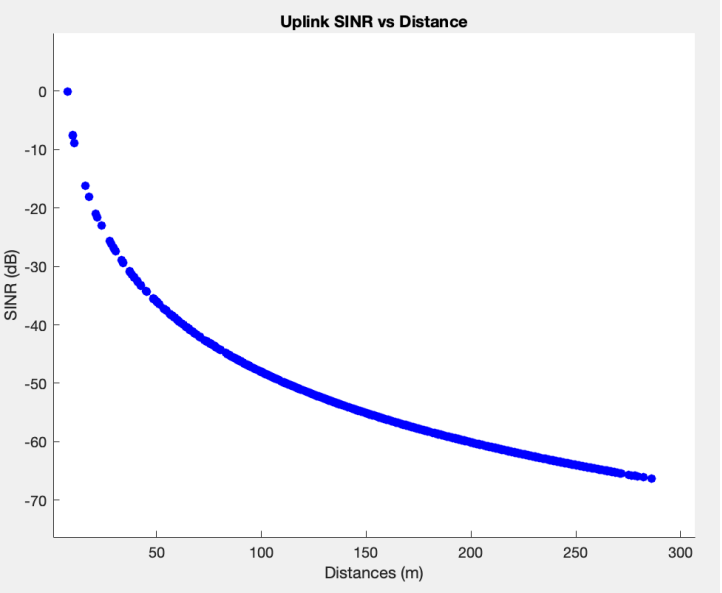

Figure 9: SINR vs Distance during Uplink