HW2 Report

Let $N = 19$ denote the number of cells, $M = 50$ denote the number of mobile devices (MSs) per cell, $T = 300$ denote the temperature (in Kelvin), $B = 10^7$ denote the channel bandwidth (in Hz), $P_{BS} = 10^{0.3}$ denote the power of each BS (in Watt), $P_{MS} = 10^{-0.7}$ denote the power of each MS (in Watt), $G_T = 10^{1.4}$ denote the transmitter antenna gain, $G_R = 10^{1.4}$ denote the receiver antenna gain, $h_{BS} = 51.5$ be the height above ground level of each BS (in meter), and $h_{MS} = 1.5$ be the height above ground level of each MS (in meter).

Define the BSs by $BS_1, BS_2, \ldots, BS_N$, where BS_1 is the central BS. For $1 \leq i \leq N$, define the M MSs in the ith cell by $MS_{i,1}, MS_{i,2}, \ldots, MS_{i,M}$.

Let $\mathbf{x}_i$ be the coordinate of BS_i and $\mathbf{y}_{i,j}$ be the coordinate of $MS_{i,j}$ for every $1 \leq i \leq N, 1 \leq j \leq M$. Note that $\mathbf{x}_1 = (0, 0)$.

Since the height of transmitter and receiver must be h_{BS} and h_{MS}, the path-loss $g(d)$ according to two-ray-ground model is:

$$g(d) = \frac{h_{BS}^2 h_{MS}^2}{d^4},$$

where d is the distance between the transmitter and the receiver.

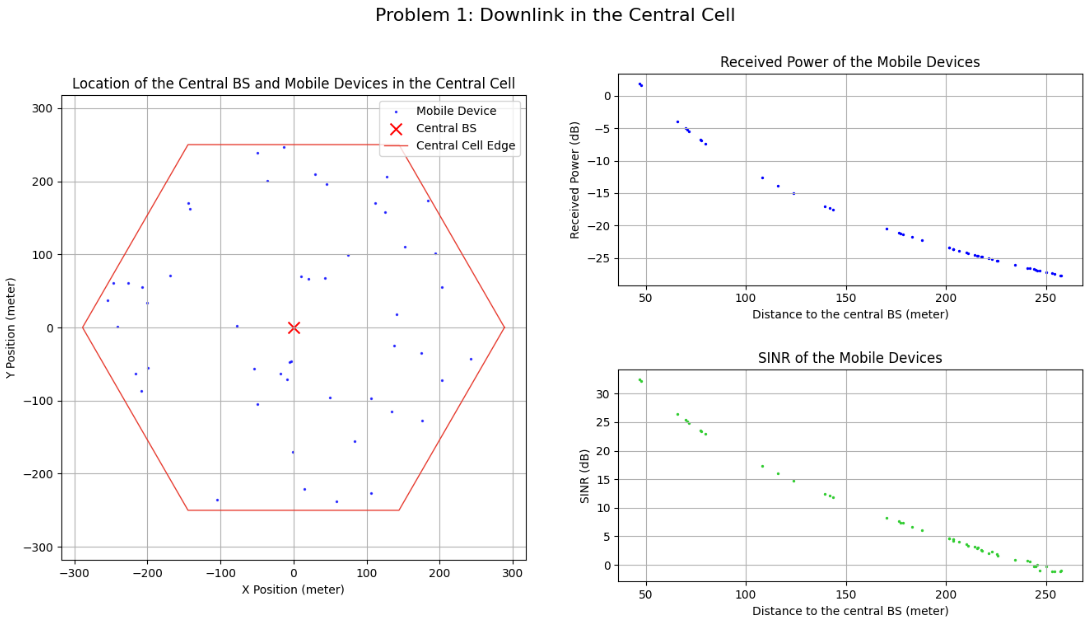
Moreover, the thermal noise, denoted by $Noise$, is given by:

$$Noise = kTB$$

where k is the Boltzmann constant.

For each problem n, there is only one resulting figure consisting of 3 graphs, where the graph for problem n-1 is on the left, n-2 is on the top right, and n-3 is on the bottom left.

Problem 1



1-2

For $1 \leq i \leq M$, the received power (in Watt) of $MS_{1,i}$, denoted by $P_{DL,MS_{1,i}}$, can be calculated by:

$$P_{DL,MS_{1,i}} = P_{BS} \cdot G_T \cdot G_R \cdot g(||\mathbf{y}_{1,i} - \mathbf{x}_1||),$$

which, in dBW, is $10 \log_{10} P_{DL,MS_{1,i}}$.

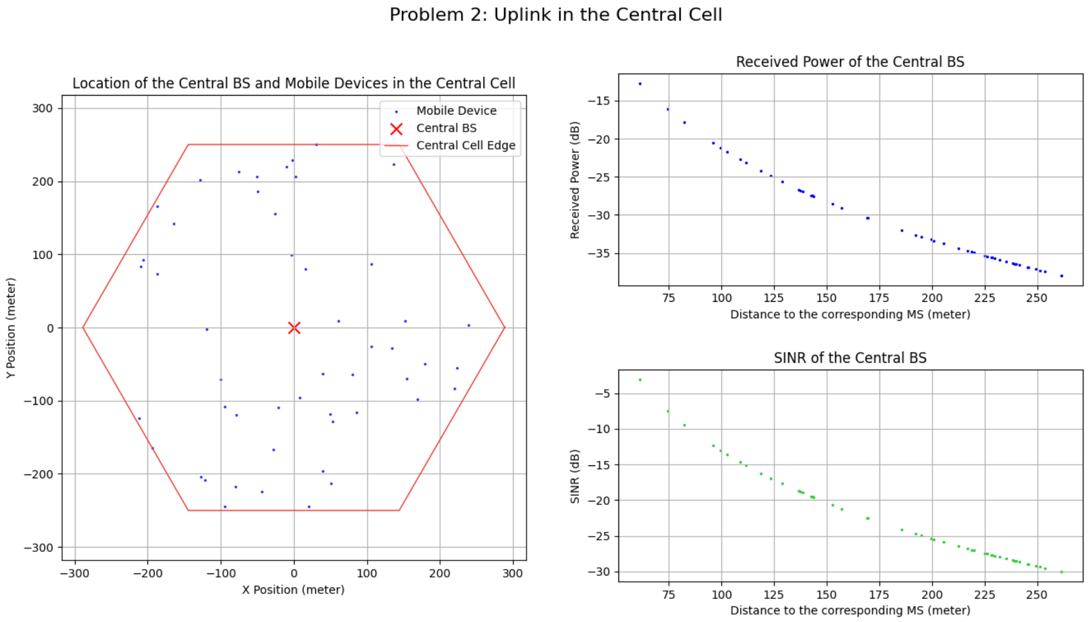
1-3

For $1 \leq i \leq M$, the SINR of $MS_{1,i}$, denoted by $SINR_{DL,MS_{1,i}}$, can be calculated by:

$$SINR_{DL,MS_{1,i}} = \frac{P_{BS} G_T G_R \cdot g(||\mathbf{y}_{1,i} - \mathbf{x}_1||)}{Noise + \sum_{1<j\leq N} P_{BS} G_T G_R \cdot g(||\mathbf{y}_{1,i} - \mathbf{x}_j||)},$$

which, in dB, is $10 \log_{10} SINR_{DL,MS_{1,i}}$.

Problem 2



2-2

For $1 \leq i \leq M$, the received power (in Watt) of BS_1 (the central BS) from $MS_{1,i}$, denoted by $P_{UL,MS_{1,i}}$, can be calculated by:

$$P_{UL,MS_{1,i}} = P_{MS} \cdot G_T \cdot G_R \cdot g(||\mathbf{y}_{1,i} - \mathbf{x}_1||),$$

which, in dBW, is $10 \log_{10} P_{UL,MS_{1,i}}$.

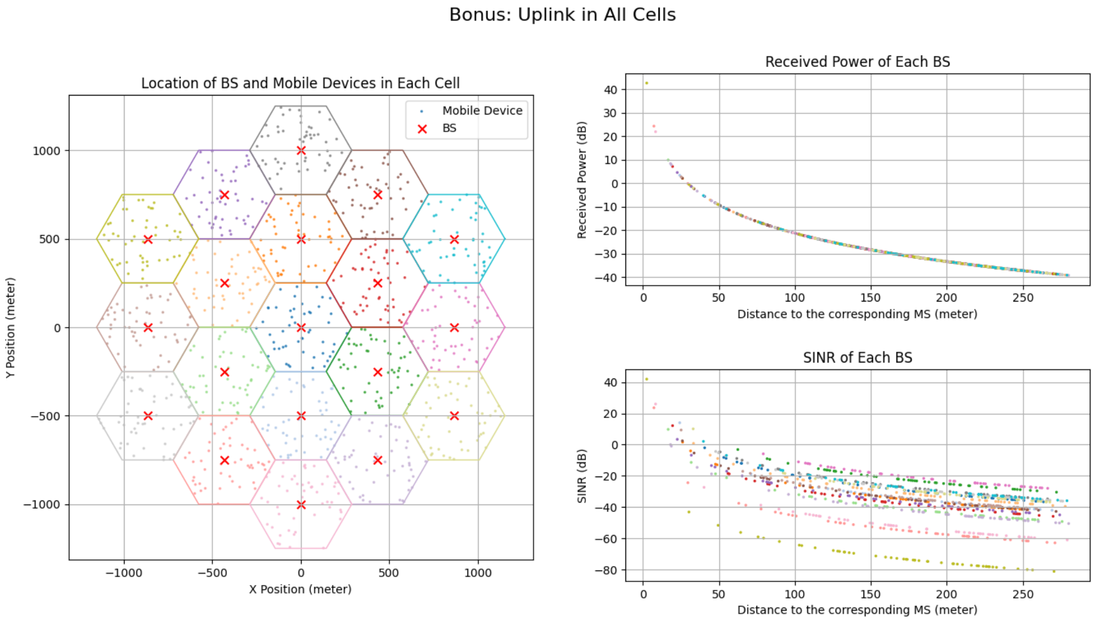
2-3

For $1 \leq i \leq M$, the SINR of BS_1 from $MS_{1,i}$, denoted by $SINR_{UL,MS_{1,i}}$, can be calculated by:

$$SINR_{UL,MS_{1,i}} = \frac{P_{MS} G_T G_R \cdot g(||\mathbf{y}_{1,i} - \mathbf{x}_1||)}{Noise + \sum_{j \in \{1,\ldots,M\} \setminus \{i\}} P_{MS} G_T G_R \cdot g(||\mathbf{y}_{1,j} - \mathbf{x}_1||)},$$

which, in dB, is $10 \log_{10} SINR_{UL,MS_{1,i}}$.

Bonus



B-2

For $1 \le i \le N$ and $1 \le j \le M$, the received power (in Watt) of BS_i from $MS_{i,j}$, denoted by $P_{UL,MS_{i,j}}$, can be calculated by:

$$P_{UL,MS_{i,j}} = P_{MS} \cdot G_T \cdot G_R \cdot g(||\mathbf{y}_{i,j} - \mathbf{x}_i||),$$

which, in dBW, is $10 \log_{10} P_{UL,MS_{i,j}}$.

B-3

For $1 \le i \le N$ and $1 \le j \le M$, the SINR of BS_i from $MS_{i,j}$, denoted by $SINR'_{UL,MS_{i,j}}$, can be calculated by:

$$SINR'_{UL,MS_{i,j}} = \frac{P_{MS} G_T G_R \cdot g(||\mathbf{y}_{i,j} - \mathbf{x}_i||)}{Noise + \sum\limits_{(p,q) \in (\{1,\ldots,N\} \times \{1,\ldots,M\}) \setminus \{(i,j)\}} P_{MS} G_T G_R \cdot g(||\mathbf{y}_{p,q} - \mathbf{x}_i||)},$$

which, in dB, is $10 \log_{10} SINR'_{UL,MS_{i,j}}$.