Homework 1 submission

ECET 512 — Wireless Systems

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1 Submitted files

For this assignment, this report and the archives outlined below were created and submitted.

1.1 SRC Folder

+ *"main.m"*: The MATLAB script will run a simulation that shows a mobile user moving through a set of generated hexagonal cells. Cell clusters may be generated according to specified *i* and *j* values corresponding to N values of 3, 4, or 7. Various aspects of the simulation can be modified including the center, cell radius, video recording, and how many clusters to generate. The script concludes by plotting the signal strength received by the mobile user as they 'move' through the simulation. Variable function handles can be used to determine power.

+ *"drawCell.m"*: This function was provided for the homework to generate a hexagonal cell with a center and defined radius. It remained unmodified.

+ *"drawCluster.m"*: This function allows the user to plot a cluster of N cells. The cluster is defined by the *i* and *j* values to calculate N. The center of the cluster and radius of the cells are given as a parameter and the number of the cluster is provided as a parameter as well. The output provides the centers of each cell in the cluster as a row vector.

+ *"drawManyClusters.m"*: This function functions the same as the "*drawCluster"* function but instead creates a number of clusters equal to the provided parameter. It uses the process of picking a direction, moving *i* spaces, turning sixty degrees and then continuing *j* spaces to start the center of the next cluster. Currently, this function only supports generating up to seven clusters. It returns a set of cell centers with each cluster's cell centers in a row whose number corresponds to the cluster number.

+ *"findServingCell.m"*: This function takes all cell centers provided by drawing one or many clusters and determines which cell center is closest to the mobile user. The function then provides information of the corresponding closest cell.

+ *"calcRXPower.m"*: This function calculates the receive power encountered by the mobile user as a result of the closest base station. It takes the mobile user's position, the position of the serving cell, the transmission frequency and a function handle of a function that will calculate the power given some distance and parameters. Currently this function is only prepared to accept the "*friisFreeSpace*" function.

+ *"friisFreeSpace.m"*: This function calculates receive power of a mobile user based on the Friis Free Space Path Loss Equation. The function takes as its parameters the distance from the base station, the transmit power, transmission gain, receiving gain, and a value for system losses. The provided frequency parameter is used to determine the wavelength in the equation. It returns a receiving power in watts.

1.2 DOC Folder

+ *"homework_1_n7.avi"*: This video shows a mobile user moving through a set of seven clusters of seven cells each. A blue line connects the mobile user to the center of the cell that services the user at any particular time.

+ *"homework_1_n3.avi"*: This video shows the mobile user traveling through seven clusters of three cells each similar to the aforementioned video file.

+ *"homework_1_n4.avi"*: This video shows the mobile user traveling through seven clusters of four cells each similar to the aforementioned video file.

+ *"PathLossFriisHW1"*: This photo shows the plot of the received signal strength as the mobile user travels through the cell clusters. The power is shown in watts on the y-axis and the cell that serves the user is indicated on the x-axis as a flow from frame to frame.

2 Code execution

The MATLAB programming language was used to create the simulation for this homework. To run the simulation, simply run the "*main.m"* script file. It provides options to run the simulation for various cluster number values, various values of N for the number of cells in each cluster, as well as the option to record of a video of the simulation.

3 Homework 1 Solution

3.A & 3.B drawCluster( ) and findServingCell( ) functions

The functions asked for in this section can be found under the SRC archive folder.

3.C Co-channel interference cell plots for N = 3, 4 and 7

Running *drawManyClusters()* for 7 clusters with various values of *i* and *j* provide the plots showcased below.

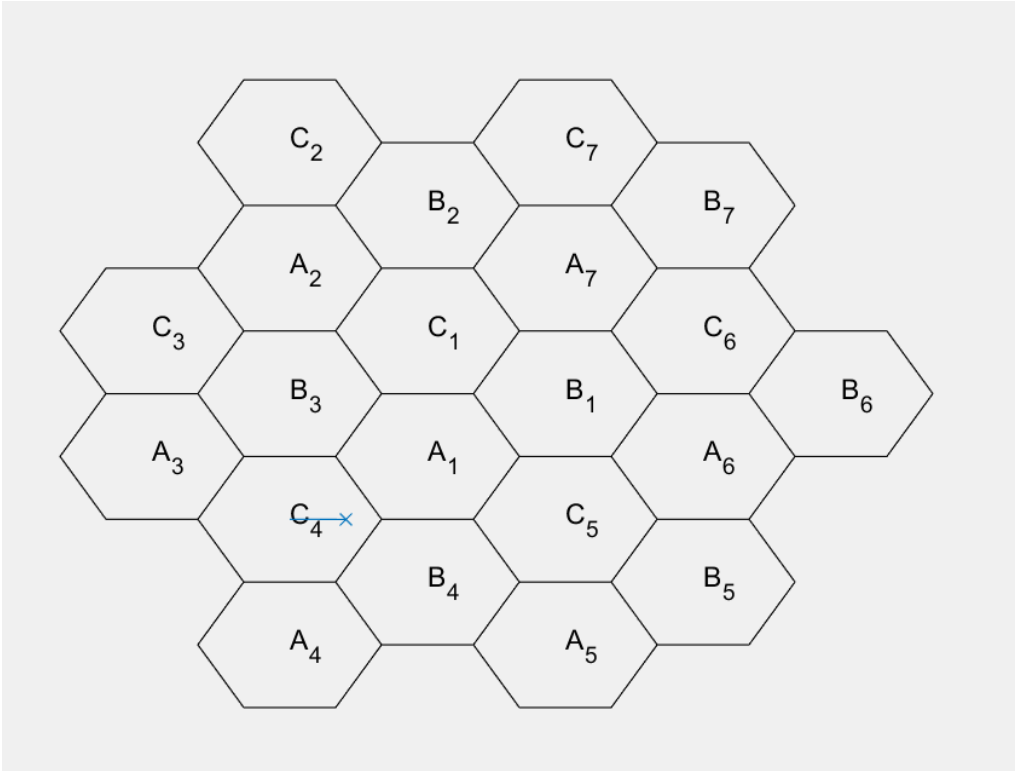

Figure 1: Co-channel interfering cell plot for i = 1, j = 1, and N = 3

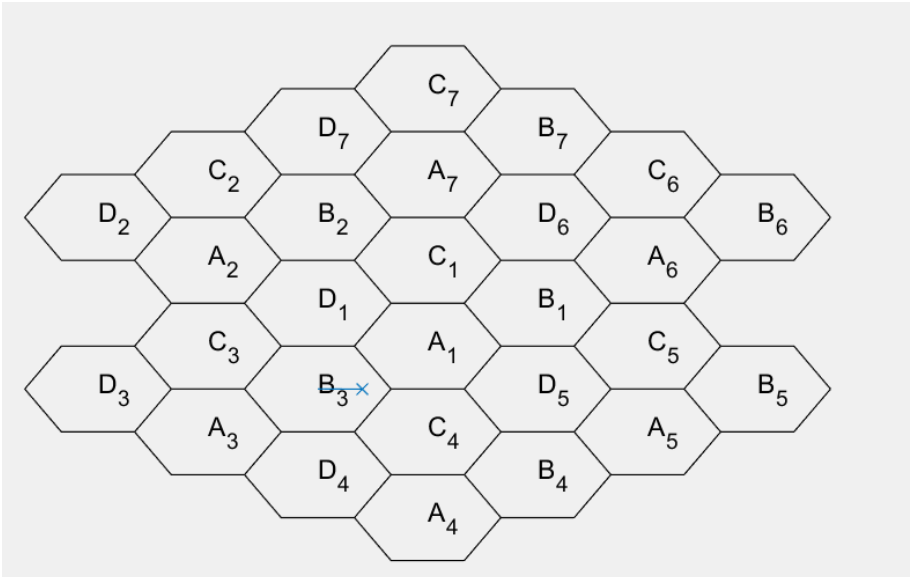

Figure 2: Co-channel interfering cell plot for i = 0, j = 2, and N = 4

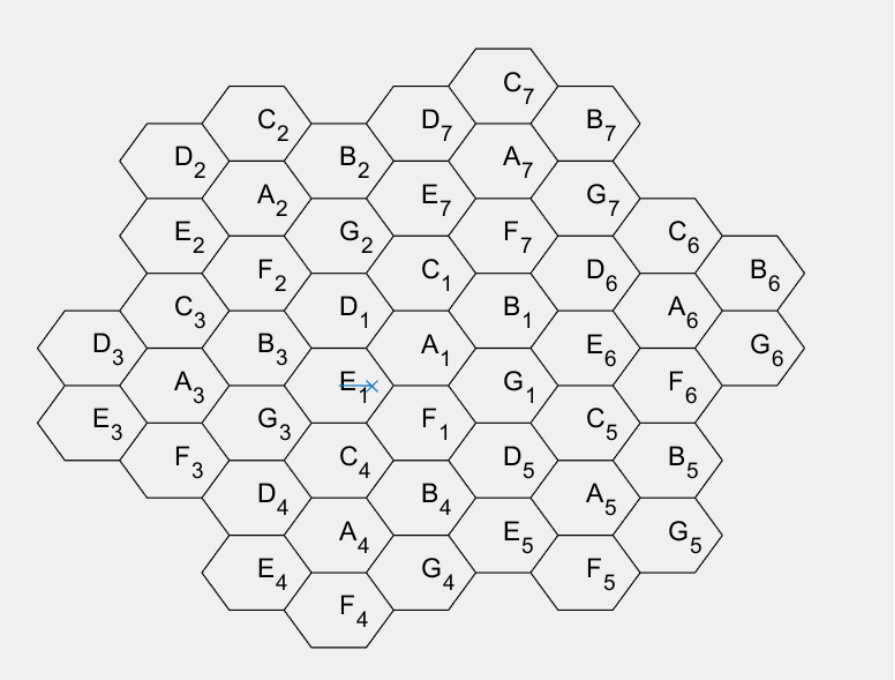

Figure 3: Co-channel interfering cell plot for i = 1, j = 2, and N = 7

3.D Received signal power calculate with Friis Free Space

Assuming a circular coverage area assumes the ideal case where truly omnidirectional antennas provide service for the mobile user. In this example the spaces for transmission have no points of reflection or signal modification making it seem isotropic. Realistically, this would never be the case except for in a very closely controlled environment. A plot of the signal power is shown below for a seven cluster group of seven cells each for a mobile user traveling through three of these cells.

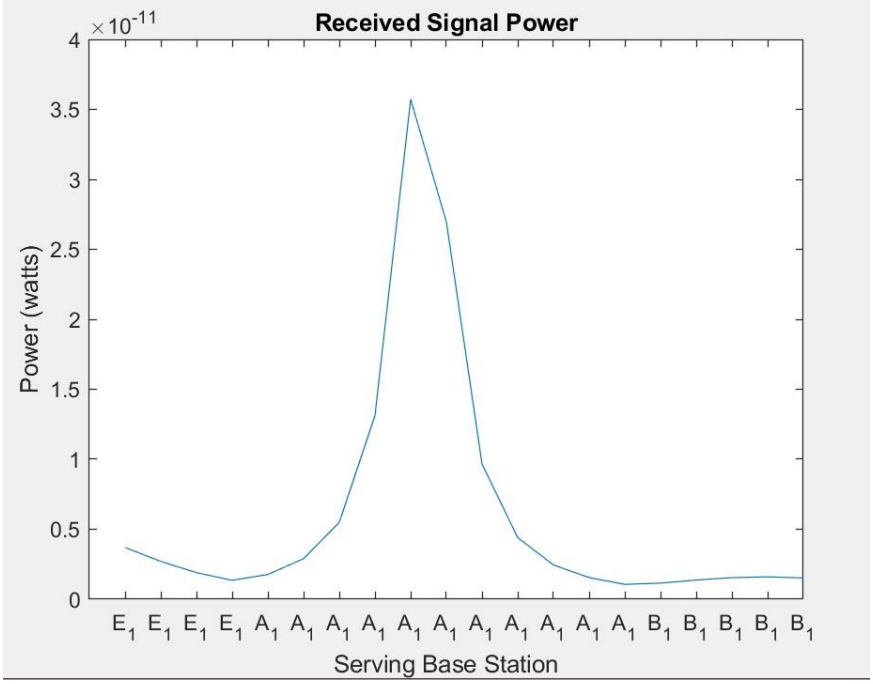

Figure 4: Estimated received power by the mobile user calculated using Friis Free Space Path Loss. The currently serving base station is shown at the bottom as the user moves through various cells within the cluster. Figure generated using MATLAB R2019b.

3.E MATLAB Movie

To view the movie illustrating the movement of the mobile user, refer to the segments provided in the DOC archive for N = 3, 4, and 7.