Homework No. 1

Simulation of the Constrained TPC Algorithm

1 System Model

In this homework, you should apply constrained TPC algorithm to a two-cell CDMA network. Consider an uplink model of the wireless network wherein two base stations (BSs) and 10 users are located in a $500_m \times 1000_m$ rectangle area. Two BSs are located at points $(250_m, 250_m)$ and $(750_m, 250_m)$, respectively. Each BSs serves 5 users in a $500_m \times 500_m$ coverage area. The set of users served by the first and second BSs are $\mathcal{M}_1 = \{1, \ldots 5\}$ and $\mathcal{M}_2 = \{6, \ldots, 10\}$, respectively .The users are uniformly spread in the coverage area of its corresponding BSs. The noise power level at the BSs are assumed to be $5 \times 10^{(-15)}$ Watt. We consider the path gain model as $h_{ij} = kd_{ij}^{-4}$ where d_{ij} is the distance between the user i and the corresponding BS of the user j and $k = 0.09$ is the attenuation factor. For each user i, we assume $\overline{p}_i = 1$ Watt, and $\widehat{\gamma}_i = 0.05$.

2 Feasible System

Check if the system (target-SINR vector) is feasible (Note: the network contains two cells). If the system is infeasible, again distribute users in the cell so that the target-SINRs become feasible. Simulate the TPC for the feasible system explained above.

- Plot SINR and power of the users versus the number of iterations (as a measure of time).
- Change the initial transmit power of users. Does it make change the equilibrium transmit power vector (where the TPC converges to)?
- Do all users reach their target-SINRs at the equilibrium transmit power vector?

3 Infeasible System

Now change one of the simulation parameters (for instance, the number of users, users' location, target-SINRs, or noise power level) to make the system infeasible.

- Plot SINR and power of the users versus the number of iterations under the infeasible system setting.
- Do all users reach their target-SINRs at the equilibrium transmit power vector?
- How can we can check the feasibility or infeasibility of system by observing the equilibrium transmit power vector or SINR vector of the TPC?
- How much interference is imposed to BS 1 (the based station located in $(250, 250)$) by each user in cell 2? which user impose the most interference? Discuss about its location and its transmitting power level.
- Similarly, how much interference is imposed to BS 2 (the based station located in $(750, 250)$) by each user in cell 1? which user impose the most interference? Discuss about its location and its transmitting power level.

4 Performance Comparison of the TPC in Feasible and Infeasible Systems

- Compare the performance of TPC for two cases of feasible and infeasible system simulated above. Based on your simulation results, explain the positive and negative aspects of the TPC algorithm.
- Discuss how we can reduce the number of unsupported users (those who have not reach their target-SINRs) in infeasible system?

Please note that you should upload your HW in a zipped folder named 'HW1_*your student number*'. This folder must include 1- your code files (ending in .m) and 2- your report file containing your plots and answers to different parts of HW. Your report file should be in PDF.