Homework No. 1

Simulation of the Constrained TPC Algorithm

In this homework, you should apply constrained TPC algorithm to a simple CDMA network. Consider a tow-cell 1000 m $\times$ 500 m network area. Two base stations are located in points $(250, 250)$ m and $(750, 250)$ m, respectively. Each base station covers a 500 m $\times$ 500 m square area; additionally, five users are uniformly distributed through the each cell. The network conditions are chosen such that the system is feasible:

- Number of users $N_u = 10$
- Background noise power $\sigma^2 = 10^{-10}$
- Maximum power of each user $P_i = 1\text{mW}$
- Target SINR $\hat{\gamma} = 0.05$
- Path gain $h_i = 0.09d^{-3}$

1 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?

2 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 interfernce? Discuss about its location and its transmiting 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 interfernce? Discuss about its location and its transmiting power level.

3 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.