Homework No. 3

Simulation of DTPC Algorithm

In this homework, apply TPC, OPC, and DTPC algorithms to a simple wireless network with 6 users. For TPC and DTPC, each user has a minimum target-SINR denoted by $\widehat{\gamma}_i$. The users should be uniformly distributed in the cell. This homework has two sections namely unconstrained (there is no limit on maximum power i.e., $\bar{p}_i \to \infty$) and constrained (the maximum transmit power of each user is limited) systems. The following parameters are fixed for both cases:

- Cell coverage area = $100 \text{ m} \times 100 \text{ m}$
- Background noise power σ^2= 10^{-10} W
- OPC and DTPC constant $\eta_i = 10^{-3}$
- Path gain h_i = $0.09\ d^{-3}$

I. Unconstrained System

Simulate the system under a condition which is no constraint on maximum power i.e., $\bar{p}_i \to \infty$ for all $i = 1, 2, \cdots, 6$.

1 Plot the SINR and power of each user versus the number of iterations (a measure of time), for several values of minimum target-SINR. (Plot the aforementioned figures for each algorithm, separately).

2 Compare and discuss the results in terms of outage ratio, aggregate transmit power, and system throughput for TPC, OPC, and DTPC algorithms with change in minimum target-SINR.

3 Discuss the convergence of DTPC and OPC algorithms.

4 Which distributed power control algorithm can be used for feasibility checking in wireless networks, TPC, DTPC, or OPC? Why?

5 Do all users obtain a SINR greater than their minimum target-SINR in DTPC? If not, which user(s) obtain a SINR greater than the minimum target-SINR in DTPC? Obtain the maximum value of SINR the best user can reach by employing $\sum_{i=1}^{6} = \dfrac{\widehat{\gamma}_i}{\widehat{\gamma}_i + 1} \leq 1$, so that minimum target-SINR is guaranteed for other users?

6 Could you modify the unconstrained DTPC so that all users obtain a SINR greater than their minimum target-SINRs? How? Explain.

7 Assume that the users are running different services with different minimum target-SINRs as follows $\widehat{\gamma_1} = 1.5$, $\widehat{\gamma_2} = 0.5$, $\widehat{\gamma_3} = 0.75$, $\widehat{\gamma_4} = 1.25$, $\widehat{\gamma_5} = 1$, and $\widehat{\gamma_6} = 1.5$.

- Are these minimum target-SINRs feasible? Why?
- All users are active from the start time ($t = 0$ s), and each user stops its transmission immediately after its respective activity time intervals, i.e., users $1-6$ are active in the time intervals of $[0, 2]$, $[0, 4]$, $[0, 6]$, $[0, 8]$, $[0, 10]$, and $[0, 4]$, respectively. Each user updates its transmit power every 1 ms according to TPC, DTPC, and OPC algorithm. Plot SINR and power versus time for each user. (Please plot these figures separately for each aforementioned algorithms).
- Compare and discuss the results in terms of outage ratio, aggregate transmit power, and system throughput for TPC, OPC, and DTPC algorithms in each time interval.
- Discuss in each time interval, which user(s) can meet its minimum target-SINR? Why?

II. Constrained System

Now consider a constrained system in which $\bar{p}_i = 1$ mW for all $i = 1, 2, \cdots, 6$.

1 Repeat the steps 1 and 2 as previous section.

2 Assume that system is infeasible for some minimum target-SINRs. Is the number of admitted users in TPC same as DTPC (for different minimum target-SINRs)? If not, which algorithm has larger number of unadmitted users? Why? Discuss and try to find a solution to resolve this problem.