

1 Game and System Setup

This game considers a wireless communications network which includes a both macro cell and femto cell users.

1.1 Players

Individual femto cells are the players in this game. Here each player $f \in \{1...F\}$ is considered to have a number of antennas T_f with which to transmit to K_f femto cell users.

In this setting femto cells are assumed to be spaced far apart in distance permitting the simplification that femto cell f cause no interference to the users of femto cell $j \in \{1...F\} \setminus f$

Femto base stations with multiple antennas can beamform their transmission with transformation $U_f \in C_{T_f \times L_f}$.

Femto base station f has power constraint $\sum_{i=1}^{L_f} p_{f,i} \leq P_f^{Total}$.

Femto base stations are assumed to have a utility function $U_f()$ based upon the quality of service provided to its users.

Macro Cell user $m \in \{1...M\}$ experiences receiver interference to due transmission by femto cell base stations. These macro cell users have limits to the amount of interference they will tolerate $\sum_{f=1}^F \tilde{h}_m^H U_f x_f \leq I_m^{Threshold}$.

Femto base station f is assumed to have full channel information (H_f) for all user with which it transmits. The received signal for user j of femto base station f experiences the inner product of $h_{fj}^H u_{fj}$

Femto cell f is assumed to have full channel information (\tilde{H}_f) for all user with which it interferes .

Users of femto cell f have SINR $\gamma_{f,i} = p_{f,i} |h_{fi}^H u_{fi}|^2 / \sigma_n^2$ *oise* $i \in \{1...L_f\}$ with AWGN $\sim \mathcal{N}(0, \sigma_n^2)$

1.2 Optimization Problem

Each player f attempts to maximize utility function $U_f()$ while playing a strategy that falls in the region constrained by the interference caused to macro cell users.

2 Solving