Decentralized Spectral Resource Allocation for OFDMA Downlink of Femto Networks Using Filled Function Method

Lamia Benmeshbah1, Bingo Wing-Kuen Ling2, Vikram Chandrasekhar3, Xiaoli Chu1 and Mischa Dohler4
1King’s College London, 2University of Lincoln, 3University of Texas at Austin and 4Parc Mediterrani de la Tecnologia
Lamia.benmeshbah@kcl.ac.uk, wling@lincoln.ac.uk, cvikram@mail.utexas.edu, xiaoli.chu@kcl.ac.uk and mischa.dohler@cttc.es

Abstract
• For an orthogonal frequency division multiple access (OFDMA) downlink of a femtocell network, the aim of a resource allocation scheme is to maximise the Area Spectral Efficiency (ASE) subject to constraints on the radio resources per transmission interval accessible by each femtocell.
• In this work, the filled function method is employed to find the global maximum of such an optimization problem.
• Simulation results show that our proposed method is efficient and effective.

Problem Statement
• The size of each RB subset per transmission interval is determined based on optimizing the throughput per cell & ASE [3]
• To optimize such a decentralized resource allocation leads to a nonconvex optimization problem.

Problem Formulation
• For a given RB, denote the received SIR of a femto UE as:

\[ \text{SIR}_i = \sum_{\ell \in \mathcal{F}} \frac{\theta_i H_{\ell i}^{o o}}{\sum_{\ell \in \mathcal{F}} \theta_i H_{\ell i}^{o o} |Y_{\ell i}|^{\alpha_{\ell i}}} \]

• The ASE offered by femtocells is given by:

\[ \text{ASE}_F (\rho_F) = \rho_F \lambda_F \mathbb{E}[\sum_{i=1}^{\mathcal{F}} \exp\left(-\rho_F k_i r_i^{d_i} \psi_{o i}^{d_i} \right) - \sum_{i=1}^{\mathcal{F}} \exp\left(-\rho_F k_i r_i^{d_i} \psi_{o i}^{d_i} \right)] \]

• The optimization problem is formulated as the following:

\[ \max_{\rho_F} \text{ASE}_F (\rho_F) \]
subject to \( 0 < \rho_F < 1 \)

Conclusions
• As the proposed method only evaluates the stationary points of the cost function, the computational effort for solving the globally optimal solution of the optimization problem is significantly reduced.

Acknowledgments
• This work is supported by an EPSRC grant.

Introduction
• A large number of femtocell access points (FAPs) are overlaid on macrocells.
• A pertinent challenge is the management of interference between neighbouring femtocells. The interference avoidance strategies [1] are preferred.
• Closed access femtocells are considered and OFDMA radio resources are partitioned into resource blocks (RBs) [2].
• The spectrum allocation policy in [3] avoids cross-tier interference by assigning orthogonal spectrum resources to the macrocell and femtocell tiers.
• It diminishes femto-to-femto interference by allowing each femtocell to access only a random subset of the spectrum resources that are assigned to the femtocell tier.

Solution Proposed
• The filled function method [4] is employed for solving the global minimum of the optimization problem.
• The proposed method only needs to evaluate the stationary points of the cost function.

Results and Discussions
• Using the filled function based algorithm, we obtain the same set of optimal values of \( \rho_F \) as those obtained in [3].
• It takes only one iteration for our proposed method to reach the globally optimal solution for the considered values of number of FAP.
• Our proposed method is more efficient than the one discussed in [3].

References.