

In this paper, we develop a data rate fairness optimal cooperative beamforming technique for a cognitive radio system with multiple secondary receivers (SRs) and multiple primary receivers (PRs) in the presence of asynchronous interferences. In particular, the data rate fairness beamforming design is formulated as an optimization problem to maximize the minimum data rate of the SRs subject to transmission power constraints at the secondary cooperative transmitters (SCTs) and asynchronous interference power constraints at the PRs. The optimal beamforming design is a quadratically constrained quadratic program max-min optimization problem, which is non-convex and non-linear. Therefore, we reformulate the optimal beamforming design as a quasi-convex problem using the semidefinite program (SDP) relaxation, which can be solved using the SDP solvers and bisection method. The complexity of the optimal beamforming scheme stands against its practical implementation. So, we study important properties of the optimization problem. By exploiting these properties, we also propose low complexity suboptimal beamforming techniques. Furthermore, we extend the beamforming techniques to incorporate the uncertainties in channel and propagation delay estimation between SCTs and PRs.