Cooperative beamforming and relay selection in cognitive radio systems

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SUMMARY

In this paper, a new scheme is suggested for cooperative beamforming (BF) and relay selection in CR networks, where a pair of secondary users communicates with each other assisted by some multiple antenna relay nodes. The goal of the algorithm is to maximize signal to interference plus noise ratio of secondary user receiver subject to limited interference caused for primary user receiver and power constraints of relay nodes. The relay selection and BF optimization problem is solved separately by employing convex semidefinite programming through rank-one relaxation. It is shown that our proposed algorithm outperforms conventional relay selection and BF schemes. Copyright © 2014 John Wiley & Sons, Ltd.

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KEY WORDS: cognitive relay radio; semidefinite programming; cooperative beamforming; relay selection

1. INTRODUCTION

Spectrum usage efficiency can be improved using cognitive radio (CR) technology in which secondary users (SUs) are allowed to access licensed bands that are originally allocated to primary network without causing any harmful interference to primary users (PUs) [1–7]. There are three kinds of CR networks based on secondary access schemes to licensed bands, called interweave, underlay, and overlay. The first approach is based on opportunistic communications in which SUs can access the licensed bands only when PUs are absent. This approach is called ‘interweave’ technique. In the second scheme, SUs are allowed to access the licensed bands simultaneously with PUs. Note that in this scheme, the interference induced from SUs to PUs must be limited by a specific threshold which is known as ‘interference temperature’. This scheme is called ‘underlay’ technique. In the overlay CR system, SUs regulate the interference induced to PUs by assisting and relaying PU signals to their destinations [8–11].

Because of adverse effects of environment such as loss, shadowing, and fading, the receive signal at SUs may be too weak, thereby decreasing the QoS. To mitigate these destructive effects of wireless channels, SUs can cooperate with each other, and some SUs can act as relay nodes. These relay nodes cooperate with SU transmitters (SU-Tx) to relay their signals to desired destinations. Using relay nodes further enhances the spectrum efficiency by increasing spatial diversity.

2. RELATED WORKS

In recent years, many relay schemes are investigated. In [12], a resource allocation algorithm is developed in which suboptimal subcarrier pairing, power allocation, and relay selection is adapted based on the dual decomposition technique. The authors applied their scheme in relay OFDM-based