Editorial for Crowncom 2013 Special Issue

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This special issue features six selected papers with high quality from the conference CrownCom 2013, which was held in Washington DC, USA, July 8–10, 2013.

The first article titled “Coopetive Spectrum Trading – Creating Endogenous Spectrum Holes” by Liu Cui, Taieb Znati, and Martin B.H. Weiss, discusses the problem of dynamic spectrum access. The authors argue that spectrum holes should be endogenous, enabled by incentives to incumbent users to increase spectrum availability while mitigating risks. In the proposed framework, the primary users’ spectrum is organized in three bands, namely exclusive usage band, usage right band, and management right band. Based on this structure, spectrum is traded as financial options to increase trading flexibility and capture the value primary and secondary users attach to spectrum access and usage. Spectrum trading between primary and secondary users is formalized as a utility maximization problem. Approximate solutions to this problem are derived and their performance is analyzed. The results show that spectrum trading, which combines revocable and exclusive leasing, provides higher utilities for both primary and secondary users.

The second article, “Performance of Secondary Wireless Networks With Contention Control in TV White Spaces”, is co-authored by Byungjin Cho, Konstantinos Koufos, and Riku Jäntti to study the spectrum coexistence of secondary wireless networks with contention control and TV services. In the proposed approach, a carrier sensing threshold is used as a parameter to control the density of secondary transmitters and accordingly the generated secondary interference to the TV

system. In order to obtain the calculated threshold, a simple method to assess the data rate of the secondary system is developed. Using this method, one can study whether the secondary performance is limited due to the TV protection requirements. The method can also be used to investigate the trade-off between the secondary performance and the TV protection requirements.

The third article, “Multi-channel Energy Detection under Phase Noise: Analysis and Mitigation” from Ahmet Gokceoglu, Yaning Zou, Mikko Valkama and Paschalis C. Sofotasios, investigates the impact of oscillator phase noise on energy detection (ED) based spectrum sensing in multi-channel direct-conversion receiver scenario. Based on complex Gaussian PU signal models, the authors first derive the detection and false alarm probabilities in closed-form expressions. They also show that the false alarm probability of multi-channel energy detection increases significantly, compared to the ideal RF receiver case. In order to prevent such performance degradation in spectrum identification, an enhanced energy detection technique is proposed. This technique calculates the leakage power from neighboring channels for each channel and improves the sample energy statistics by subtracting this leakage power from the raw value. An analytical expression is derived for the leakage power, which is shown to be a function of power spectral levels of neighboring channels and 3-dB bandwidth of phase noise process. Practical schemes for estimating these two quantities are discussed. Extensive computer simulations show that the proposed enhanced detection yields false alarm rates that are very close to those of an ideal RF receiver and hence clearly outperforms classical energy detection.

The fourth article, “Efficient Spectrum Sensing with Minimum Transmission Delay in Cognitive Radio Networks”, is co-authored by Hang Hu, Hang Zhang, and Hong Yu. This article investigates the problem of designing the sensing time to minimize the SU transmission delay under the condition of sufficient protection to PUs. A novel cooperative spectrum

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sensing (CSS) framework is designed, in which one SU's reporting time can be used for other SUs' sensing. The analysis focuses on two fusion strategies: soft information fusion and hard information fusion. Under the soft information fusion, it is proved that there exists one optimal sensing time that minimizes the SU transmission delay. Under the hard information fusion, the novel multi-slot CSS for time varying channels is derived. The performance of SU transmission delay is studied in both perfect and imperfect reporting channels. Some simple algorithms are derived to calculate the optimal sensing settings that minimize the SU transmission delay. Computer simulations show that fundamental improvement of delay performance can be obtained by the optimal sensing settings. In addition, the novel multi-slot CSS scheme shows a much lower transmission delay than CSS based on general frame structure.

The fifth article, "Cooperative Spectrum Prediction in Multi-PU Multi-SU Cognitive Radio Networks", co-authored by Xiaoshuang Xing, Tao Jing, Wei Cheng, Yan Huo, Xiuzhen Cheng and Taieb Znati, proposes a novel coalitional game theory based approach to investigate cooperative spectrum prediction in multi-PU multi-SU CRNs. In this approach, cooperative groups, also referred to as coalitions, are formed through a proposed coalition formation algorithm. The novelty of this work, in comparison to existing cooperative sensing approaches, stems from its focus on the more challenging case of multi-PU CRNs and the use of an efficient coalition formation algorithm, centered on the concept of core, to ensure stability. Theoretical analysis is conducted on the upper bound of the coalition size and the stability of the formed coalition structure. A thorough simulation study is performed to assess the effectiveness of the proposed approach. The simulation results indicate that cooperative spectrum prediction leads to more accurate prediction decisions, in comparison with local spectrum prediction individually performed by each SU.

The last article, "Game-Theoretic Joint Power Allocation and Beamforming for Cognitive MIMO Systems with Finite Feedback" from Feng Zhao, Chen Wang, Hongbin Chen, and Rongfang Bie, considers the imperfect channel state information (CSI) in practical cognitive MIMO systems. The feedback of quantified CSI from the primary user (PU) is analyzed and a joint game theory based power allocation and beamforming algorithm is proposed. Compared with the game under the condition of perfect CSI, new utility function and cost function are constructed under imperfect CSI. This article also analyzes the error introduced from the uniformly quantified CSI and obtains new constraints. Besides, the existence of the Nash equilibrium (NE) in the case of both perfect CSI and imperfect CSI are proven and a new iterative algorithm to reach the NE is presented. Simulation results show that the proposed algorithm can converge quickly.

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