Global Secrecy Energy Efficiency in CR Networks with Untrusted Secondary Users

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Abstract: The information security and energy efficiency in cognitive radio (CR) networks have been extensively studied. However, the practical scenario involving multiple untrusted secondary users (SUs) in CR networks under the underlay spectrum sharing mechanism has not been studied so far. This talk considers the downlink secrecy energy efficient coordinated beamforming design for multiple inputs single output (MISO) CR networks under this scenario. Our goal is to maximize the global secrecy energy efficiency (GSEE), defined as the ratio of the sum of secrecy rates of all the primary users (PUs) to the total power consumption, under requirements on quality of service of Pus and SUs as well as constraints on power budget at the primary transmitter (PTx) and the secondary transmitter (STx). To tackle the non-convex GSEE maximization (GSEEM) problem, an algorithm is proposed based on Dinkelbach method and successive convex approximation to jointly optimize beamforming vectors of the PTx and the STx. The convergence behavior and the computational complexity of the proposed GSEEM algorithm are analyzed, followed by the connection with the secrecy rate maximization design and the power minimization (PM) design in terms of GSEE. In view of significantly higher computational complexity of the proposed GSEEM algorithm than that of the PM design, a 2-step searching scheme is further designed to efficiently search for an approximate solution to the considered GSEEM problem based on the PM design and the golden search method. Simulation results demonstrate the efficacy of the proposed GSEEM algorithm and the searching scheme, and show that the spatial degrees of freedom (primarily determined by the antenna numbers of PTx and STx) is the key factor to the performance of the proposed GSEEM algorithm.

Chong-Yung Chi (**祁忠勇**) received B.S. degree from Tatung Institute of Technology, Taipei, Taiwan in 1975, Master degree from National Taiwan University, Taipei, Taiwan in 1977, and Ph.D. degree from the University of Southern California, Los Angeles, California, in 1983 all in Electrical Engineering. Currently, he is Professor of National Tsing Hua University, Hsinchu, Taiwan. He has published more than 240 technical papers (with citations more than 6,000 times by Google-Scholar), including more than 85 journal papers (mostly in IEEE Trans. Signal Processing), more than 140 peer-reviewed conference papers, 3 book chapters, and 2 books, including a recent textbook, *Convex Optimization for Signal Processing and Communications from Fundamentals to Applications*, CRC Press, 2017 (which has been popularly used in a series of invited intensive short courses at 10 top-ranking universities in Mainland China since 2010 before its publication). He received *2018 IEEE Signal Processing Society Best Paper Award*, entitled "Outage Constrained Robust Transmit Optimization for Multiuser MISO Downlinks: Tractable Approximations by Conic Optimization," *IEEE Tran. Signal Processing*, vol. 62, no. 21, Nov. 2014. His current research interests include signal processing for wireless communications, convex analysis and optimization for blind source separation, biomedical and hyperspectral image analysis, and graph based learning and signal processing.

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