UNIVERSITY OF THE WITWATERSRAND

Abstract

Doctor of Philosophy

Cooperative Spectrum Sensing in Multi-channel RF Energy Harvesting Cognitive Radio Networks

The need to improve the utilization efficiency of the limited radio resources in the face of the increasing number of radio network services, coupled with the growing interest in making wireless and mobile technologies energy smart has prompted research interest in energy harvesting based cognitive radio networks (EH-CRNs). EH-CRNs promises to jointly facilitate dynamic spectrum access (DSA) and a cheaper and more convenient energy alternative source to the replaceable batteries in wireless radio networks. However, investigations have shown that the performance of the technology is limited in terms of achievable throughput due to energy shortage occasioned by the random energy arrival at the SU terminal.

The main focus of this thesis is therefore to develop a cooperative spectrum sensing scheme, which maximizes the achievable throughput of energy harvesting based secondary users, while ensuring adequate protection of the primary user (PU) against interference. The objectives are four-fold. Firstly, to appropriately allocate the secondary users (SU) to the PU channels in a many-to-many combinatorial assignment, taking into consideration the effect of PU independence and the time-varying channel conditions. Secondly, to develop a robust and generalized cluster head selection scheme that follows the network dynamics for efficient cooperative spectrum sensing. Thirdly, to develop a decision fusion rule that minimizes the total error rate in cooperative spectrum sensing; and finally, to determine the cooperative sensing parameters that maximize the capacity of the SU, subject to the harvested energy and PU protection in the multichannel EH-CRNs.

Performance analysis and evaluation of the developed scheme is presented as simulations results and analytical models. The presented results demonstrate improved channel allocation, cooperative spectrum sensing performance, energy arrival rate and the SU's energy efficiency, when the characteristics of the PU channels, and the SU networks are taken into consideration.