AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Electronics and Communication Engineering Department

Performance Evaluation of Collaborative Sensing Cognitive Radio

A Thesis

Submitted in Partial Fulfillment of the Requirements
For the Degree of Master of Science in Electrical Engineering
(Electronics and Communication Engineering)

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Degree: **Degree of Master of Science in Electrical Engineering (Electronics and Communication Engineering)**

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Electrical Engineering (Electronics and Communication Engineering).

The work included in this thesis was carried out by the author at the Electronics and Communication Engineering Department, Faculty of Engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or qualification at other university or institution.

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To my beloved father, mother, sisters and husband for their help and support

Abstract

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Master Thesis, Ain Shams University

Nowadays, Cognitive Radio Network (CRNs) becomes an emerging and rising technology which uses spectrum utilization more efficiently through spectrum sharing between licensed users (primary users (PU)) and unlicensed users (secondary users (SU)). One of the most challenging tasks in CRN is spectrum sensing (SS), which is facing problems like shadowing and fading. In these cases, SU cannot distinguish between a free band and a deep fading. Thus, collaborative SS is proposed to enhance the sensing performance. This thesis focuses on the performance of collaborative SS over Nakagami-*m* faded channel. Besides, it concentrates on this performance in case of non-faded AWGN channel in CR while malicious users are present. Furthermore, this thesis discusses the performance of collaborative SS over composite multipath fading and shadowing using K faded channel in the presence of malicious users. Moreover, it illustrates that SS gives better performance when more CR users cooperate.

This thesis presents a comparison between the collaborative sensing through faded channel (Nakagami-*m* model) and AWGN channel based on fusion rule which is defined by q out of n_s rule.

This thesis deals with wireless security on the upper layers through encryption and authentication. However, for more effective performance of the SS, CR networks depend heavily on the physical layer because it is considered as a vulnerable hole to protect from any attack. This thesis investigates the security of CRNs by considering a physical security threat on SS and studies the performance of the CR system under channel impairments and malicious users (who can report false information in collaborative sensing).

In this thesis, analytical and numerical methods are used to investigate the performance of the collaborative sensing in cognitive radio networks under malicious attacks over different channel impairments. It illustrates the most suitable individual probability of detection $\left(\overline{P_{dNAK}}\right)$ in a real faded channel by using Nakagami-*m* model.

The presented work performs a reduction of operation parameter to get the suitable probability of detection against malicious attack in real faded channel using Nakagami-*m* model. Furthermore, it concentrates on more reliable channel attitude which includes the multipath fading and shadowing together. The modeling is performed by using the generalized faded distribution (K_G distribution) in order to get a closed form for the probability of detection (P_d).

This thesis illustrates the effectiveness of the attacks and channel impairments (in case of composite) on the performance of collaborative spectrum sensing process and gives a mathematical formula for calculating the suitable P_d against a certain SNR.

Keywords: Cognitive radio, collaborative sensing, malicious attacks, Nakagami-*m* faded channels, K_G distribution, fusion center's rules.

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