A Malicious User Filtration via Double Sided Neighbor distance based Genetic Algorithm in Cognitive Radio Networks

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***Abstract*—Spectrum sensing plays a vital role in cognitive radio network (CRN). The fading and shadowing degrades the sensing performance of the individual user. Cooperative spectrum sensing (CSS) enhanced the performance of the cognitive radios. However, the performance of CSS severely degrades, when malicious users (MUs) appear in the network. In the paper, we proposed a double sided neighbour distance algorithm based on Genetic algorithm (GA) to filter out MUs sensing in CSS by utilizing soft and hard combination techniques. The work in the paper is tested in the presence of MUs. Simulation outcomes show the effectiveness of the proposed scheme.**

Keywords—Cognitie radio, cooperative spectrum sensing, double sided neighbor distance, genetic algorithm.

I. Introduction

Cognitive radio network (CRN) consist of an intelligent wireless communication system embedded with the key functionality of providing highly consistent communication at all times with proficient utilization of resources [1]. The underutilization of the spectrum fallout in spectrum holes representing the frequency band assigned to the legitimate primary user (PU), but certain time and specific geographical locations show that the band is not in use of the PU. The major issue in CRN is to properly detect PU channel. Proper detection of PU is vital at the secondary user (SU) for minimizing interference to the PU due to the SU transmission, when the PU is active. SUs get knowledge about the PU existence by following several detection plans such as feature detector, match filter detector and energy detector [2].

CSS performs well in a fading and shadowing environment, where multiple radios provide an independent realization of related random variable in the course of distributed transmission [3]. CSS is exposed to the false sensing reports in the cooperative scheme is essential for minimizing their adverse effects. Significant investigations are carried out to make the cooperative system resistant to the attack of MUs. The attacker transfers erroneous sensing reports to the data collection center, in order to create confusion about the spectrum conditions. Such attacks are referred to as spectrum sensing data falsification (SSDF) attack, and the cooperative schemes need to be robust against them [4]. The study made in [5] focused on Genetic Algorithm (GA) for optimizing the detection and false alarm probabilities to minimize the error probability.

In this paper, the normal SUs and MUs report their local sensing to FC. The abnormalities are first identified by the GA with the DSND algorithm. The best results are further used for assigning weights to SUs and reports to FC for performance measurement.

The remaining of the paper is organized as follows. In Section II, we describe the proposed system description. In Section III, simulation results and analysis are given. Finally, the paper is concluded in Section IV.

II. Proposed System Description

In this paper, the normal SUs and MUs reports their local findings to the FC. When enough statistics are collected against the cooperative users, abnormalities are first identified by the GA with the DSND. GA then randomly mutate the sensing data of the detected abnormalities along with the crossover operation to search more suitable sensing information against the reporting users. The GA selection is further used to find best sensing data based on Hamming distance of all SUs from its neighbors during each history interval and minimum Hamming distance report is decided at the best sensing results on behalf of all SUs for majority voting hard decision fusion. The best selection results are further used for assigning weights to SUs reports in the soft decision fusion based global decision at the FC. The effectiveness of the proposed scheme is tested against other schemes in the presence of opposite MUs (OMU), random OMU (ROMU), always yes MU (AYMU) and always no MUs (ANMU). The overall proposed scheme flowchart is shown in Fig. 1.

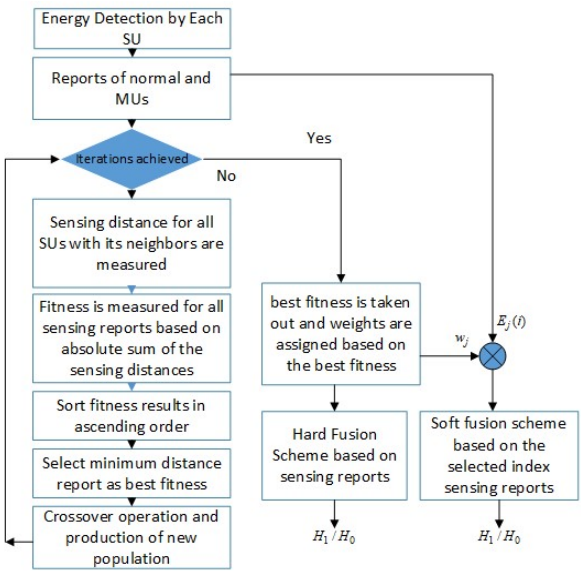

Fig. 1. Proposed cooperative spectrum sensing flowchart.

III. Simulation Results and Analysis

In this section, we present simulation results. We considered total *P (10-20)* SUs. Among total SUs, 4 users are randomly selected as AYMU, ANMU, OMU and ROMU. For the GA, total number of chromosomes is taken as 16 containing the sensing information of P cooperating SUs with random crossover point. The crossover and mutation operations were performed for 10 cycles and best fitness results were selected. Fig.2 illustrates the ROC curve of the GAW-SDF, GAMV-HDF, MV-HDF, EGC-SDF and MGC-SDF schemes. It is shown that probability of detection increases as the SNR increases. The result shows that the proposed soft and hard fusion scheme combination using prior identification of MUs with DSND algorithm followed by the crossover and mutation operation produce sophisticated PU detection against the simple traditional schemes.

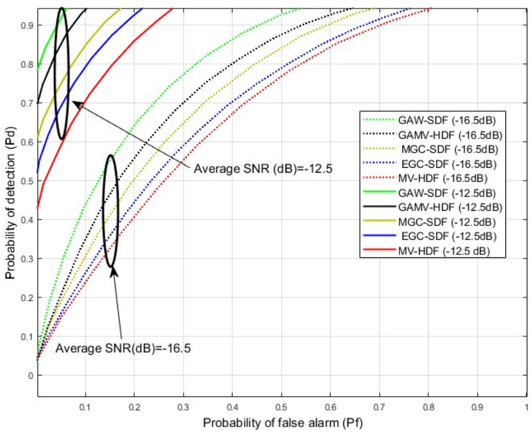

Fig. 2. ROC curve of the proposed scheme.

Fig. 3 demonstrate probability of error for different number of cooperating SUs. The results demonstrates that the proposed scheme is more effective in comparison with the traditional schemes.

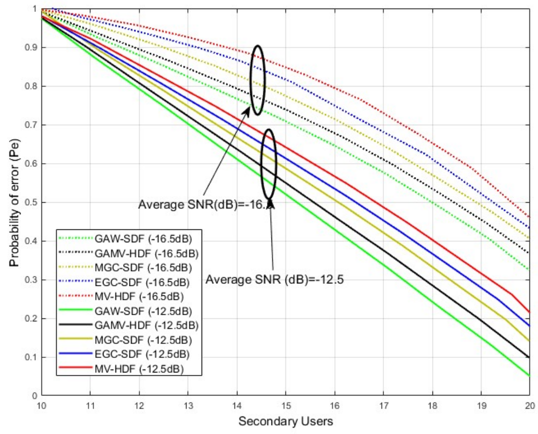

Fig. 3. Probability of error vs. Secondary users.

IV. Conclusion

The false sensing data of MUs reduce effectiveness of CSS. It is therefore essential to evade any confusion in sensing. This paper focuses on improving the existing soft and majority voting hard fusion combination scheme using GA in the presence of abnormalities. GA employed DSND for detecting abnormalities and use crossover and mutation to get precise and reliable sensing results at the FC. Simulations shows that performance and accuracy of the traditional schemes are greatly improved after adopting the proposed scheme.

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