Chapter 9
Multiple Antennas-Based Improved Sensing Detector

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ABSTRACT

5G is one of the newest and most acclaimed engineering technology of wireless era. This technology is also known as CRNs, in which spectrum detection plays a key role. Through this chapter, the authors explore multiple antennas-based improved sensing detector (MA_ISD). In the said scheme by using adaptive threshold and multiple antennas patterns, its easy to mitigate sensing failure issue enriches reliability. The presented scheme uses two detectors (TD) concept. The concept of two detectors (i.e., TD scheme has been applied in which multiple antennas are used for electing the quality signals). The considered model upgrades the detection operation and acquires limited or inferior detection time. The first energy detector uses a single adaptive threshold (ED-SAT) while another energy detector employs two adaptive thresholds (ED-TAT). The threshold value is accommodative as it relays on noise variance (σ_ω^2), the behavior of noise variance transforms in accordance with noise signal. Both the detectors run collaboratively and their gain is then supply to a decision device which operates OR functions. In this research work, results shows that with cooperation of two antennas (Nr=2) in multiple antennas-based improved sensing detector (MA_ISD) technique delivers enhancement in detection performance by 24.6%, 53.4%, 37.9%, and 49.6%, in contrast to existing schemes (i.e., EDT-ASS-2015 scheme, ED and cyclo-2010, adaptive SS-2012, and conventional-ED) scheme at -12dB SNR, respectively. During the time, proposed technique also reduces the sensing time in the order of 47.0 ms, 49.0 ms, and 53.2 ms as compared to existing schemes (EDT-ASS-2015, Adaptive SS-2012, and ED and Cyclo-2010) scheme at - 20 dB SNR, respectively.

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INTRODUCTION

There is several essential sensing techniques have been proposed by the investigators to sense licensed signal . In (Maleki, Pandharipande, & Leus, 2010), authors presented two-stage detectors, energy detector and cyclostationary detector respectively. Generally detector also has some limitation like complex computations and additional sensing time. Moreover, in (Ejaz, Hasan, & Kim, 2012), authors suggested adaptive spectrum sensing scheme to mitigates the sensing period. These two stage detectors can't operate at the same time. So it can be stated that system complexity sustains while having minimum sensing time period. Furthermore, in (Sobron, Diniz, Martins, & Velez, 2015), authors presented adaptive sensing technique using energy detector (EDT-ASS). In which, cost-function and the presence/absence of PU's signal is concluded.

In this Chapter, the two detectors i.e. ED_SAT and ED_TAT performs sensing task concurrently in order to improve detection performance using multiple antennas. Adaptive Thresholds value leads less sensing failure problem (Liu, Hu, & Wang, 2012). The results of detectors inset to decision device (DD) who takes ultimate decision using OR-rule. Decision device with value 1shows frequency band is occupied i.e (H_1), else it is free (H_0). The proposed model is much more concerned about spectrum sensing failure (Liu, Hu, & Wang, 2012), and fading problem while the other (Maleki, Pandharipande, &Leus, 2010; Ejaz, Hasan, & Kim, 2012; Sobron, Diniz, Martins, & Velez, 2015) techniques overlooked at the same. Adaptive threshold scheme diminishes the problem of sensing failure and the use of multiple antenna deals the fading problem. Meanwhile, (Pandharipande, & Linnartz, 2007; Taherpour, Nasiri-Kenari, & Gazor, 2010), remarks that the use of multiple antennas gives the reliability for spectrum sensing. The main feature of this technique to tackle out sensing failure and fading problem. Simulation results approve that the proposed model advances detection performance at $P_f = 0.1$, operates well at low SNRs, and decreases sensing period also.

BACKGROUND

Energy Detector and Cyclostationary Detector (ED and Cyclo-2010) (Maleki, Pandharipande, & Leus, 2010)

In this section, authors proposed two-stage spectrum sensing detector, who carried energy detector and cyclostationary detector. Further, authors assumed that the total numbers of channels are L, and channels are sensed serially by secondary users. First stage is known as coarse sensing stage, carries energy detector to take spectrum sensing decision, if the energy of detected signal is greater than or equal to a certain threshold, the channel is announced to be busy. Else, second stage detector known as fine sensing stage, carries cyclostationary detector will come on picture and try to identify licensed frequency band. If the decision metric in second stage is above a certain threshold, the channel is announced to be busy. Else, it is declared to be free and available for cognitive radio users for their use. Authors are examined the performance of proposed two-stage detectors in terms of the probabilities of detection alarm, probability of false alarm, and sensing time.