CHAPTER 1

INTRODUCTION

1.1. Background

Cognitive Radio (CR) is an intelligent wireless communication system that is able to realize the condition of the surrounding environment and use the "understanding-by-building" methodology to learn from the environment and adapt its internal status to the statistical variations on RF stimulants that come with making changes to certain operating parameters such as transmission power, carrier frequency, or modulation strategy. Everything is done in real time with two objectives, namely reliable communication and efficient spectrum utilities.

In various recent studies, Compressive Sensing (CS) has been widely implemented in the field of signal processing and wireless communication for detection signal. With the CS method it can reduce the sampling rate of the received signal thereby reducing the converter processing time. Energy minimization is the main feature of CS. Primary User (PU) signals on CR are detected optimally using the signal sparse representation. The received PU signal is compressed in the time domain to extract the minimum coefficient. Furthermore, the signal is detected using the energy detection technique and recovered using the CS algorithm. Then the detection performance for various levels of compression will be analyzed.

In previous studies, Compressive Sensing has been used in various technologies. First Literature [1], discuss the application of CS methods in wideband spectrum sensing, signal parameter estimation, and Radio Environment Map (REM) based on RF parameters. In its application, the basic principles of CS are used in cognitive radio communication and classifies various areas of CS application. Then in research [2], discuss about signal acquisition in CS which is more efficient when compared to the traditional sampling method for sparse signals or compressible signals. In CS, most

optimizations are not sufficient for signal reconstruction, and must involve other types of convex optimization. Next, at [3] CS has inspired the entire signal processing community to the next generation of wireless communication technology, as well as the application of CS to a variety of technologies including massive MIMO, NOMA systems, transmission bandwidth, millimeter wave communication, etc. On the one hand, a very wide bandwidth, hundreds of antennas, and an ultra deployed BS to support large-scale users in the 5G technique will produce enormous overhead, unreachable complexity, high costs and power consumption due to the large number of samples needed by the Nyquist theorem sampling. The research discussed that CS theory has provided a sub-Nyquist sampling approach to efficiently overcome the 5G challenges. The CS algorithm shows a reduction in complexity and increased reliability.

When compared with the usual sensing spectrum, where the sensing process is carried out one by one in each subband, so it requires more time. In this study, the CS method with reconstruction uses Convex Optimization (CVX) method, so that the reconstruction process is carried out as a whole. With this proposed method, the bandwidth used becomes less so it is more efficient and the sensing process is faster.

1.2. Problem Identification

Identifying the problems in this study are as follows:

1. How is the effect of noise on the reconstructed signal on the user's Cognitive Radio receiver using the Compressive Sensing method.
2. How is the effect of SNR on the Spectrum Sensing detection results of the Compressive Sensing method used in Cognitive Radio.
3. How is the effect of the compression ratio on the Spectrum Sensing detection results of the Compressive Sensing method used in Cognitive Radio.
4. How is the detection performance using the Compressive Sensing method and without the Compressive Sensing method.

1.3. Objective

The purpose of this research is to apply and analyze the performance of the Compressive Sensing method used to detect signal recovery on cognitive radio.

1.4. Research Contributions

This research contributes as follows:

1. In this algorithm, the Spectrum Sensing detection results will be tested on the compression ratio, SNR and False Alarm Probability.
2. Obtain data on the performance comparison of the Spectrum Sensing system using the CS method and without CS on Cognitive Radio.

1.5. Scope of Work

In this research, there are several problem constraints, including the following:

1. The signal used by the sender's side will be generated randomly with sparsity = 4.
2. The channel used for testing is AWGN channel
3. The reconstruction algorithm used is CVX
4. The Spectrum Sensing method used for detection analysis is the energy detector in baseband
5. The reconstruction process in this research is getting an estimate of the original signal from the system output
6. Performance analysis is only done on the side of the recipient.

1.6. Research Methodology

The method used to complete this thesis is as follows:

1. Literature study

   At this stage, searching, collecting, and understanding information relating to Cognitive Radio and spectrum efficiency from various sources such as reference books, internet, journals and various other sources.

2. System model design

   At this stage, the literature obtained at point 1 is used to analyze the knowledge obtained to further design the program to be created. In this study an experiment will be conducted using the Compressive Sensing method to improve the efficiency of the spectrum on Cognitive Radio.Desain Algoritma

   Pada tahap ini, akan didesain algoritma Compressive Sensing dalam efisiensi penggunaan band pada Cognitive Radio.

3. Implementations

   Utilizing various software to carry out research and algorithms will be tried to be implemented. Information obtained from literature studies will be used as a guide to support this research.

4. Testing and analysis

   At this stage simulation testing and analysis will be carried out for the proposed method.