COOPERATIVE SPACE-TIME BLOCK CODING

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FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

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Tajuk Projek : COOPERATIVE SPACE-TIME BLOCK CODING

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Dedicated, in thankful appreciation for support, encouragement, love and understanding especially to my beloved father, mother, all the family members and to my entire colleague.

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ABSTRACT

The aim of this project is to reduce the power loss while increasing the data rate of the system. The objective of this project is to design and develop the cooperative space-time coding for wireless sensor network and to compare the performance of cooperative space-time coding with non-cooperative system. In order to develop, it is a requirement to study and compare with other technique available. Furthermore, in order to compare cooperative space-time coding with non cooperative system, it is required to perform simulation and study the graph. The parameters measured are the Power Loss and SNR ratio. A part from that, I had also compared the performance of the cooperative system and non cooperative system. Thus, producing an analysis of the best system obtain.

ABSTRAK

Matlamat utama projk ini adalah untuk mengurangkan kehilangan kuasa dan dalam masa yang sama meningkatkan kadar data yang di hantar dalam sistem berkenaan. Objektifnya adalah untuk reka dan membangunkan kod sistem kerjasama ruang dan masa dalam komuniti jalur tanpa wayar dan membandingkan prestasi sistem berkenaan antara sistem kerjasama dan tidak kerjasama. Dalam membangunkan sistem ini, ianya adalah satu kemestian untuk mendalami pengetahuan tentang bidang yang berkaitan dan membandingkn nya dengan teknik yang lain. Dalam pada itu, dalam membandingkan antara sistem kerjasama dan sistem tidak kerjasama ianya adalah satu kemestian untuk melalui proses simulasi dan memahami graf yang di hasilkan . Antara parameter yang di ukur adalah Kadar Bit Rosak, Kadar Tundaan dan Kadar Pengunaan Tenaga . Selain dari itu, dalam laporan ini juga di sertakan perbandingan antara teknik lain yang wujud.

CONTENTS

CHAPTER 4

LIST OF FIGURE

CHAPTER 1

INTRODUCTION

1.1 Overview

Wireless communication is the transfer of information over a distance without the usage of electrical conductors or cables [1]. The distances involved may be short (a few meters as in television remote control) or long (thousands of kilometers for radio communications). When the context is clear, the term is often shortened to "wireless". Wireless communication is generally considered to be in the telecommunications family. [1]

It offers various types of fixed, mobile, and portable two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Other examples of *wireless* technology include GPS units, garage door openers and or garage doors,

wireless computer mice, keyboards and headsets, satellite television and cordless telephones.[3]

Wireless operations permits services, such as long range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems (e.g. radio transmitters and receivers, remote controls, computer networks, network terminals, etc.) which use some form of energy (e.g. radio frequency (RF), infrared light, laser light, visible light, acoustic energy, etc.) to transfer information without the use of wires. Information is transferred in this manner over both short and long distances.[2]

So, with the existing and development of Wireless system, there is Wireless Sensor Network system in telecommunication. One of the main purpose we used Wireless Sensor Network in telecommunication is because of its reliability, performance and the cost effective factor.[4] This Network system have been research and developed widely in military, industrial and safety purpose. Thus, in telecommunication, it is a need to have higher performance system with compact and high capability system. So, major research, new theories and application of this system have been done.

MIMO which also known as Multiple Input Multiple Output is a new and sophisticated system that are widely used in Wireless Sensor Network. In its family it has SISO (Single Input Single Output), SIMO (Single Input Multiple Output), MISO(Multiple Input Single Output).[8] The types of the network represent its physical form of port. So, the evolution starts from Single Output Single Input, SISO in 1948, evolutes to Multiple Input Multiple Output (MISO) and Single Output Multiple Input (SIMO) in 1996 and lastly Multiple Input Multiple Output (MIMO) in 2003. The evolutionary of the system is because of Fading; the main cause of degradation of signal and interference of other signal that travels thru multiple paths.[7]

Space Time Block Code is one of the techniques used in Multiple Input Multiple Output (MIMO) technologies. The other techniques are Spatial Multiplexing techniques and Beamforming techniques. Space Time Block Code (STBC) is a very simple yet very effective means of achieving transmit diversity when other form of diversity may be limited or non-existent.

1.2 Project Summary

Generally, this project focuses on the design and development of cooperative Space-Time Coding (STC) for wireless sensor network implementation in MATLAB environment. During implementation, the layers of the architecture must be understood and able to used the tools and features available in designing the system. The cooperative space-time coding will be designed and simulated by in MATLAB. The results will be analyzed and compared with existing technique of non-cooperative technique in terms of energy consumption and network delay. In order to analyzed and compared the technique, I need to make some research and study the existing theories and techniques available. Then, compared with other techniques existed.

1.3 Objective

In order to ensure the project goes smoothly, the objectives of the project that I have discovered are:

- To design and develop the cooperative space-time coding for wireless sensor network implementation in MATLAB environment. Monitor performance in terms of energy consumption and delay.

- To compare the performance of cooperative space-time coding with non-cooperative system in terms of energy consumption and delay.

1.4 Problem Statement

During performing the project, there are some problems that I have faced with. The followings are the problems that occurred and show up during performing the project:

- Implement To implementation of coding designed in MATLAB software to monitor the performance of the system in terms of energy consumption and delay.

- To determine the most efficient method in terms of energy consumption and delay between other methods (beamforming and spatial multiplexing)

1.5 Scope Of Project

The purpose of the project is related to the wireless sensor network and the communication system. In order to do the are several steps to be taken to accomplish the objective. The action starts from the research of the wireless system which also covers the MIMO system. Thus, concentrating the technique which proposed for this techniques; Space-Time Block Coding. The initial part that is taken is with the planning of the project and studying the related topics. Then followed by constructing the coding to implement in MATLAB software. Here, the system application, ability and performance are designed. The parameterscovered in the project are energy consumption and delay. Energy consumption and delay will be measured in terms of Signal to Noise Ratio (SNR) and decibel (dB). Then, it will be compared to other MIMO technologies such Beamforming and Spatial Multiplexer. As we all know, Space Time Block Code (STBC) is the very effective means of achieving diversity compared to other techniques. By debugging the coding using MATLAB software the data obtained are the analyzed. The form of data obtained is in the graphical form.

1.6 Report Structure

Generally, the report consists of 5 chapters which are;: Introduction, Literature Review, Methodology, Result and: Discussion and Conclusion. Each chapter will be explained briefly on the title that it represent.

The first chapter represented the Introduction part. So, it is related to the introductory of the titles that I have chosen, project background, the objective, problem statement and scope of work that I have planed and discovered.

The second chapter represented the literature review that involves in this project. So here, we will discuss on the information gathered from different types of sources. Then, it will be represented in the form that I have studied and simplified.

The third chapter which is methodology will cover on the theories and method related applied in the project. The software and tools related in order to obtain the result will be discussed briefly in this chapter.

The fourth chapter represents the result of the project. Here, the analysis of the result obtained will be discussed briefly. The graph of Signal to Noise Ratio (SNR) and Energy consumption will be discussed widely in this part.

The fifth chapter; discussion and conclusion will discuss on the result obtain. The reason of choosing each technique and method will be explained briefly in this part. Lastly, the conclusion will be made here to state the status of objective.

CHAPTER 2

LITERATURE REVIEW

In this chapter, it will discuss on the theories concept applied in order to complete the project. So, it will contain several theories that are related and used in order to have root understanding.

2.1 Wireless Sensor Network

As we all know wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors. The main purpose of sensors are to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants, at different locations.[1] The advantages by using the sensor nodes are that, it can be applied to the place that human can not reach e.g.: septic tank, tiny holes, human internal body parts and others. The development of wireless sensor networks was originally motivated by military applications such as battlefield surveillance. However, wireless sensor networks are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control.[3]

Physically, each sensor node is equipped with several components or parts that enable the nodes to perform the communication process. The basic elements that involve are; radio transceiver or other wireless communications device, a small microcontroller, and an energy source, which are usually a battery[4]. The envisaged size of a single sensor node can vary from shoebox-sized nodes down to devices the size of grain of dust, although functioning 'motes' of genuine microscopic dimensions have yet to be created.[1] The cost of sensor nodes is similarly variable, ranging from hundreds of ringgit to a few cents, depending on the size of the sensor network and the complexity required of individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth.[3]

2.1.1 Physical Architecture

As we all know, wireless sensor has its own architecture that enables it to perform the communication. It consists of several elements that permit communication between nodes and source. Basic communication consists of receiving and transmitting part. For wireless sensor network, it has its own antenna and radio transceiver acts as the receiving and transmitting part. [2] The power source is the most important part that enables the system to perform the operation. So, this part represented by battery. The „brain" of the sensor is controlled by microcontroller; applied the programmed application. Sensor Node is responsible to monitor record and perform the sensing process. Figure 1.0 illustrates the physical of the listed elements stated before. [5]

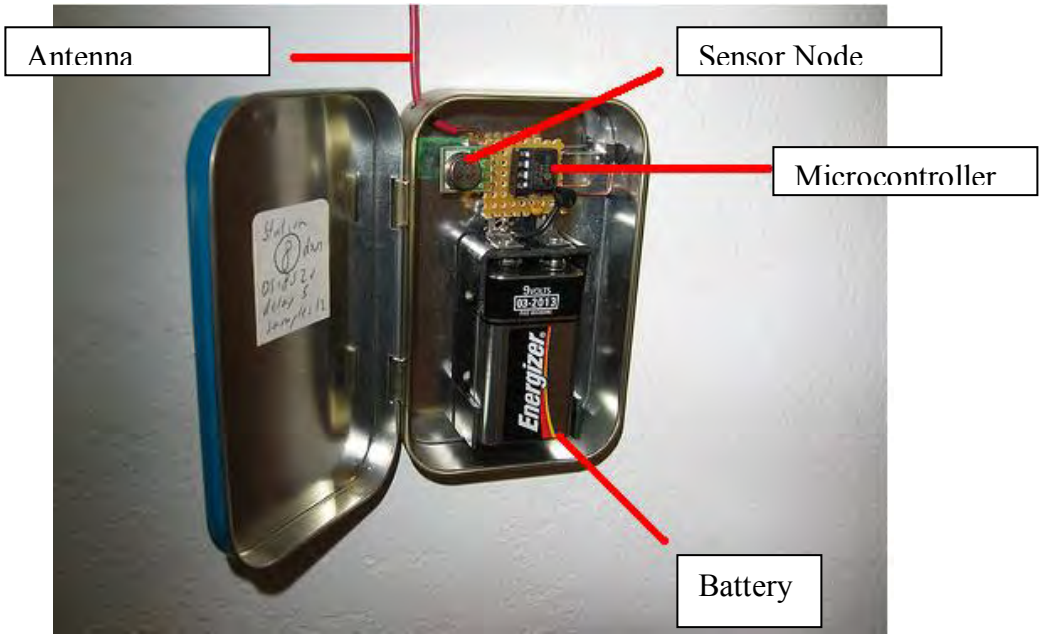

Figure 2.1: Wireless Sensor Nodes physical architecture