UNIVERSITI TEKNOLOGI MARA

REDUCING MULTIUSER INTERFERENCE IN THE DOWNLINK TRANSMISSION OF MIMO BROADCAST SYSTEM USING STBC-DPC TECHNIQUE

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ABSTRACT

Space Time Block Code (STBC) technique can provide more benefit for mobile users with computational efficiency over the fading channel environment. Due to multiple transmit antennas requirement for the STBC system, it is hard to realize on mobile devices. It is always deployed on base station, also called downlink system. Based on the STBC downlink system, many literatures have proposed a double STBC system to acquire diversity gain and spatial multiplexing gain, simultaneously. However, it needs more computational complexity to combat the spatial interference at receiver. It will induce a heavy computation load for mobile user. In order to overcome the interference problem and reduce the computational loading for mobile user, this research investigated the precoding technique at base station, which can pre-cancel the spatial interference at base station. It is well known that the dirty paper coding (DPC) uses precoding technique to eliminate multiuser interference on single user or multiusers interference. Moreover, due to the DPC with interference free and low complexity benefits, this research propose the joint processing for single STBC and DPC (STBC-DPC) precoding techniques to acquire the spatial diversity and multiplexing gains. To the best of our knowledge, there is no publication paper which proposed joint single STBC and DPC precoding techniques for MIMO downlink systems. In this research, the MIMO STBC with four transmitter antennas and four receiver antennas is studied. To reduce the computational complexity at receiver, the STBC-DPC precoding technique is proposed to achieve the low computational complexity benefit for mobile station. Besides, to improve the performance of the proposed STBC-DPC system, the ordering LQ decomposition of channel matrix is proposed for the sequential one dimensional symbol detection. Simulation results confirmed that the proposed single STBC-DPC can reduce the multiuser interference which decreases the probability of error and achieves excellent BER performance of 70% with low computational complexity compared to double STBC-DPC.

ACKNOWLEDGEMENT

In the name of ALLAH,

Most Compassionate,

the Merciful, Praise to ALLAH, Lord of the Universe.

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CHAPTER ONE
INTRODUCTION

This chapter discusses a brief introduction of the project, including problem statement, objectives, scope of work and the outline of the thesis. It also highlights the importance of the thesis, including its arrangement towards the conclusion of its outcome.

1.1   BACKGROUND

The demand for high speed mobile internet access and high quality streaming multimedia prompted the advancement in digital communications system with the subsequent introduction of 3G technology, from Enhanced Data GSM Environment (EDGE) to High Speed Packet Access (HSPA) which has increased the theoretical speed from 200 kbit/s to 14.4 Mbit/s and to the current 4G Long Term Evolution (LTE) and upcoming Advance Long Term Evolution (LTE-A) with a theoretical speed of 1 Gbit/s. This has created a demand in the industry for reliable and high speed data access that works within the limited and costly spectral bandwidth without requiring additional transmission overhead.

Multiple input multiple output (MIMO) communication techniques using multiple transmit and/or receive antennas has the potential for high capacity, increased diversity and interference suppression [1]. MIMO techniques has been well investigated for single user scenarios, however, for application such as wireless Local Area Network (LAN), Mobile WiMAX and LTE, MIMO systems will be used in an environment where a single base station must communicate with many users simultaneously, which results in the use of multiuser MIMO [2]. While multiuser MIMO provides high capacity to the system, the interference may degrade the performance [3]. MIMO systems have drawn a lot of attention in the past few years due to high throughput that can be achieved in wireless communication system.

Multiuser MIMO systems can be classified as multiuser MIMO multiple access channel (MAC) and multiuser MIMO broadcast channel (BC). In the case MAC of uplink communication, more than one user will transmit signals to a base station. From the mathematical model in Figure 2.13, it is proven that the interference