DIFFERENT MULTIPLE INPUT MULTIPLE OUTPUT SYSTEMS

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The undersigned hereby certify that they have read and recommend to the Faculty of Engineering and Science for acceptance a thesis entitled "**Different Multiple Input Multiple Output Systems**" by **Mohammed Alamgir** in partial fulfillment of the requirements for the degree of **Masters of Engineering in Electrical Engineering**.

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To my wife Geeti and our daughter Apona

Table of Contents

List of Tables

List of Figures

Abstract

The use of multiple antennas at the transmitter as well as at the receiver can greatly improve the capacity of a wireless link when operating in a rich scattering environment. In such an arrangement all transmitting antennas radiate in the same frequency band so the overall spectral efficiency becomes very high. Such a multiple antenna scheme, popularly known as Multiple Input Multiple Output (MIMO) has potential application in wireless local area networks (WLAN) and cellular micro-cells. One reason is that the WLANs and other short range wireless systems often operate in an indoor environment, which offers rich scattering. The other reason is the demand for higher data rates in cellular and WLAN systems to cater for multimedia services. Recently researchers have proposed different architectures for materializing the potential of the MIMO scheme. VBLAST (Vertical-Bell Labs Space Time) is a popular architecture that will play an important role in future standardizations. Furthermore, different decoding methods have been proposed for VBLAST. The SVD (Singular Value Decomposition) based system is envisioned as a highly effective MIMO technique in a TDD (Time Division Duplex) framework. Such a system operates by adapting the constellation size across different subchannels.

In this work we study the VBLAST and SVD architectures and compare the performance and computing power requirement of these architectures. Also in this study a new efficient decoding method for the VBLAST architecture is proposed. The original VBLAST decoding method relies on the repetitive computation of the pseudoinverse

of the channel matrix. Alternatively, there are methods based on the QR decomposition, the matrix square root etc. Our new decoding method is based on a relatively less known matrix decomposition, the Polar Decomposition. The new method requires less computation and has several other advantages like the possibility of incremental updates, channel rank tracking, etc. We consider three different types of channels: IID random, slow fading and measured channels. The entire work is simulated in the MATLAB environment.

The main contribution of this work includes: a comparative study and a head to head comparison of the VBLAST and SVD-based MIMO systems. The application of adaptive modulation in the SVD-based system and the introduction of a new efficient decoding method for the VBLAST system are also included. Simulation results are reported with comments and conclusions.

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