Multiple Input Multiple Output Channel Technology(MIMO)

PRIFYSGOL BANGOR UNIVERSITY
Presented by: Sadq Alqatan | Supervisor: Dr. Roger Giddings
School of Computer Science and Electrical Engineering

Introduction

- Multiple-Input, Multiple-Output is a wireless technology that enables multiple transmitters and receivers to send data simultaneously.
- MIMO Channel Technology being implemented in broadband wireless access systems, wireless local area networks (WLAN), 3G networks, 4G networks etc.
- MIMO uses multiple antennas to make use of parallel wireless links to provide gains in channel robustness(spatial diversity) and throughput(Spatial Multiplexing).
- This technology is seen as a blind source separation (BSS) technique are the most common and beneficial method in signal processing.

Objectives

- To study and understand the opiating principles of Multiple input multiple output(MIMO) transmission systems.
- To study the operation of MIMO transmission systems.
- To model a MMO system and demonstrate spatial multiplexing and spatial diversity.

MIMO Operating principal

- We implement MIMO system in MATLAB.
- We have designed the Simulink model on two signal at transmitter and two signal at receiver by using this equation.

$$Y = X\,W_c, (y_1, y_2) = (x_1, x_2) \times \begin{pmatrix} h_{1,1} & h_{1,2} \\ h_{2,1} & h_{2,2} \end{pmatrix}$$

- The training signals are used to estimate the channels stream.
- .Then take the inverse of matrix, so Values H-1 is computed.
- We successfully demonstrated multiplexing as the MIMO processing recovers each data stream.

Simulink model of MIMO system with Quadrature Amplitude Modulation (QAM)

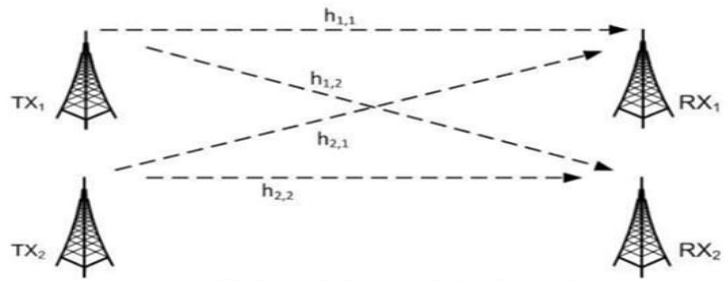


Figure 3 Channel characteristic of a 2 x 2 MIMO wireless communication system

Simulink model of MIMO system with Quadrature Amplitude Modulation (QAM)

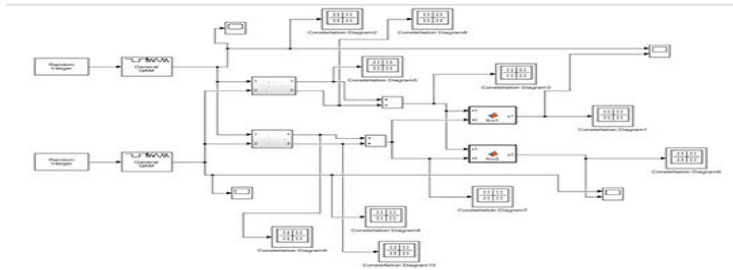
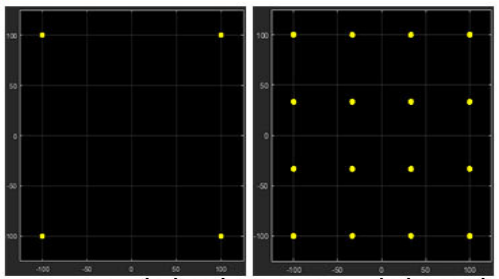


Figure 1: Simulink model of MIMO system with Quadrature Amplitude Modulation (QAM)

Result

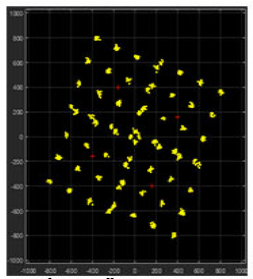
- In operation principle of MIMO system, the modulated signal at transmitter side is getting multiplied with the mixing matrix:
- The signal at the receiver side is a combination of transmitted signal.
- To get the original transmitted amplitude modulated signal by taking the inverse of mixing matrix is getting multiplied with the received signal.

constellation diagram at transmitter and receiver side

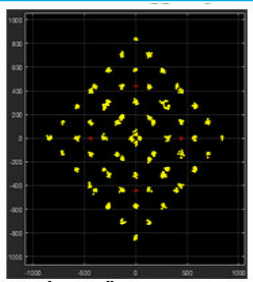


Transmit signal 1 (QAM)

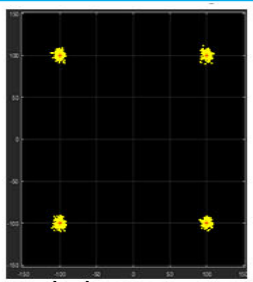
Transmit signal 2 (16 QAM)



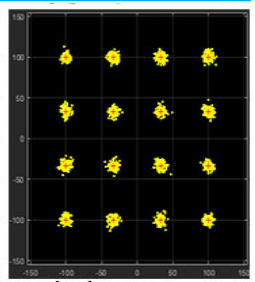
Signal constellation at receiver 1



Signal constellation at receiver 2



Signal 1 after MIMO Processing



Signal 2 after MIMO Processing

(Figure 2)

Conclusion & Future Work

- Developed an operational 2x2 MIMMO model in Simulink.
- Demonstrated robustness and throughput spatial Multiplexing.
- in future we demonstrate spatial diversity, where the same data is transmitted at both TX antennas to improve the total received signals SNR.