RV College of Engineering ®, Bengaluru-59

(Autonomous Institution Affiliated to VTU)

Department of Electronics and Communication Engineering

16EC73P Minor Project

Synopsis

Development of MCM-MIMO Processing for Urban Cellular Link

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Guide Details	
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1. Introduction

Single antenna systems were the most prominent communication technology used before the 4G revolution. However multipath propagation in single carrier systems leads to signal interference and information degradation. In order to overcome this shortcoming, MIMO was used in spatial diversity mode in 4G technology. Diversity is a concept in which the receiver receives multiple versions of the same signal so that even if one signal is corrupted, information is not lost.

Though spatial diversity results in improved SNR, it does not contribute towards increasing capacity. In order to increase the capacity, different spatial channels could be loaded with different symbols. This concept is called spatial multiplexing. To achieve this, we first modulate in multi carrier mode where bits are loaded in different frequency bands. We intend to simulate spatial multiplexing using MATLAB as part of this project.

2. Literature Survey

1. Data Transmission by Frequency - Division Multiplexing Using Discrete Fourier Transform - IEEE Transactions on Communications Technology, 1971
   Outcomes :
   i. Sampling MCM signals in the transmitter.
   ii. These sampled signals imply the IDFT of information symbols.
   iii. One simple IDFT block instead of N modulators

2. Generation of Pseudorandom Binary Sequences by Means of Linear Feedback Shift Resistors (LFSRs) With Dynamic Feedback – Elesevier Journals on Mathematical and Computer Modelling, 2011
   Outcomes :
   i. 2 LFSRs used of PRBS generation
   ii. M - length LFSR acts as address to N - length LFSR
   iii. Higher level of randomness when compared with 1 LFSR generator

3. Closed - Form CLRBs for CFOs and Phase Estimation from Turbo Coded Square QAM Modulated Transmissions – IEEE Transactions on Communications Technology, 2015
   Outcomes :
   i. Recursive construction of higher order QAM constellation
   ii. Start from 4QAM or 8QAM for even or odd number of bits respectively
   iii. Saves memory

4. Asymmetric digital subscriber line transceivers 2 (ADSL2) – Telecommunication Standardization of ITU, 2009
   Outcomes :

i. CREVERB1 for generation of PRBS
ii. Computationally less complex way to generate PRBS
iii. Recursive construction of QAM constellation as per ITU standards

5. Adaptive Loading in MIMO/OFDM Systems – Semantic Scholar, 2001
   Outcomes :
   i. Adaptive Loading
   ii. Energy Minimization problem
   iii. Based on Shannon Capacity Law

3. Motivation

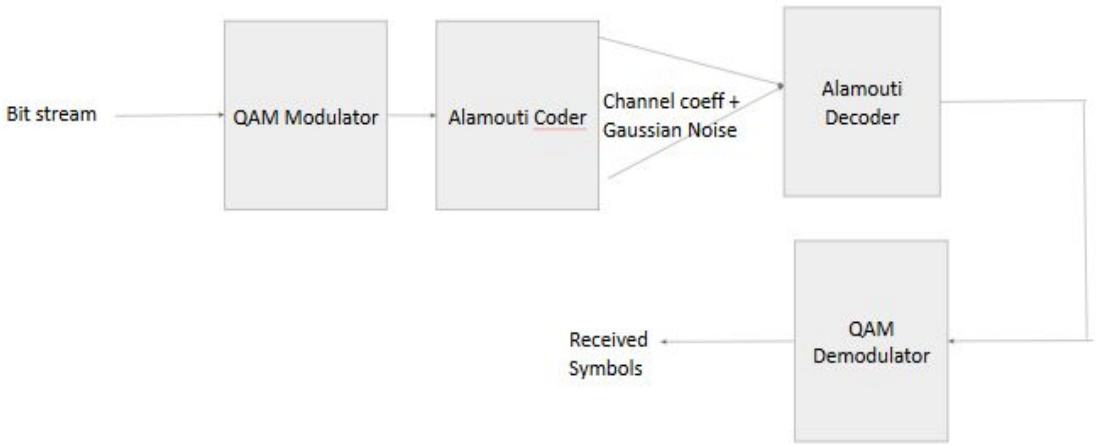
With the increase in the number of mobile users, the data requirements are shooting up exponentially. At present, MIMO is being used in spatial diversity mode which limits the capacity. Hence it is desirable to operate MIMO in multiplexing mode as well in order to maintain a given SNR

4. Objectives

1. Development of an effective channel model for 1 X 2 SIMO , 2 X 1 MISO and 2 X 2 MIMO links
2. Development of efficient transmitter and receiver supporting MCM-MIMO processing

5. Methodology

1. Develop Pseudo Random Binary Sequence Generator, and with Adaptive Bit Loading Algorithm perform tone loading on DMT system.
2. Develop a constellation mapper and QAM modulator to map the bits to QAM symbols.
3. Develop coding scheme for 2 X 1 MISO. Implement 1 X 2 SIMO and use the understanding of these to develop 2 X 2 MIMO
4. PRBS generator, adaptive bit loader, QAM encoder and Alamouti coder all form the transmitter end of the system.
5. Determine the channel coefficients by transmitting pilot signals
6. Construct an Alamouti decoder and QAM demodulator to form the receiver system to obtain the transmitted signal



6. Hardware / Software tools used

1. The system is simulated using MATLAB.
2. If possible, use NI setup for emulation

7. References

1. Faouzi Bellili , Achref Methenni and Sofiene Affes, " Closed - Form CLRBs for CFOs and Phase Estimation from Turbo Coded Square QAM Modulated Transmissions", IEEE Transactions on Communications Technology, vol. 14, no. 5, 2015
2. Theodore S. Rappaport , George R. McCartney, Mathew K. Samimi and Shu Sun , "Wideband Millimeter-Wave Propagation Measurements and Channel Models for Future Wireless Communication System Design", International Transaction on Communications, vol. 63, no. 9, 2015
3. S B Weinstein and Paul M Ebert, " Data Transmission by Frequency - Division Multiplexing Using Discrete Fourier Transform", IEEE Transactions on Communications Technology, vol. 19, no. 5, 1971
4. Prateek Bansal and Andrew Brzezinski, " Adaptive Loading in MIMO/OFDM Systems", Semantic Scholar, Corpus ID : 29212466, 2001
5. Peter S Chow, John M Cioffi and John A C Bingham , "A Practical Discrete Multitone Transceiver Loading Algorithm for Data Transmission over Spectrally Shaped Channels", IEEE Transactions on Communications, vol. 43, no. 2/3/4, 1975
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7. S M Alamouti , " A simple transmit diversity technique for wireless communications", IEEE Journal on Selected Areas in Communications, vol. 16, no. 8 , 1998