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Simulation of MIMO System with STBC in Simulink and MATLAB

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Анотація

В цій роботі, по-перше, порівнюється випадок одного користувача, при цьому включені кілька приймальних антен. По-друге, порівнюється випадок декількох користувачів, при цьому включені кілька приймальних антен. Результати моделювання після експериментальної перевірки добре узгоджуються.

Ключові слова: Технологія МІМО, просторово-часові блокові коди(ПЧБК), системи бездротового зв'язку, імітаційна модель, пакет Simulink.

Annotation

In this work, firstly, compares the case of single user while incorporating multiple receiving antennas. Secondly, compares the case of multiple users while incorporating multiple receiving antennas. The simulation results after experimental testing are in good agreement.

Keywords: MIMO technology, space-time block codes(STBC), wireless communication systems, simulation model, Simulink packet .

Introduction

Nowadays there is an increasing demand in high speed connections with a high operating quality. It is promoted by introduction of such new communication services as Voice over Internet Protocol (VoIP), videoconferences, Video on Demand (VoD) etc.

At the moment of their introduction there were no wireless techniques which could provide high quality connection standards. The existing wireless techniques cannot provide customers with the high standards of connection at the border of a service zone because the attainable transmission speed of data quickly diminishes with an increase in the distance between the customer and the base station.

It results in deterioration of the quality of connection leading to inability to get real time connections with high quality in the whole area of network. The effective way of solving this problem lies in a design of adaptive antenna arrays. The communication systems with such arrays are named Multiple Input Multiple Output (MIMO).[1]

The MIMO systems give a possibility to increase the data transmission capacity of a communication network by means of space diversion of channels and also to achieve a gain in power by means of space-time codes. The channel capacity is increased almost proportionally to the number of transmitting and receiving antennas of MIMO, but a large number of antennas leads to significant complication of space-time codes and enlargement of a receiving system.[2,3]
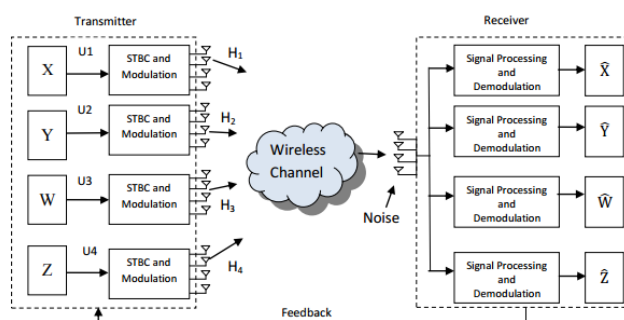

Figure 1 - STBC coded multiuser MIMO system

The results of research

Figure 2 illustrates the system block diagram. I took two examples, one with single user and other with multiuser (four users). Experiment 1: I considered single user with two transmitting antennas and observed results by increasing number of receiving antennas. We plotted these results for better understanding as shown in Figure 2. I used QPSK modulation and space-time block coding (STBC) for transmission and reception of symbol. To prepare Simulation model i took source as Binary Generator and signal was then modulated using QPSK modulator. Orthogonal spacetime block code (OSTBC) was used for transmission of signal. I used two antennas at transmitter and signals were passed through Rayleigh fading channel, AWGN was used to add white Gaussian noise to input signal. This signal was then received by OSTBC decoder and finally was demodulated the signal using QPSK demodulator to predict original signal. Comparing the output signal and input signal i plotted the graph of signal to noise ratio (SNR) versus Bit error rate (BER). I followed this method for one, two and four receive antennas and compared their results in a single graph. Experiment 2: As per system block diagram Figure 2 was modeled simulation setup for multiuser MIMO system. I took integer generator and modulated the signal by 4-QAM, using orthogonal space-time block coding (OSTBC) and four transmitting antennas for each user. Taking into consideration channel state information (CSI) i multiplied signal with precoder. Signal traversed channel and AWGN noise was added. OSTBC combiner was used to receive the signal and simple maximum likelihood (ML) decoding was used. I demodulated the signal and compared it with original transmitted signal. I followed this procedure for four; six and eight receive antennas and plot the results for Signal to Noise Ratio (SNR) versus bit error rate (BER).
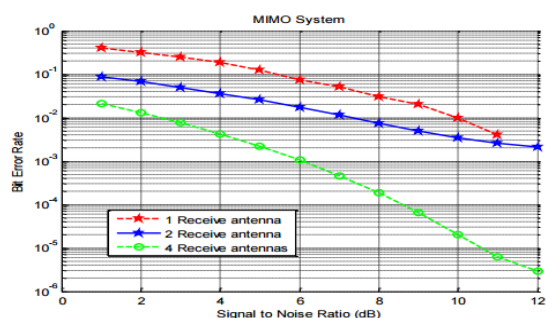
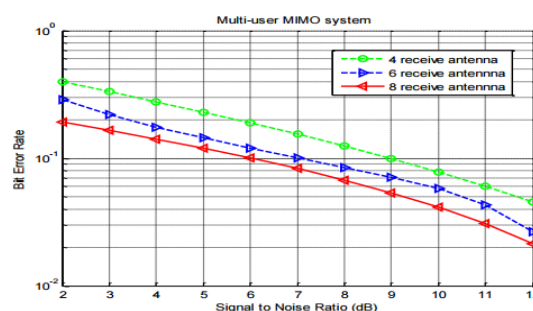Figure 2. Single user MIMO STBC system with two transmitting antennas and QPSK modulation

Figure 3. Four users MIMO with four transmitting antennas for each user and QAM modulation

Conclusions

The article showed how the space time block codes (STBC) using multiple receive antennas increases the diversity, which results in high (Signal to Noise Ratio) SNR. It is observed that by using multiple receive antennas SNR increases for both single and multiple users. Future scope of this idea includes examination of the results for more than 8 receive antennas for multiple users.

СПИСОК ВИКОРИСТАНОЇ ЛІТЕРАТУРИ / REFERENCES

1. N. Seifi, A. S. Tehrani, and M. Viberg, ""Simulation of a Wideband Reconfigurable Multi-Antenna System with Space-Time Coding"," in Nordic Matlab Users Conference, Stockholm, Sweden, Nov. 2008, submitted.

2. Bakulin M.G., Varukina L.A., Kreindelin V.B. Technology MIMO: principles and algorithms. Moscow: Publishing House "Hot line – Telecom", 2014. 244 p. (in Russia)

3. G. Foschini and M. Gans, ""On Limits of Wireless Communications in a Fading Environment when Using Multiple Antennas"," Wireless Personal Communications, vol. 6, pp. 311–335, March 1998.

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