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A Review on BER Performance Analysis and PAPR Mitigation in MIMO OFDM Systems

CH. Nagaraju[1], Dr.Anil Kumar Sharma [2], Dr.M.V.Subramanyam[3]

[1]*Research Scholar, Electronics & Communication Engineering, Sunrise University-Alwar, Rajasthan*

[2]*Professor & Principal, Institute of Engineering & Technology, Alwar, Rajasthan*

[3]*Professor & Principal, Santhiram Engineering College, Nandyal*

E-Mail (s): [1] ch_nag2000@yahoo.com , [2] aks_826@yahoo.co.in,

Abstract:
New Technologies and thereby new applications are emerging not just in wired environment but also in the wireless arena. The next generation mobile systems are expected to provide a substantially high data rate to meet the requirements of future high performance multimedia applications. The minimum target data rate for the 4G system is expected to be at 10-20 Mbps and at least 2 Mbps in the moving vehicles. To provide such a high data rate with high spectral efficiency, a new modulation scheme is to be used. A promising modulation technique that is increasingly being considered for adoption by 4G community is a multi-carrier system. Existing 3G systems uses single carrier modulation technique whereas a multicarrier system which is otherwise known as Multicarrier Modulation (MCM) / Discrete Multi-tone Technique (DMT) sends a high speed data stream by splitting it up to multiple lower speed stream and transmitting it over a lower bandwidth subcarriers in parallel. Multi-Carrier system is a multiple access scheme used in OFDM-based telecommunication systems, allowing the system to support multiple users at the same time. Generally in a multi carrier system utilizes each user symbol in the frequency domain. That is, each user symbol is carried over multiple parallel subcarriers, but it is phase shifted (typically 0 or 180 degrees) according to a carrier value. The values differ per subcarrier and per user. The receiver combines all subcarrier signals, by weighing these to compensate varying signal strengths and undo the code shift. The receiver can separate signals of different users, because these have different (e.g. orthogonal) code values. Since each data symbol occupies a much wider bandwidth (in hertz) than the data rate (in bit/s), a signal-to-noise-plus-interference ratio (if defined as signal power divided by total noise plus interference power in the entire transmission band) of less than 0 dB is feasible. High peak to average power ratio (PAPR) is the major drawback of multicarrier transmission. Various approaches were had been proposed previously to reduce this factor. Though the main problem associated with these conventional approaches is they concentrated on reducing the number of carriers to reduce this PAPR but it increased the total amount the power required to transmit the power and also increased the complexity as well as loss of bit error rate. In this paper literature survey is carried out for BER Performance Analysis and PAPR reduction techniques.

1. Introduction

Currently we are witnessing the deployment of third generation (3G) mobile communication systems which are expected to outperform second generation (2G) systems in terms of supported data rates. Despite the fact that the 3G systems can offer up to 2 Mb/s data rates, they may not be sufficient to meet the requirements for future high data rate applications. New multimedia applications such as video streaming and wireless teleconferencing require higher data rate communications. Recent advances in wireless communications have made use of orthogonal frequency division multiplexing (OFDM) techniques to allow for high data rate transmission in multipath fading channels. This growing interest was due to the realization that OFDM is an efficient scheme to convey information in a frequency selective fading channel without requiring complex time-domain equalization techniques, OFDM also uses the available bandwidth efficiently and allows for efficient digital signal processing (DSP) based transceiver implementations.

Orthogonal frequency-division multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme for wideband digital communication, used in applications such as digital television and audio broadcasting, DSL Internet access, wireless networks, power line, and 4G mobile communications. OFDM is a frequency-division multiplexing (FDM) scheme used as a digital multi-carrier modulation method. A large number of closely spaced orthogonal sub-carrier signals are used to carry data[1] on several parallel data streams or channels.

Corresponding author: CH. Nagaraju

Each sub-carrier is modulated with a conventional modulation scheme (such as quadrature amplitude modulation or phase-shift keying) at a low symbol rate, maintaining total data rates similar to conventional *single-carrier* modulation schemes in the same bandwidth.

Primary advantage of OFDM over single-carrier schemes is its ability to cope with severe channel conditions (for example, attenuation of high frequencies in a long copper wire, narrowband interference and frequency-selective fading due to multipath) without complex equalization filters. Channel equalization is simplified because OFDM may be viewed as using many slowly modulated narrowband signals rather than one rapidly modulated wideband signal. The low symbol rate makes the use of a guard interval between symbols affordable, making it possible to eliminate intersymbol interference (ISI) and utilize echoes and time-spreading (on analogue TV these are visible as ghosting and blurring, respectively) to achieve a diversity gain, i.e. a signal-to-noise ratio improvement. This mechanism also facilitates the design of single frequency networks (SFNs), where several adjacent transmitters send the same signal simultaneously at the same frequency, as the signals from multiple distant transmitters may be combined constructively, rather than interfering as would typically occur in a traditional single-carrier system.

2. Need and Importance of Research Problem

OFDM can be used in conjunction with a multiple-input multiple-output (MIMO) transceiver to increase the diversity gain and/or the system capacity because the OFDM system effectively provides numerous parallel narrowband channels. MIMO-OFDM arrangements have been suggested for frequency-selective fading channels. MIMO-OFDM is considered a key technology in emerging very-high-speed data-rate systems such as 4G, IEEE 802.11n, 802.16, 802.20 etc.

Despite rapid progress in MIMO-OFDM communication systems, lack of understanding and modeling of spatial aspects of wireless channels is a critical obstacle to the further development of this technology.

3. Objectives and Scope

The Objectives of this research work are given below in a simple and obvious way

By the end of the extensive literature study, it is observed that

1. A robust novel method to reduce PAPR in MIMO OFDM systems are not there in present literature.
2. An efficient method of channel estimation and data detection scheme for STBC-OFDM to combat the effects of interference is not there in present literature.

MIMO systems**,** exploit the spatial channel created by transmit and receive antenna arrays to increase quality, capacity, and coverage in wireless communication systems. By proposing new approach for the frequency-offset estimation and perform the bit error rate (BER) analysis as well as propose a novel technique to mitigate PAPR and an interference canceller to reduce the inter carrier interference there by increasing the performance of the multiple-input and multiple-output OFDM (MIMO-OFDM) system.

4. Methodology

The Methodology is given below as a step by step procedure to solve the further research in OFDM based systems as follows:.

1. A new PAPR reduction schemes for proposed MIMO OFDM system are to be developed.
2. Robust ICI AND ISI cancellation procedures in MIMO OFDM are to be developed.
3. New iterative channel estimation techniques and signal detection techniques for MIMO-OFDM systems are to be developed.

5. Conclusion

A literature review of BER Performance Analysis and PAPR reduction techniques for multiple-input and multiple-output OFDM (MIMO-OFDM) Systems is materialized and explained about proposed methodology and plan of action to obtain the objective of the research work. And also discussed to establish a robust model for achieving the reduced PAPR.

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