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RESEARCH ARTICLE

Inter Carrier Interference Cancellation Technique in OFDM System

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ABSTRACT

Modern high data rate wireless communication systems are increasingly using Orthogonal Frequency-Division Multiplexing (OFDM) as their preferred modulation technique. The European Digital Audio and Video Broadcast Radio System has implemented OFDM, and it is currently being researched for use in broadband wireless communication networks. Because there is less complicated equalization in the receiver design, OFDM systems have excellent spectral efficiency because their sub-carrier spectra overlap The primary idea of this work is that the influence of ICI on the distant sub-carriers is first cancelled using the symbol shift cancellation (SSC) method, and the impact of ICI on the adjacent sub-carriers interference is then cancelled using the adjacent sub-channel interference filter (ASIF) method. By processing in this way, the OFDM system's bandwidth efficiency is rarely lost and the impact of ICI is minimized. A pilot-symbol approach is presented to simplify the adjacent interference filter method and increases the accuracy of channel estimate by examining the distributions of the adjacent inter carrier interference. The results of the simulation demonstrate that the suggested method can successfully raise the OFDM system's BER (Bit Error Rate) performance. The proposed system will be implemented in MATLAB for its functional realization.

Keywords: OFDM, SSC, ASIF, Bit Error rate, ICI, Channel Estimation etc.

INTRODUCTION

There doesn't seem to be a pause in the fast rising demand for high data rate services. Virtually every physical medium that is currently in use or will be used in the future is able to facilitate the transmission of broadband data to our homes, offices, and educational institutions. This covers both wireless and wired media, such as DSL, cable modems, and power lines. These services frequently need extremely dependable data transfer over extremely severe conditions in order to be robust in handling these impairments in several contexts. Numerous degradations, including significant attenuation, noise, multipath, interference, time variation, and non-linearity, are experienced by the majority of these transmission systems. Additionally, they must adhere to numerous constraints, including finite transmit power and, crucially, finite cost. One physical-layer method that has been increasingly well-known lately is carrier modulation. In order to provide clients with a range of new high-quality services, modern transceivers need to meet a number of requirements, including high capacity and variable bit rate information transfer with high bandwidth efficiency. Traditional single carrier mobile communication systems do not function well in the wireless environment because signals are typically impeded by fading and the multipath delay spread phenomenon. Extreme signal amplitude fading and Inter Symbol Interference (ISI) at the receiver end result from the frequency selectivity of these channels. As a result, there is a greater chance of errors, and the system performs much worse overall. Methods like as adaptive equalization and channel coding have been applied extensively to address these issues. However, using these approaches in systems operating at large data rates, say multiple Mbps, is rather challenging because to the inherent latency in the coding and equalization process and the high cost of the hardware. Using a multi carrier system is another method. One example of it is called orthogonal frequency division multiplexing (OFDM), which finds use in a variety of applications, including asymmetric digital subscriber lines (ADSL), a method that enables high bit-rates across copper cables with twisted pairs. It is now in use for terrestrial digital video broadcasting (DVB-T) and was recently standardized and recommended for digital audio broadcasting (DAB) in Europe. OFDM is also the foundation of the IEEE 802.11a standard for wireless local area networks (WLAN).

This project aims to study the performance of OFDM in an Additive White Gaussian Noise (AWGN) channel exclusively. In this channel, noise and constant attenuation are the only factors taken into account, and there is only one path between the transmitter and the receiver. As a result, the multipath effect is ignored. This is a preliminary study meant to serve as a foundation for a deeper knowledge of OFDM in preparation for more in-depth research on the technology in multipath channels. Among the issues that arise when utilizing these strategies to operate with wireless networks are (1) multi-path fading (2) Inter-Symbol Interference caused by temporal dispersion (ISI) (3) Interference between carriers (ICI) (4) greater transmission power needed to achieve high bit rate; and (5) lower spectral efficiency. The poor spectrum usage of the FDMA technology is one of its drawbacks. One of the drawbacks of the TDMA technology is the Multipath Delay Spread issue. The transmitted signal travels via a number of separate, varying-length pathways to reach the receiver in a typical terrestrial broadcast. It becomes challenging to retrieve the original information since different versions of the signal interfere with one another. For the aforementioned issues, the orthogonal frequency division multiplexing (OFDM) approach offers a superior solution.

LITERATURE SURVEY

OFDM is a method that uses a lot of modulated sub-carriers to send data in parallel. These sub-carriers, often referred to as sub-channels, split the available bandwidth and have enough frequency separation (also known as frequency spacing) to be orthogonal. Each carrier has an integer number of cycles throughout a symbol period due to the carriers' orthogonality. As a result, every carrier in the system has a null in its spectrum at the center frequency of every other carrier. The carriers' spectra overlap, yet there is no interference between them as a consequence. CK. Wen et al. [1] proposed Gaussian Mixture Bayesian Learning, which indicates that the intra cell interference disappears as the BS antenna numbers rise. However, the other cells' intercellular interaction remains a consequence of system success, including the reasonable rates. Different intra-cell and inter-cell interference affect achievable pace

following the channel measurement error and pollution of the pilot. It reduces the cumulative numbers that can be obtained. The possibilities of cell-side UTs are more degraded by their higher cross-takes than others. A channel approximation based on compressed sensing methods was exercised into account where a marginal amount of random incoherent estimates reconstructed the sparse channel vector, unlike previous attempts, more recent results [2] generalize the signal's vector sparsity design principle to the low-rank matrix variable model. The mm Waves have substantially high, hundreds of GHz bandwidth and are thus an ideal candidate for potential cellular networks. The greatest challenge in the use of mm Waves is the high propagation attenuation leading to minimum SNR at the receiving terminals [3]. For enhanced efficiency, the BS integrates large numbers of highly directive antennas. Therefore, the transition to mm Wave needs entirely different equipment designs, architectures and signal processing. The miniature wavelength of the mmWaves enables a massive count of the antennas on the BS.
Du L et al. [4] developed a low complexity hybrid LMMSE precoding that maximizes the sum rate in a multiuser scenario. Hybrid LMMSE, based upon linear successive allocation, which is a linear form of successive encoding and successive allocation method (SESAM), designs analog precoder based on the normalized intermediate solution of LMMSE and the digital precoder to mitigate the interference. By analyzing the distributions of the adjacent inter carrier interference, a pilot-symbol scheme is proposed to improve the accuracy of channel estimation and simplify the adjacent interference filter method. Simulation results show that the technique proposed can effectively improve BER (Bit Error Rate) performance of the OFDM system.

PROPOSED SYSTEM

OFDM Transceiver Architecture

The SSC-ASIF ICI scheme was introduced by Li Zhao and Juan Li to combat the impact of ICI on OFDM systems, both the SSC method and the ASIF method are jointed in this ICI cancellation scheme. Its transceiver architecture is shown in Fig.1. The input serial data stream is converted into a parallel format after being formatted into the word size needed for transmission, such as 2 bits/word for QAM. Next, each data word is assigned to a single carrier in the transmission, allowing the data to be delivered in parallel. Using a serial-to-parallel port, the input data stream is divided into N parallel data streams. The duration of the data is elongated by N times. Serial-to-parallel conversion is depicted in Fig. 2.

FFT

Fast Fourier Transform (FFT) methods are used to apply the technology in a cost-effective manner by doing away with the arrays of sinusoidal generators and coherent demodulation needed in parallel data systems. Unlike a simple computation that requires N 2 multiplications, an N-point FFT only requires on the order of N log N multiplications. Because of this, compared to an analogous system with equalization, an OFDM system usually requires less computations per unit time. The time domain samples are transformed back into a frequency domain representation using the Fast Fourier Transform (FFT). The frequency components' magnitudes match the original data. In essence, the receiver operates on the transmitter in reverse. The original transmitted spectrum is then determined by taking the FFT of each symbol. After then, each transmission carrier's phase angle is calculated, and the received phase is demodulated to transform it back to a data word. After that, the data words are merged once more to have the same word size as the initial data.

RESULT ANALYSIS

Fig.4 shows the BER performance of the OFDM systems with the ICI cancellation schemes has been improved obviously. The BER performance curve of the regular scheme has floor effects, but that of the two improving schemes doesn’t exist in the observed range.

CONCLUSION

In comparison to a normal scheme and the SSC-ASIZ scheme, the SSC-ASIF cancellation scheme offers superior BER performance and can effectively lessen the sensitivity of the OFDM system to ICI caused by frequency offsets or spread. Its bandwidth efficiency has clearly improved as compared to the SSC-ASIZ method. In particular, the channel estimate scheme is straightforward and simple to use. The SSC-ASIF scheme is compatible with a conventional OFDM system and adds only a few circuits to it, without making the system overly complex.

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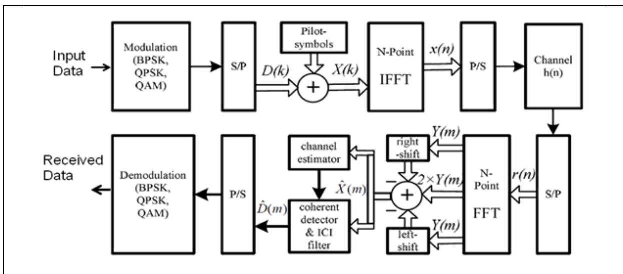


Fig.1. Transceiver Architecture with the SSC-ASIF scheme

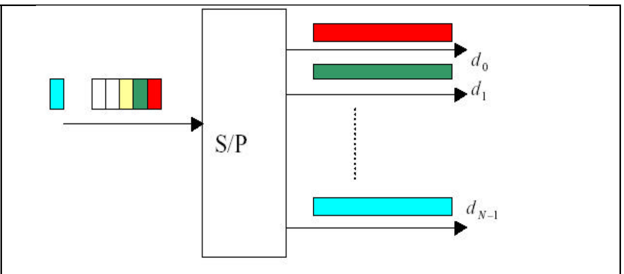
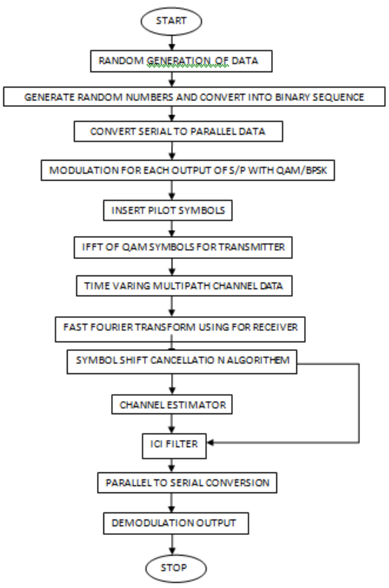


Fig 2. Serial to Parallel conversion



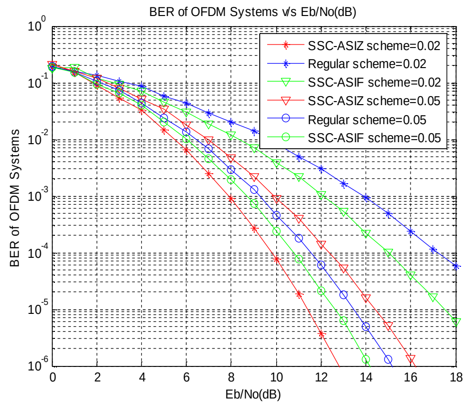


Fig 3: Flow Chart	Fig: 4. BER Performance of the OFD M Systems