

Image and Video Error Rate Analysis in Full Duplex Communication using Phase Offset

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Abstract

One of the most efficient way to utilize the bandwidth in wireless communication systems is Full- duplex communication. It is proposed for full duplex wireless communication over a single channel. The signals are transmitted and received at a same time and same frequency. It creates the large self-interference over the transmitted and received signals and lead to large loss of data. We used different values of phase offset to reduce the self-interference between the transmitted and received signals. The full duplex communication system is designed for input as image and by using wavelet transform. The performance of full-duplex communication system using various modulations like 16-QAM, QPSK and 64-QAM along with Haar, Daubechies2 and Daubechies 4 wavelets over different values of phase offset are evaluated by bit error rate.

Keywords: BER, Full-duplex Communication, OHWDM, QAM, QPSK, Wavelet Transform

1. Introduction

In Wireless communication systems efficient utilization of bandwidth is a major constrain. Because we have to use headers to acknowledge the source and destination device address in transmission and reception. Now-a-days, wireless communication systems engage either a time-division or frequency-division approach for full duplex transmission and reception of signals. It involves splitting up the temporal or spectral signals into orthogonal signals and leads to an orthogonalization of the two signals. Many present day wireless devices operate in half-duplex mode. Here transmission and reception of similar frequency signals is not possible. The main dispute in achieving full-duplex communication is to transmit and receive signal through air at the same time and frequency. There exists a large power loss in the system due to the self-interference in wireless transmissions between transmitted and the received signal.

Broadcasting huge amount data for making communication is applied by multicarrier inflection performance.

Forthcoming multimedia relevance accommodate increased data rate gives the next mobile innovation method. This was the prosody procedure adopted by 4G system. The data rate required for 4G arrangement is 10-20Mbps with transportation data rate is the least 2Mbps¹.

Wavelet transform is very much useful for examining the signals in time and as well as in frequency domain also. It is used because it owns better orthogonality. Wavelets are racy to inter carrier interference (ICI) than OFDM^{2,3}. DWT based OFDM systems have improved performance. It has scaling and wavelet functions, implies a LPF and HPF⁴. A wavelet is a little part of a continuous signal. A Wavelet Transform must orthonormal basis and the perfect reconstruction property. The wavelet Transform decomposes the signal into small wavelets by using the wavelet function and the basis function. The DWT has got both lpf and hpf and it acts as the Quadrature Mirror Filters (QMF). The lpf and hpf coefficients are called as approximated and detailed coefficients⁵. To use of available bandwidth in effective manner wavelet based OFDM⁶ is chosen in this work

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The wireless communication for future development mainly target on the changable and suitable for the spectrum. The wavelet suits for scacity in wireless full duplex communication⁷. By achieving full duplex in single channel we can utilize the bandwidth in very efficient way than half duplex communication.

2. Full Duplex Communication Model Design

The full duplex communication system for input as an image with self-interference cancellation block and OWDM instead for usual OFDM is proposed in Figure 1,

The above block diagram shows full-duplex communication transmitter and receiver are located in either sides of the system. The input image is converted into binary stream by the block shown above. The different modulation schemes like QPSK, 16-QAM, 64-QAM done by modulator block used to modulate the binary stream⁸. The modulated stream is converted into frames and appropriate Wavelet transforms are done before transmitting in channel. We consider wavelet transforms as Haar, Daubechies 2 and 4 for performance analysis. Self-interference cancellation block is used to reduce the self interference between the transmitter and receiver signal by various values of phase offset.

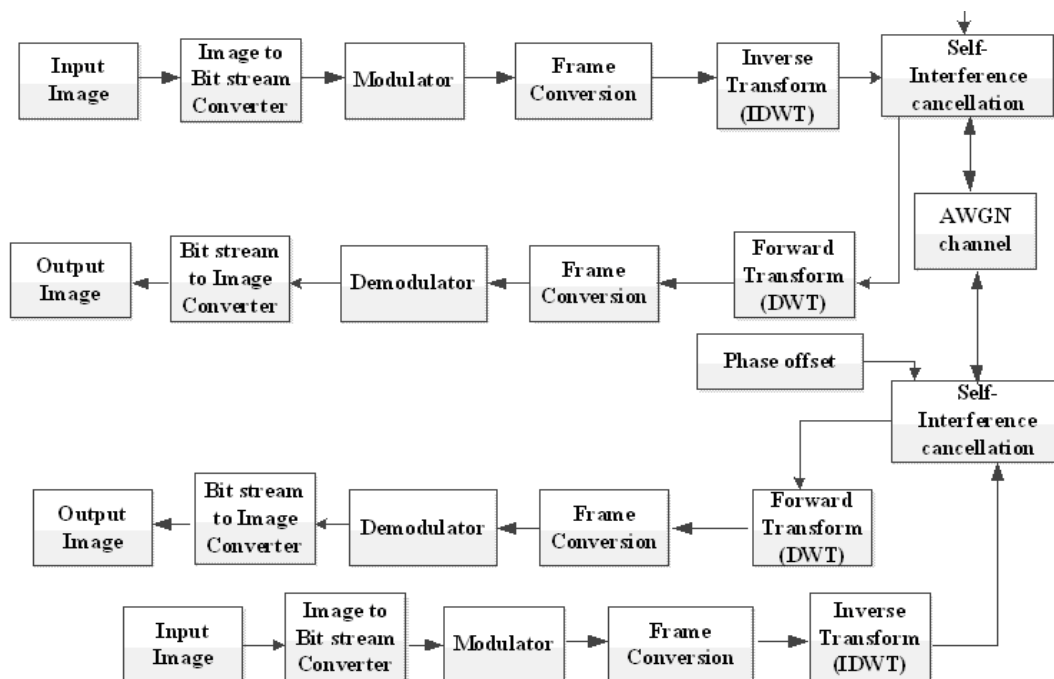


Figure 1. Block diagram of Full Duplex system in single channel.

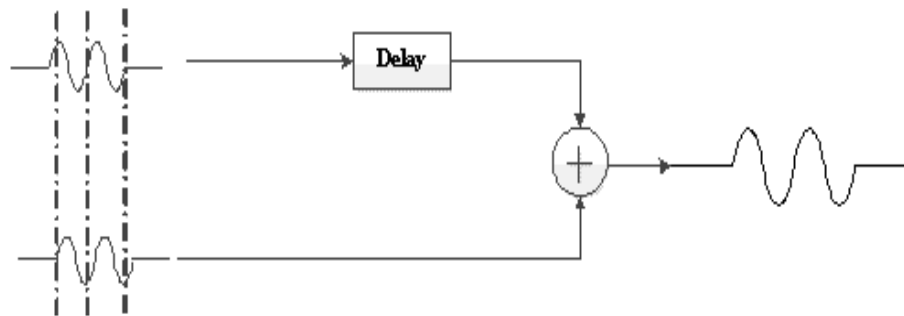


Figure 2. Cancellation using Phase offset.

2.1 Cancellation of Self-interference

In full duplex communication system signal must be transmit and received simultaneously. The big problem is transmitted and received creates self-interference. The value is $\sim 70\text{dB}$ for wireless communication systems⁹. Cancelling of self-interference is very tough because it is stronger than received signal. We proposed the phase offset method is shown below. The Phase offset values are changed for different modulation schemes with different type of wavelets and the efficient value of phase offset was found. Other techniques are analog cancellation and digital cancellation has details of transmission signal to remove the self-interference. Cancellation by phase offset is shown in Figure 2.

3. Experimental Results

The full duplex communication system with various phase offset values are implemented in MATLAB using DWT and IDWT blocks for three wavelet transforms as Daubechies 2, Haar and Daubechies 4 transforms. By using modulation schemes like 16-QAM (Quadrature amplitude modulation), Quadrature Phase Shift Keying (QPSK) and 64-QAM the BER performance of this system is analyzed. The above modulation schemes like QPSK and QAM are used to modulate the input signal before wavelet transform applied in transmitted signal.

3.1. Numerical Outputs

The BER values of different modulations of various phase offset values are mentioned along with three wavelets in full duplex communication are tabulated below in Table 1.

3.2 Simulation Outputs

Simulation inputs and outputs of the best performance in the above three comparison of phase offset values in full

duplex communication transmitter and receiver blocks implementing in QPSK, 16-QAM and 64-QAM modulations for three wavelet transforms is shown below,

3.2.1 Inputs

Image is taken as an input and converted into bitstream on both transmitters. Figures 3 and 4 show the modulated bitstream using the modulation techniques 16-QAM and QPSK. After modulation of the bitstream wavelet operation is done by using Inverse wavelet transform and the signal is transmitted through channel.

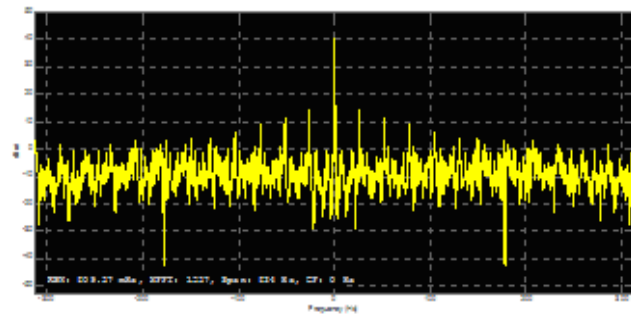


Figure 3. Input of 16-QAM.

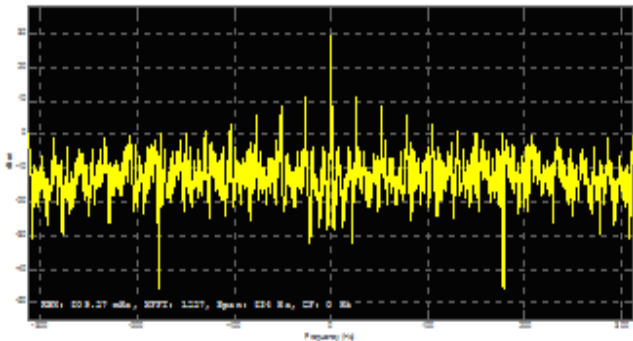


Figure 4. Input of QPSK.

Table 1. BER values for Various Phase offset values

Modulation Schemes	BER for Phase offset value 1			BER for Phase offset value 2			BER for Phase offset value 3		
Type of Wavelets	Haar	Db2	Db4	Haar	Db2	Db4	Haar	Db2	Db4
QPSK	0.9089	0.9999	0.8174	0.0881	0.3527	0.3529	0.9000	0.9910	0.8088
& 16-QAM	0.5910	0.7735	0.8734	0.9383	0.9471	0.9647	0.6912	0.8734	0.8912
QPSK	0.9088	0.9998	0.8176	0.0882	0.2705	0.3530	0.9002	0.9912	0.8087
& 64-QAM	0.5912	0.7736	0.8736	0.9384	0.9473	0.9736	0.6914	0.8736	0.8910

3.2.2 Outputs

At the receiver sides the received signal went under discrete wavelet transform and then demodulated by respected 16-QAM or QPSK methods. Figures 5 and 6 show the recovered signal after wavelet transform and demodulation. The Bit error rate between transmitted and received signal is taken and shown in the Table 1.

4. Conclusion

The full-duplex communication using orthogonal Haar wavelet division multiplexing (OHWDM) system with phase offset value 2 for image as input gives the low bit error rate value than other systems, when it uses either QPSK and 16-QAM or QPSK and 64-QAM modulation schemes. It is proposed to evolve the performance parameters for various values of phase offset in full duplex communication for various modulation schemes. Now-a-days the full duplex technology is started to implemented practically. This proposed system had the potentiality of managing high data under versatile constraints like bandwidth and power consumption with minimal bit error rate.

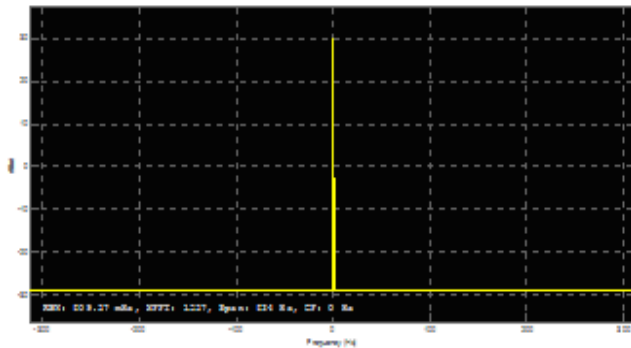


Figure 5. Output of QPSK.

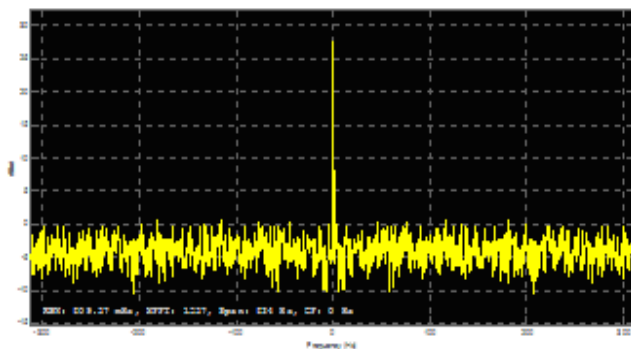


Figure 6. Output of 16-QAM.

5. References

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