ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 07, pp.34955-34958, July, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

REDUCTION OF ICI IN MIMO OFDM BY SELF-CANCELLATION TECHNIQUE WITH FFT

*,[1]Monika Tiwari and [2]Ankiet Saxena

[1]EC, MTech Scholar, Mandsaur Institute of Technology, Mandsaur, India
[2]EC, Asst Professor, Mandsaur Institute of Technology, Mandsaur, India

ARTICLE INFO

Article History:
Received 10th May, 2016
Received in revised form
28th June, 2016
Accepted 27th July, 2016
Published online 31st July, 2016

Key words:
OFDM, Implementation of OFDM, Cognitive radio.

ABSTRACT

Increasing speeds and complexity of wireless communication systems have necessitated the progress and advancement of high performance signal processing components. Today's developing technologies involve fast processing and efficient use of properties. These properties include memory, power, and chip area. UWB delivers much potential for design of high speed wireless communication system. MB-OFDM (UWB) offers high data rates access for wireless communications. OFDM system is use for high speed applications. Ongoing research seeks to optimize resource usage as well as act. Design develops a balance and trade off flexibility, performance, difficulty, and budget. In this paper, it specifically address the power-efficient design of an FFT processor as it relates to emerging OFDM communications. OFDM is one of the efficient solutions for implementing high speed data transmission for wireless communications.

Citation: Monika Tiwari and Ankiet Saxena, 2016. "Reduction of ICI in MIMO OFDM by self-cancellation technique with FFT, *International Journal of Current Research*, 8, (07), 34955-34958.

INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) is a multi-carrier modulation technique which divides the available spectrum into numerous carriers. OFDM consumes the spectrum well compared to FDMA by spacing the channels much closer together and making all carriers orthogonal to one another to prevent interference between the closely spaced carriers. The main advantage of OFDM is the ability to enhance the basic signals that overcome channel impairments. Multi-Band Orthogonal Frequency Division Multiplexing (MB-OFDM) transmitter too provide high speed for application than OFDM. Multi- Band Orthogonal Frequency Division Multiplexing (MB- OFDM) is a suitable solution to implementation of high speed data transmission in ultra wideband spectrum by dividing the spectrum available into multiple bands. In OFDM, the frequency band containing the message is divided up into parallel bit streams of lower-frequency carriers, or sub-carriers. OFDM is a multicarrier modulation method, which offers higher bandwidth efficiency as the carriers are orthogonal to each other and multiple carriers share the data between themselves. The key advantage of such transmission technique is their robustness to channel fading in wireless communication situation. Orthogonal frequency-division multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies. OFDM over has ability to cope with severe channel conditions. OFDM has high spectral efficiency as compared to other double sideband modulation schemes, spread spectrum, etc. It can easily adapt to severe channel conditions without complex time-domain equalization. It is strong against narrow-band co-channel interference. Also robust against inter symbol interference (ISI) and fading caused by multipath propagation. It can be efficiently implemented using Fast Fourier Transform (FFT). OFDM has several advantages compared to other type of modulation technique implemented in wireless system. OFDM combats the effect of frequency selective fading and burst error. It overcomes the effect of ISI (intersymbol interference), bandwidth efficiency etc.

Corresponding author: Monika Tiwari,
EC, MTech Scholar, Mandsaur Institute of Technology, Mandsaur, India.

Implementation of OFDM

The ASIC Implementation of OFDM transmitter and receiver is based on WLAN for better optimized power and scheduling. RTL synthesis of trans-receiver block without (Viterbi) decoder is used in the receiver. The Punctured Convolution Coding (PCC) is used to improve the data rate and bandwidth is improved with Quadrature Amplitude Modulation techniques (QAM). OFDM is implemented using IFFT/FFT controller. Separate clock are used for modulator/demodulator in transmitter/receiver section respectively to improve the data rate. Multi-VTH principles and Clock gating are applied to reduce power consumption. Novel circuit design strategies have been employed for realization of optimal hardware and power efficient architecture. This enabled the high-speed transmission system. Implementing low power methods, the hardware components can be compact and it leads to less power consumption (Mamidi. Nagaraju and Madala. Rakesh, 2012). A study done on Multi-band-Orthogonal Frequency Division Multiplexing (MB-OFDM) Ultra-Wideband (UWB) signal transmission through a single-mode fiber which is based on intensity modulated laser via Radio over Fiber (RoF) system (Yee *et al*., 2007). Packet Error Rate (PER) measurement is done to analyze and evaluate the system performance based on different optical fiber sizes, information rates, and transmitting UWB power levels. UWB signals send over RoF show very encouraging results over long distances even in the demanding ultra-wideband environment. PER degrades when data rate is increased, UWB power levels decreases or the fiber length is longer. Comparison between PER degradation in longer fiber case and lower UWB power gives a 2:1 relationship between the RF loss and optical loss (Yee *et al*., 2007). Multi-Band Orthogonal Frequency Division Multiplexing (MB-OFDM) is a solution for implementation of high speed data transmission in ultra wideband spectrum by dividing the available spectrum into number of bands. The assembly of MB-OFDM scheme transmitter is introduced (Xu Jinsong *et al*., 2008) and the design of transmitter baseband centred on FPGA. This baseband of transmitter is one of the most important parts in OFDM system. The results of all modules designed shows that it has achieved the expected purpose both in precision and source, with simple and highly efficient. It can meet the demand of MB-OFDM systems. The results indicate that the timing of each module is true for meeting demands of requirement. Baseband of transmitter provides the basis for the design of MB-OFDM system (Xu Jinsong *et al*., 2008). The figure below shows the set of orthogonal signals.

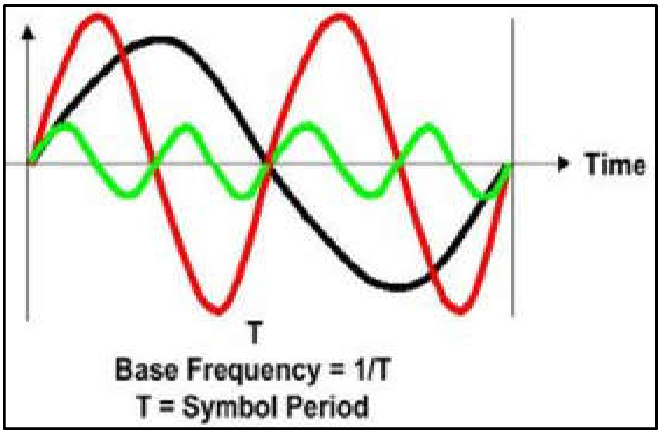
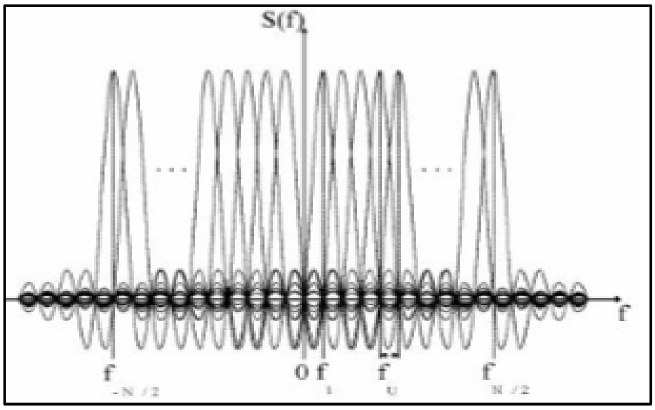


Fig.1. A set of orthogonal signals

OFDM carrier

OFDM is a special form of Multi Carrier Modulation (MCM) and the OFDM time domain waveforms are chosen such that mutual orthogonality is ensured even though subcarrier spectra may overlap. In general, with respect to OFDM, it can be definite that orthogonality is an implication of a definite and fixed relationship between all carriers in the group. Which means that individual carrier is positioned such that it occurs at the zero energy frequency point of all other carriers. The sinc function exhibits this property and it is used as a carrier in an OFDM system.



f_u is the sub-carrier spacing

Fig.2. OFDM sub carriers in the frequency domain

FFT controller is one of the important parts of receiver in OFDM system for demodulation of signals. The design, implementation and synthesis of a FFT module that has been used in the OFDM based multiband UWB system to get the best results, although the work is applicable to many other OFDM based receiver systems. The requirements for FFT module within OFDM system coupled with modern digital architecture principles and low power design criteria to converge on optimized solution. The FFT design is applicable for implementation of IFFT module for design of transmitter with the inverse of FFT (Simon Sherratt *et al*., 2005). The multiband OFDM UWB shows to be a particular potential to consumer electronics as it offers a Wireless Personal Area Network (WPAN) connection for an uncompressed video at a low cost. A cost-effective and low power efficient multiband UWB receiver can be made viable (Simon Sherratt *et al*., 2005). Orthogonal frequency-division multiplexing (OFDM), coded OFDM (COFDM), and discrete multi-tone (DMT) forms of modulation are broadly scattering finding their way into wireless and wired communications in various appliances including digital television, high-speed wired data connections, and wireless local area networks. Increasing the level of assimilation by modern complementary metal oxide semiconductor (CMOS) processes and the associated computer-aided design tools communications in wired and wireless is made possible. The VLSI inferences of coded OFDM modems designed for various applications ranging from terrestrial digital broadcasting, to high-speed wired ADSL modems, to high-speed wireless LANs (Neil Weste and David J. Skellern, 1998). For long length FFTs operating at high data rates, the FFT section have need of large part of chip which increases the area and hardware circuitry, but new processes and possibly new FFT designs will require less area on chip the FFT. In the case of short-length FFTs as used in WLANs, the complete modem areas are already quite small and are approaching the size where they can fit on the corner of a chip. High-speed OFDM modems provide productive floor for the communication systems architecture and VLSI system designer to thoroughly cooperate, mainly to reduce the power to extremely low levels consistent with long mobile battery use

(Neil Weste and David J. Skellern, 1998). MB-OFDM (Multi Band Orthogonal Frequency Division Multiplexing) UWB devices suffer from frequency dependent non-idealities due to extreme wideband operation. An efficient methodology for BIST (Built in self-test) helped in testing, approximation and compensation of wideband (UWB) devices has been proposed (Shyam Kumar Devarakond *et al*., 2009). The method uses an envelope detector at the output of the UWB transmitter to track the performance at each of its preferred operating frequencies and carry out compensation. Multi-way and unified are the two approaches have been developed for compensation and tradeoffs. End to end linearity development proves the effectiveness of the technique across wide operating frequency under minor as well as process skewed occurrences (Shyam Kumar Devarakond *et al*., 2009).

FFT processor relates to emerging OFDM communications

Cognitive radio is a method of wireless communication by way of dynamically adapting the transmission of multiple subcarriers to changing conditions in the communication channels. These subcarriers are enabled by a modulation scheme known as orthogonal frequency division multiplexing (OFDM). OFDM converts a high data rate signal into multiple lower data rate signals for simultaneous transmission through numerous channels. The Fast Fourier Transform (FFT) processor is the heart of OFDM that enables its fast and efficient modulation of signals.

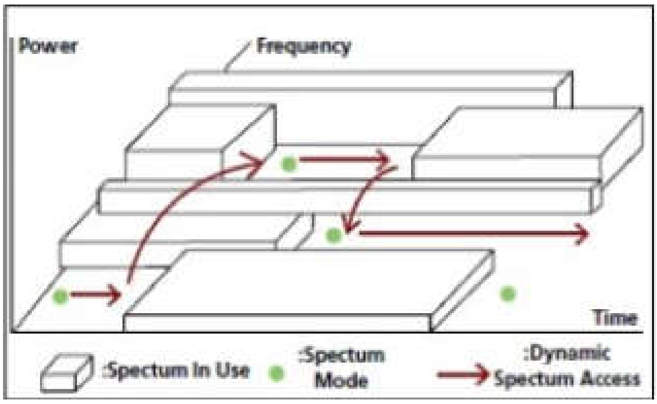


Fig. 3. Cognitive radio

The FFT algorithm is a fast computation of the Discrete Fourier Transform (DFT) which is an essential component of the modulation scheme used in OFDM. As the FFT processor is the most computationally intensive component in OFDM communication, an improvement in the power efficiency of this component can have great impacts on the complete system. These influences are significant since the number of mobile and remote communication devices that rely on limited battery-powered operation. This project will serve as an exploration of current FFT processor algorithms and architectures as well as optimization techniques that aim to reduce the power consumption of these devices. Ultra-Wideband (UWB) Technology brings the convenience and mobility of wireless communications to high-speed interconnects in devices throughout the digital home and office (Meer Nazmus Sakib *et al*., 2009). Instead of wired connection, this technology enables wireless connection for transmitting audio, video, and further data with high data speed and consume less power. In February 16 2002, the Federal Communications Commission (FCC) in USA issued the ruling that Ultra-Wideband (UWB) could be used as data communication. Later, UWB has turn out to be a hot research topic and plenty of research results have been issued. Multiband-OFDM is one solution for UWB technologies. A scheme for Multi-band OFDM UWB standard is published by IEEE 802.15 3a study group (Weste and Eshraghian, 1994). After IEEE 802.15 3a was reserved in the Spring of 2006, Multiband OFDM has been organized by ECMA International. In December 12 2007, the next reviewed version Standard ECMA-368: High Rate Ultra Wideband PHY and MAC Standard' was released, which specified physical layer (PHY) and medium access control layer (MAC) of the UWB technology based on Multiband-OFDM (Neil Weste and David J. Skellern, 1998). However, some key issues need to be solved for designing CMOS based Multiband- OFDM UWB solution in support of the low power requirement. One of the issues focuses on its FFT (Fast Fourier Transform) block, which takes 25% design complexity of the total digital baseband transceiver (Sinha *et al*., 2000). Although many results have already been published in this research area in the past few years (Simon Sherratt *et al*., 2005), some key problems still exist and need to be improved for the speed, area and power consumption. According to ECMA-368, for the necessity of Multiband-OFDM system, this FFT processor should work on few no. of hundred MHz, which marks it challenging to implement. Besides this system targets for the wireless manageable devices, small area and consume less power are also imperative. Therefore, this paper focuses on the area and power consumption improvement under the ECMA-368 standard requirements. This paper aims at designing ASIC (Application Specific Integrated Circuit) FFT processor for Multiband-OFDM UWB system. In order to attain this goal, numerous steps required to be follow. The initial step is to find specifications for FFT processor, which is determined by the Multiband OFDM UWB standard. The step requires the analysis on OFDM and UWB technology and the constraints of its FFT processor. After defining the specifications, enhanced FFT algorithm and design should be used for these specifications. There are huge number of FFT algorithms and architectures in the signal processing literature (Cosmin Cirstea, 2011). Therefore, the state of art algorithms and architectures should be analyzed and relate. Based on diverse algorithms and architectures, different power consumption, speed and area of the processor will be achieved. So their ASIC suitability should be analysed and the effort should be focused on the choosing algorithms and architectures and optimization. Moreover, the enhanced space should be analysed and the architecture should be more optimized. The suggested algorithm and design should be validated by Matlab simulation before execution. After this circuit requires to be realized with VHDL. The synthesis step is followed by using both simplify Pro targeted for FPGA and Design Compiler for ASIC.

RESULT AND CONCLUSION

Orthogonal frequency division multiplexing (OFDM) is a method of programming digital data on multiple carrier frequencies. Multiband Orthogonal Frequency Division

Multiplexing (MB-OFDM) is a suitable solution for implementation of high speed data transmission in ultra wide band spectrum by dividing it into various bands. MB or MIMO OFDM has been chosen for several current and future communications systems all over the world Mobile Wireless Communication, Terrestrial Digital Video Broadcasting, Digital Broadcasting etc.

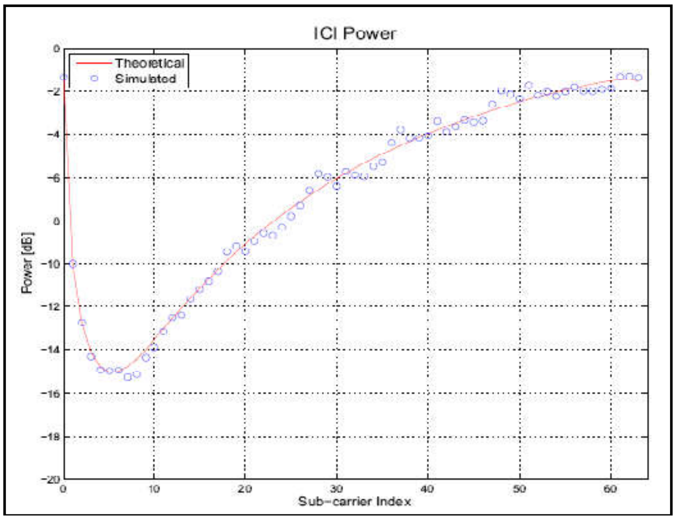


Figure 4. Inter Carrier Interference power at Receiver

Figure4 showing the power of ICI at the receiver for ICI self cancellation technique in MIMO OFDM with FFT. This graph display that the simulated ICI power is approximate equal to theoretical power. Here this power is in negative form showing that the probability of occurring intercarrier interference is totally negligible. MIMO OFDM has also been accepted into several European wireless communications appliances such as the digital audio broadcast (DAB) and terrestrial digital video broadcast (DVB-T) systems.

REFERENCES

Chao, C., Z. Q., X. Yingke, H. Chengde, 2005. "Design of a high performance fft processor based on FPGA," in ASP-DAC proceedings, pp. 920-923.

Chidambaram, R. 2005. "A scalable and high-performance FFT processor, optimized for UWB-OFDM," M.S. thesis, Delft University of Technology, Delft, Netherlands.

Cosmin Cirstea 2011. "Energy Efficient Routing Protocols for Wireless Sensor Networks: A Survey" 2011 IEEE 17th International Symposium for Design and Technology in Electronic Packaging (SIITME) Oct.

Gutnik V. and A. P. Chandrakasan, 1997. "Embedded power supply for lowpower DSP," IEEE Trans. Very Large Scale Integration (VLSI) Syst., vol. 5, pp. 425– 435, Dec.

Haene, S., A. Burg, P. Luethi, N. Felber and W. Fichtner, "FFT Processor for OFDM Channel Estimation," Institute of Electrical and Electronics Engineers, 2007. (Online). Available: http://ieeexplore.ieee.org (Accessed: Jun. 23, 2008).

Johnson S. G. and M. Frigo, "A modified split-radix FFT with fewer arithmetic operations," IEEE Transactions on Signal Processing, vol. 55, no. 1,pp. 111-119, Jan. 2007.

Mamidi. Nagaraju and Madala. Rakesh "High-Speed and Low-Power ASIC Implementation of OFDM Transceiver Based on WLAN (IEEE 802.11a)" published in devices, circuits and systems (ICDCS) 2012 international conference, pp 436-439.

McMillan L. and L. A.Westover, "A forward-mapping realization of the inverse discrete cosine transform," in Proc. Data Compression Conf., Snowbird, UT, Mar. 1992, pp. 219–228.

Meer Nazmus Sakib, Bouchaib Hraimel, Xiupu Zhang Mohmoud Mohamed, Wei Jiang,Ke Wu and Dongya Shen "Impact of Optical Transmission on Multiband OFDM Ultra-Wideband Wireless System With Fiber Distribution" JOURNAL OF LIGHTWAVE TECHNOLOGY, VOL. 27, NO. 18, SEPTEMBER 15, 2009, pp 4112-4123

Nawab, S. H. *et al*., "Approximate signal processing," J. VLSI Signal Processing Syst. Signal, Image, and Video Technol., vol. 15, no. 1/2, pp. 177–200, Jan. 1997.

Neil Weste and David J. Skellern "VLSl for OFDM" Macquarie University and Radiata Communications IEEE Communication Magazine,October 1998 pp 127-130.

Shyam Kumar Devarakond, Shreyas Sen and Abhijit Chatterjee "BIST Assisted Wideband Digital Compensation for MB-UWB Transmitters" IEEE2009

Simon Sherratt R., Oswaldo Cadenas, Nomita Goswami and Sou Makino "An Efficient Low Power FFT Implementation for Multiband Full- Rate Ultra-Wideband (UWB) Receivers IEEE2005, pp 209-214.

Sinha A., A.Wang, and A. P. Chandrakasan, "Algorithmic transforms for efficient energy scalable computation," in Proc. Int. Symp. Low- Power Electronics and Design, Italy, Aug. 2000, pp. 31–36.

Varghese R. R. and C. G. Tharayil, "Design, Simulation and Synthesis of an FFT Processor Using VHDL," M.S. thesis, Mahatma Gandhi University, Kottayam, Kerala, 2001.

Weste N. and K. Eshraghian, Principles of CMOS VLSI Design: A System Perspective. Reading, MA: Addison-Wesley, 1994.

Xin, S., Z. Tiejun, H. Chaohuan, "A high-performance power-efficient structure of FFT (fast fourier transform) processor," in ICSP proceedings, 2004, pp. 555-558.

Xu Jinsong Lu Xiaochun Wu Haitao , Bian Yujing, Zou Decai, Zou Xiaolong, Wang Chaogang. "Implementation of MB-OFDM Transmitter Baseband Based on FPGA", published incircuitandsystemfor communications IEEE2008,pp50-54.

Yee M.L., V.H. Pham, Y.X Guo, L.C. Ong, B. Luo. "Performance Evaluation of MB-OFDM Ultra-Wideband Signals over Single mode Fiber"IEEE 2007, pp 674-677

Zhao, Y., A. T. Erdogan, and T. Arslan, "A novel low-power reconfigurable FFT processor," Institute of Electrical and Electronics Engineers, 2005. (Online). Available: http://ieeexplore.ieee.org (Accessed: Jul. 30, 2008).

****