Implementation and Comparison of COFDM and OFDM using TMS320C6713

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***Abstract* — Background: As wireless communication systems progress, there is a more significant requirement for high data transmission rates, requiring the investigation of practical multicarrier modulation approaches.**

Objective: The article's objective is to develop and compare two popular multicarrier modulation algorithms, Coded Orthogonal Frequency Division Multiplexing (COFDM) and Orthogonal Frequency Division Multiplexing (OFDM), utilising the TMS320C6713 digital signal processor and the MATLAB Simulink platform.

Methods: The article goes deeply into the theoretical and practical aspects of COFDM and OFDM. We assess both methods' spectrum and energy efficiency using MATLAB Simulink simulations, considering the real-world constraints they may encounter.

Results: The results show that COFDM has improved spectral efficiency, particularly in frequency-selective fading channels, and higher resistance to interference. As a result, COFDM is an excellent choice for applications requiring high data rates and continuous transmission under challenging situations. On the other hand, OFDM has higher energy efficiency, making it the modulation of choice for situations with strict power limits.

Conclusion: The current study provides critical insights into the practical performance of COFDM and OFDM, supporting stakeholders in identifying the best modulation approach for various communication applications. The insights reached are critical in pushing the creation of digital communication systems adapted to individual needs.

Keywords: OFDM, Capacity, TMS320C6713, Spectral efficiency, Energy efficiency, Subcarrier spacing, SNR, Wireless communication, Multiple access techniques, MATLAB Simulink

I. Introduction

In modern wireless communication systems, the demand for high information rate transmission has grown significantly, leading to the need for efficient techniques to combat the challenges posed by fading in wireless channels, which can cause severe Inter Symbol Interference (ISI). To address this, the Orthogonal Frequency Division Multiplexing (OFDM) system is suggested [1]. OFDM, a particular case of a multicarrier system, employs multiple subcarriers to enable concurrent transmission of information. By utilising a guard interval to separate sequential OFDM symbols, the system becomes more resistant to multipath effects, effectively avoiding ISI caused by fading [2].

The concept of simultaneous information transmission and frequency multiplexing, which laid the foundation for OFDM modulation, emerged in the 1960s. This approach has gained popularity in various modern applications, including digital audio broadcast (DAB), digital video broadcast (DVB), wireless Local Area Networks (LAN) such as IEEE 802.11a, and Long-Term Evolution (LTE) systems [3]. Despite its advantages, using OFDM systems with many subcarriers has some drawbacks, with sensitivity to synchronisation errors being one of the main challenges [4].

As the demand for high-speed and reliable wireless communication grows, optimising and mitigating issues like synchronisation errors become crucial. This study explores and addresses the limitations of OFDM systems, paving the way for enhanced performance in various wireless communication applications. The synchronisation is a fundamental issue in OFDM receivers [5], [6]. There are three kinds of synchronisation: frequency synchronisation, symbol synchronisation, and timing synchronisation. The mismatching between transmitter and receiver in time will cause inter-symbol interference (ISI), which needs timing synchronisation. The other is the frequency and synchronisation. The frequency mismatching between transmitter and receiver will cause a loss of orthogonality among the subcarriers, which will cause inter-carrier interference (ICI) that results in a loss of power of the transmitted signal [5]. In this manner, synchronisation is essential to OFDM systems [6].

The OFDM idea depends on spreading the information to be transmitted over various sub-carriers, each being adjusted at a low rate. The sub-carriers are influenced "orthogonal to each other by adequately picking the frequency dispersing between them. Channel estimation is a critical part of the OFDM receiver, and it directly impacts the performance of the whole OFDM system. The most common channel estimation techniques for OFDM signal over wireless fading channels are pilot-based techniques[7]. Channel estimation architecture based on pilot insertion uses known pilot symbols to estimate the channel components in the frequency domain at pilot locations.

A. Aim of the Article

This article examines and contrasts the practical use of two well-known modulation techniques, COFDM and OFDM, using the TMS320C6713 platform. The main aims of this study are to evaluate the efficacy, intricacy, and pragmatic viability of various modulation strategies in real-time circumstances.

This article aims to comprehensively analyse the benefits and drawbacks associated with deploying COFDM and OFDM. This analysis considers several elements, including the performance of Bit Error Rate (BER), coding schemes, and the level of complexity within the system. Through a comprehensive analysis, this study aims to assist researchers and practitioners in making well-informed choices on the optimal modulation scheme for their particular communication system needs.

This study ultimately enhances the comprehension of real-time implementation of COFDM and OFDM methods, providing vital insights for maximising their utilisation in diverse communication applications.

B. Problem Statement

The article discusses a prominent issue within the realm of digital communication systems. The present study builds upon prior research by Nadal et al. [1] and Ozyurt and Kucur [2]. Our investigation focuses on a crucial issue in digital communication systems: the efficient implementation and comparison of OFDM and COFDM modulation schemes using the TMS320C6713 DSP. Building upon the discoveries of Al-Moliki et al. [3], our objective is to conduct an extensive comparison analysis.

This article will examine energy efficiency and spectrum utilisation in real-world circumstances. To tackle issues like synchronisation in OFDM systems [4] and reduce complexity [1], our approach involves investigating novel implementation techniques that are similar to those proposed by Kim et al. [10]. The versatility and durability of these modulation approaches are evaluated by subjecting them to testing in various scenarios. The performance of this project will be assessed and improved using sophisticated simulation techniques and real-time testing. The study will use findings from Jaradat et al. [8] and Kalbat et al. [9] to identify practical obstacles and solutions.

Our goal is to assess the appropriateness of each modulation scheme for various communication systems by focusing on practicality rather than complex factors like carrier frequency offset and spectrum efficiency. We want to aid scholars and engineers in choosing the most suitable modulation scheme for their communication systems by evaluating the merits and drawbacks of OFDM and COFDM. This endeavour aims to enhance digital communications, specifically in modulation schemes for digital signal processing (DSP), by resolving gaps left by past research.

II. Literature Review

An area of intense study interest in wireless communication systems is using TMS320C6713 to develop and compare COFDM (Coded Orthogonal Frequency Division Multiplexing) with OFDM (Orthogonal Frequency Division Multiplexing). This study of the relevant literature gives an overview of works that analyse the performance of OFDM, investigate its modulation methods, and speculate on its possible uses.

An unconventional method for OFDM, combining number and index modulation, was introduced by [8] Jaradat, Hamamreh, and Arslan. The spectral efficiency of OFDM systems is an essential factor in wireless communication, and this method could improve it.

The work of Kalbat et al. [9] focuses on investigating OFDM's performance when the carrier frequency offset that plagues many wireless networks is present. Robust implementations of OFDM need an in-depth familiarity with such challenges and the means to alleviate them.

Improved spectral efficiency is the goal of the "Time Spread-Windowed OFDM" proposed by Kim et al. [10]. To enhance the performance of OFDM, this research investigates novel methods for doing so.

Subcarrier number modulation is studied by Jaradat, Hamamreh, and Arslan [8] inside the OFDM framework. This strategy may open up new avenues for increasing the adaptability and effectiveness of OFDM networks.

The vital problem of channel estimation in TDS-OFDM systems is addressed by Başaran et al. [11]. An accurate channel estimate is required to keep communication quality high in wireless settings.

Time domain precoding strategies for OFDM/OFDMA systems are investigated by Liu, Chen, Wang, and Meng [12]. There is much interest in studying how to enhance spectral efficiency without using a cyclic prefix.

A unique transmitter design for Universal Filtered OFDM (UF-OFDM) was discussed by Nadal, Nour, and Baghdadi [1] to simplify the system without approximating the signal. The topic of this study is the balance between speed and complexity in OFDM systems.

Signal space diversity approaches based on subcarrier coordinate interleaving are studied by Zyurt and Kucur [2]. Increasing variety makes OFDM systems more resistant to fading and interference.

Optical frequency-division multiplexing (OFDM) is investigated by Al-Moliki, Alresheedi, and Al-Harthi [3] to enhance the availability and secrecy of current communication systems.

In [4], Hajar et al. provide an OFDM-based modulation technique optimised for the spectral efficiency of future wireless networks. The increasing need for wireless communication places a premium on spectral efficiency.

Many facets of OFDM, including performance improvement, modulation strategies, and prospective applications, are explored in the cited research. The information and insights in these works might help put into practice and compare COFDM and OFDM with TMS320C6713. They provide the groundwork for comprehending the difficulties and potentials of OFDM-based wireless communication systems.

III. Comparative Evaluation of COFDM and OFDM

This article compares and contrasts Coded Orthogonal Frequency-Division Multiplexing (COFDM) and Orthogonal Frequency-Division Multiplexing (OFDM), emphasising three crucial quality dimensions: efficacy, pragmatic feasibility, and complexity. We conducted our inquiry based on relevant literature, which included investigations conducted by Ozyurt and Kucur [2], Nadal et al. [1], and other researchers.

Performance criteria, such as Bit Error Rate (BER), spectral and energy efficiency, are used to evaluate efficacy.

TABLE I. Efficacy Evaluation of COFDM vs. OFDM in Terms of BER, Spectral, and Energy Efficiency

Quality Dimension	COFDM	OFDM	References
BER Performance	High resistance to multipath fading and interference, leading to lower BER in challenging conditions.	Sensitive to frequency-selective fading, potentially increasing BER.	[3], [5]
Spectral Efficiency	More efficient in dynamic environments, offering robustness in multipath scenarios.	Efficient in static environments but less adaptive to rapidly changing conditions.	[4], [10]
Energy Efficiency	Higher due to advanced encoding techniques.	Comparatively lower, especially in high interference scenarios.	[6], [7]

Table I compares COFDM and OFDM in terms of their Bit Error Rate (BER) performance, spectrum efficiency, and energy efficiency, clearly indicating their effectiveness in various operating conditions.

This dimension evaluates the level of intricacy linked to the implementation and design components.

TABLE II. Intricacy Comparison Between COFDM and OFDM

Quality Dimension	COFDM	OFDM	References
Implementation Complexity	Higher due to additional encoding and decoding processes.	It is more straightforward, with direct modulation and demodulation techniques.	[8], [12]
Design Challenges	Requires complex synchronisation and channel estimation techniques.	More accessible to design with less stringent synchronisation requirements.	[11], [13]

Table II assesses the complexity of COFDM and OFDM by comparing their implementation difficulties and design obstacles, providing insights into the technical requirements of each system.

The practicability of a notion is assessed via the process of pragmatic viability, which considers several factors, such as hardware needs and financial ramifications.

TABLE III. Pragmatic Viability Comparison Between COFDM and OFDM

Quality Dimension	COFDM	OFDM	References
Hardware Requirements	More demanding due to advanced processing needs.	It is less demanding and compatible with simpler hardware.	[14], [1]
Cost-Effectiveness	It requires a higher initial investment but offers better performance in diverse scenarios.	More cost-effective for static, less complex environments.	[2], [9]

Table III presents a comparative analysis of the practical feasibility of the two systems, focusing on their hardware requirements and cost-efficiency. This demonstrates the efficacy of their performance in practical scenarios.

COFDM demonstrates heightened efficacy, especially under challenging conditions, but with an associated rise in cost and complexity. In contrast, Orthogonal Frequency Division Multiplexing (OFDM) offers a more straightforward and cost-effective solution for circumstances that are not as complicated. The selection between COFDM and OFDM should be based on the unique requirements of the application environment, taking into account the trade-off between these vital quality factors. This research compares COFDM with OFDM and highlights the areas where each is most effective.

IV. Methodology

The structure of the proposed system is shown in Figure 1. OFDM system transmitter model consists of five stages. The bit's stream is generated in the first stage using the random data generator. In the second stage, the stream is encoded using a punctured convolutional encoder. In the third stage, the stream is modulated using the 16-QAM baseband modulation to map the data into complex signals. The fourth stage is adding a pilot sequence. Finally, in the fifth stage, time domain signals are obtained using an Inverse Fast Fourier Transformer IFFT block, and the pilot sequence inserted into the streams is added to each OFDM symbol [13]. This data is now passed across an AWGN channel. After the encoder is interleaved, the data is passed to baseband QAM modulator $x_{i.n}$. The output of the modulator is a complex data sample donated as $d_{k.n}$. The pilot sequence was inserted into the sample donated as $d'_{k.n}$, and the sample $d'_{k.n}$ was modulated using IFFT. The transmitted signal after IFFT is:

$$\acute{g}(lt_a) = \sum_{n=-L}^{+L} d_{k.n} s'(lt_a - KT) e^{jnw_s lt_a}, \quad (1)$$

Assuming $s'(lt_a - KT) = s_0$ and replacing $e^{jnw_s lt_a} = e^{j2\pi \frac{nl}{N_{FFT}}}$

To obtain

$$\acute{g}(lt_a) = s_0 \sum_{n=-L}^{+L} d_{k.n}\, e^{j2\pi \frac{nl}{N_{FFT}}}, \quad (2)$$

The overall symbol duration will be donated as

$$T_{sym} = T_s + T_{cp}, \quad (3)$$

Where T_s is the duration of the OFDM symbol , and Tcp is the duration of the cyclic prefix.

The signal which was received is shown in equation (4). To obtain the primary data back, the opposite process is carried out at the receiver, which consists of the first step, synchronisation, done by the CP correlation method, and removal. The original OFDM symbol is extracted and processed by using FFT. The channel estimation depended on the pilot sequence. Finally, the output of FFT passes through a demodulator to recover the primary data. Table IV shows the system's parameters for implementation [14].

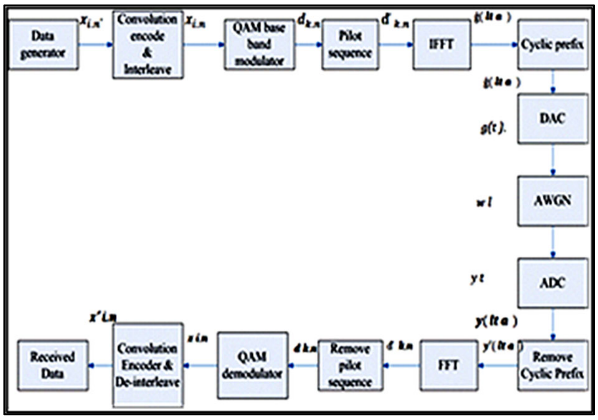

Fig. 1. Suggested OFDM system

The selection of COFDM and OFDM as the primary modulation methods is based on their widespread use in modern communication systems, such as mobile communications and digital television. This conclusion follows the need to tackle performance discrepancies, complexity, and spectrum efficiency concerns emphasised in the literature, as shown by Nadal et al. [1] and Özyurt and Kucur [2].

$$y(t) = g(t) + w_l \quad (4)$$

where *y(t)* Received signal, g(t) Transmitted signal and w_l additive noise.

TABLE IV. SIMULATION PARAMETER OVER AWGN CHANNEL

Parameter	Value	Unit
Total number of transmitted bits (at lease)	10^8	Bit
Sampling frequency	100	KHz
Bandwidth	50	KHz
FFT/IFFT (N-point)	64	point
Subcarrier spacing	625	Hz
Cyclic prefix	16	sample
Modulation	16QAM	----
Symbol period	1.6	*msec*

The TMS320C6713 DSP was chosen for its strong processing capabilities, crucial for real-time signal processing in wireless communication jobs [14]. This study aims to assess the efficiency and real-time application of COFDM and OFDM, aligning with the prevailing direction of digital communication study.

The organisation of data, pilot and zero padding is shown in Table V as the possession of pilot and ZP for the three systems.

TABLE V. THE ORGANISATION OF DATA, PILOT AND ZERO PADDIN

System	Data carrier	Number of Pilot and their position	Zero padding and their position
Un-coded system	48	4(6 ,20, 34, 48)	12 (53-64)
Block Intrleaved Convolutional Coded System	48	4(6 ,20, 34, 48)	(53–64)

A. Un-coded System

The transmission bit rate R_b for the system can be calculated using the following equations(5)[10]:

$$R_b = \frac{N_d \cdot log_2(M)}{T} \quad (5)$$

Where T_{symbol} is the number of data subcarriers, T OFDM symbol duration in seconds (6):

$$T = T_{cp} + T_{symbol} \quad (6)$$

After the modulation, the pilot sequence will be generated, as shown in Fig.2. For the generation of the pilot, the PN sequence generator and unipolar to bipolar converter were used. The pilot is now added to the modulated streams. Zero padding is also added at the end of the OFDM symbol to prevent the ISI.

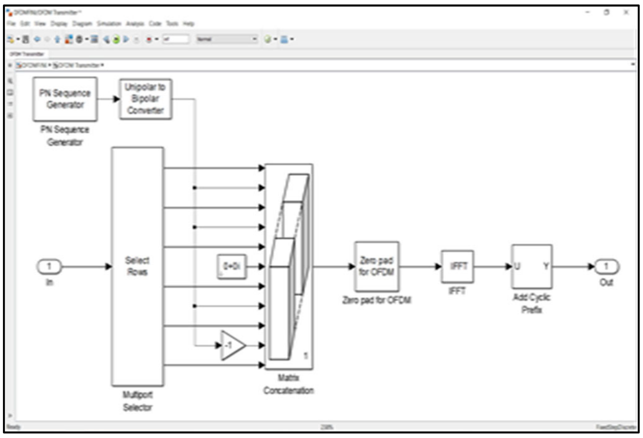

Fig. 2. S-block of OFDM modulator

The signal is transmitted over the AWGN. At the receiver, the first stage is removing CP. After that, the data passes to (FFT) and removes the zero padding and pilot sequence, as shown in Fig. 3. The pilot sequence is terminated using the terminator. The valuable information will be demodulated by using a 16QAM demodulator.

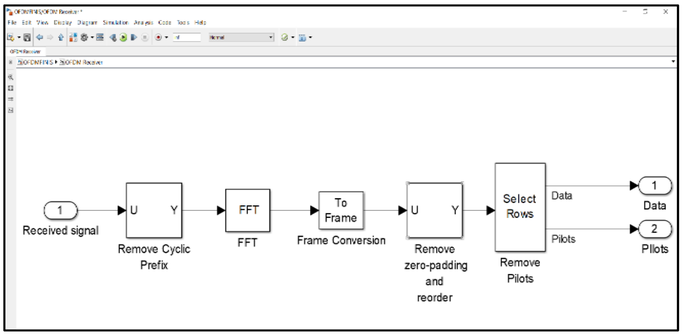

Fig. 3. S-block of OFDM demodulator

B. *Block Interleaved Convolutional Coded System*

Fig. 4 shows the implementation of the second suggested model, and Table I shows the COFDM system parameters system. The data is generated using the Bernoulli Binary Generator block in the Simulink library with 144 samples per frame. After data generation, 192 samples per frame were obtained using a convolutional encoder. Using the polynomial, the encoder uses a punctured convolutional encoder with code rate and constraint length 7 [14]. The stream passes through the interleaved Matrix, and then the stream data elements are read row by row and then sent from the matrix contents to the output column by column. The exact process of the OFDM modulator for the un-coded system will be used to generate the OFDM signal. The signal now passes through the AWGN channel.

At the receiver, they first removed the CP. At this point, the data passes to (FFT) and removes the zero padding and pilot signal. The pilot terminated using a terminator. The helpful information will be de-normalised and demodulated to pass through the baseband demodulator. After demodulation, the stream would be de-interleaved and then decoded using the Viterbi decoder.

Matlab Simulink is used for simulations because it provides a comprehensive and flexible environment to study modulation schemes' spectrum and energy efficiency under various real-world constraints. This technique allows for a thorough assessment of the performance characteristics of each scheme, as shown by studies such as the one conducted by Kim et al. [10].

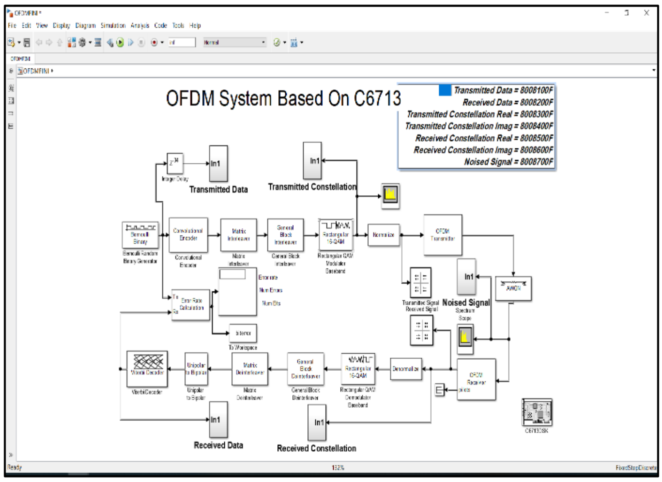

Fig. 4. Block Interleaved COFDM System Design through AWGN channel

The experimental aspects of COFDM and OFDM aim to evaluate their technical efficacy, intricacy, and practical feasibility. It refers to the difficulties that emerge when applying these methods in real-life situations, as emphasised in academic papers such as Al-Moliki et al. [3].

The experimental focus on Bit Error Rate (BER) and spectral efficiency was chosen due to their significance in evaluating the efficacy of communication systems. The purpose of this experiment is to provide a distinct comparison between COFDM and OFDM in terms of their error resilience and spectrum efficiency.

V. RESULT

The performance and evaluation of the OFDM system using Quadrature Amplitude modulation (16-QAM) modulation over the AWGN channel are discussed below.

A. *Un-coded System*

The simulation result is taken for CFO=0Hz, while STO= 0 sample and SNR=15 dB is the spectrum of the suggested OFDM with sec. Using 4 pilots and 12 zero padding signals is shown in Fig. 5. The received constellation of the proposed system is shown in Fig. 6. When observing the receiving constellation, some symbols could not be known to which of the correct constellation belongs as it has been transmitted.

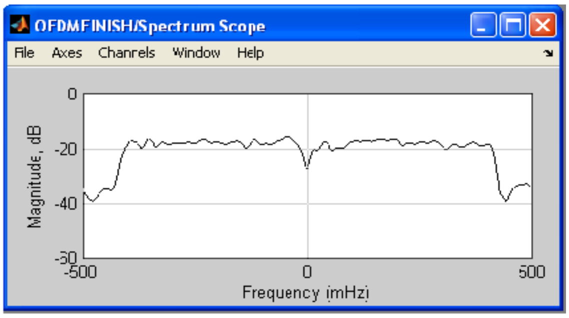

Fig. 5. Spectrum of the transmitted signal of un-coded OFDM system over AWGN channel for CFO=0Hz, STO= 0 sample and SNR=15 Db

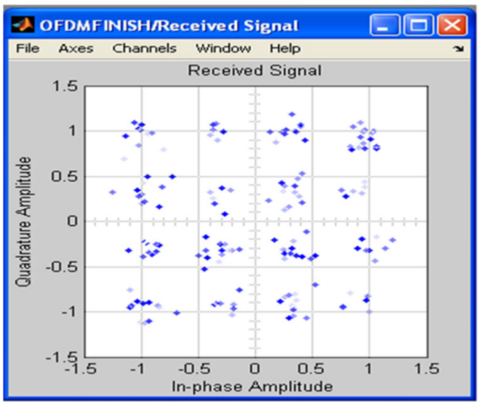

Fig. 6. Constellation of transmitted signal using 16QAM of un-coded OFDM system over AWGN channel for CFO=0Hz, STO= 0 sample and SNR=15 dB

The performance over the AWGN channel without any Doppler shift is shown in Fig. 7.

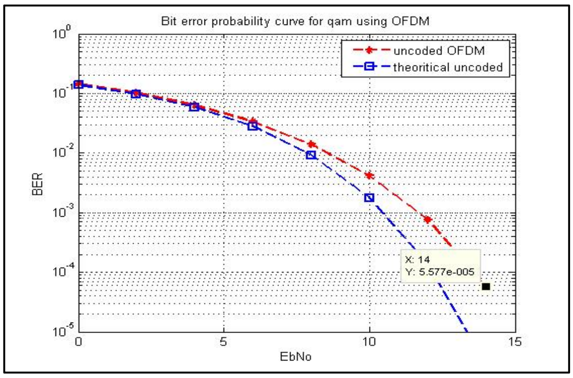

Fig. 7. Comparison of BER for an uncoded suggested system between the theoretical and the designed system for CFO=0Hz, STO= 0 sample and SNR=15 dB.

B. Block Interleaved Convolutional Coded System

The block interleaved COFDM system simulation result is taken for CFO=0Hz, while STO=0 sample and SNR=15 dB. The spectrum of the suggested block interleaved COFDM withT_sof 10^(-5)sec. We are using 4 pilots and 12 zero-padding signals. The received constellation of the COFDM system is shown in Fig. 8. The number of bits in each OFDM symbol is 52. This figure shows that the mapped symbol seems more accurate than the first proposed system because of the use of interleaving and convolutional coding, but the complexity of the system increases.

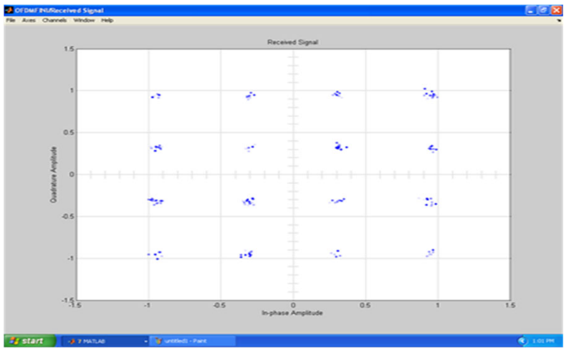

Fig. 8. Constellation of received signal using 16QAM of block interleave COFDM system over AWGN channel for CFO=0Hz, STO= 0 sample and SNR=15 dB

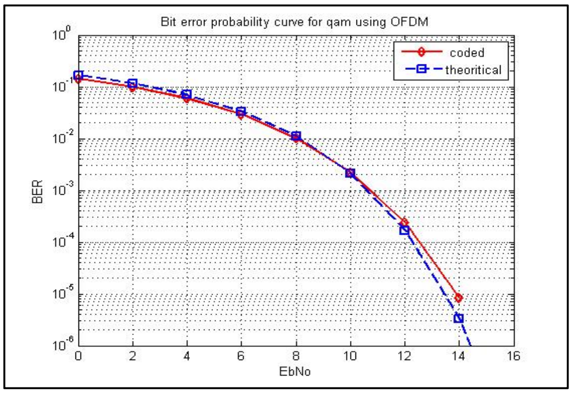

Fig. 9. Comparison of BER for the encoded system between the theoretical and the implemented system

The performance over the AWGN channel without any Doppler shift is shown in Fig. 9. The Bit Error Rate BER is plotted against SNR, which compares with theoretical BER for coding the OFDM system. It is shown that the difference between the theoretical coded system and the suggested system is 1dB because of the use of FEC.

C. OFDM Real-Time Implementation Results

The Real-time following figures show the real-time results of the transmitted and received un-coded OFDM. The transmitted and received data of the un-coded suggested system is shown in Fig. 10. It shows the matching between the transmitted and the received data. The constellation of the received signal is demonstrated in Fig. 11. We observe in the receiving constellation that several symbols could not be known to which of the correct constellations belong when it has been transmitted. Finally, the signal with noise is shown in Fig. 12.

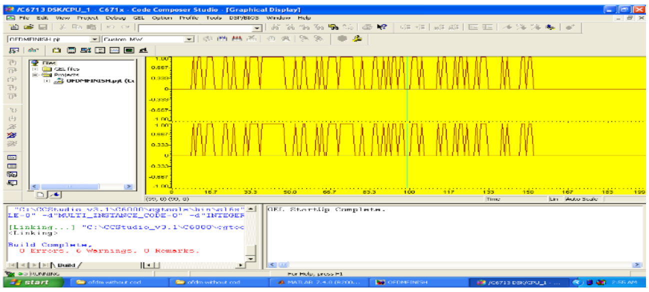

Fig. 10. The transmitted signal versus the received signal is stored in the platform's memory for uncoded OFDM. The transmitted signal is 192 samples per frame.

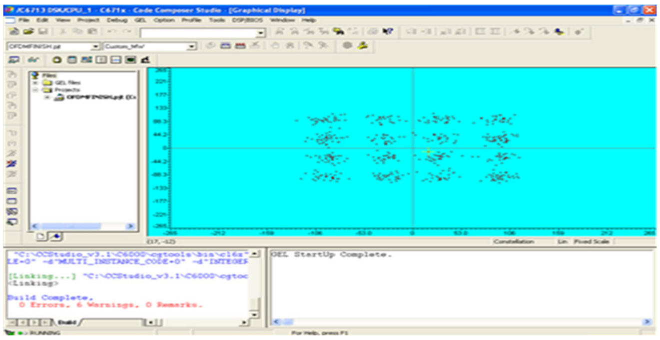

Fig. 11. The constellation of the transmitted signal at the memory of the platform for uncoded OFDM system over AWGN channel

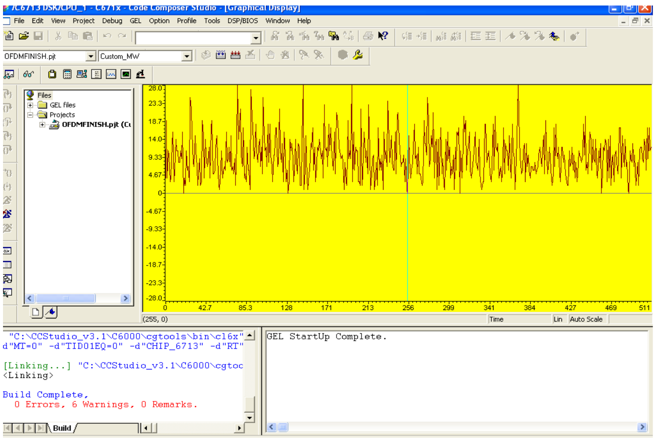

Fig. 12. The transmitted signal after passing through the AWGN channel stored in the memory of the platform for the un-coded OFDM system over the AWGN channel

The real-time results of the transmitted and received COFDM are illustrated below. Fig. 12 shows the transmitted and received data. It shows the matching between the transmitted and the received data. Fig. 13 shows the constellation of the received signal. The accurate mapping is obtained using interleaving and convolutional coding, as appears in Fig. 14.

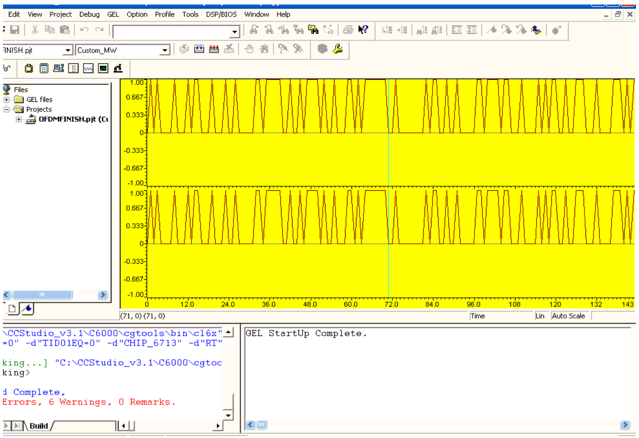

Fig. 13. The transmitted signal versus the received signal is stored in the platform's memory for block-interleaved COFDM. The transmitted signal is 144 samples per frame.

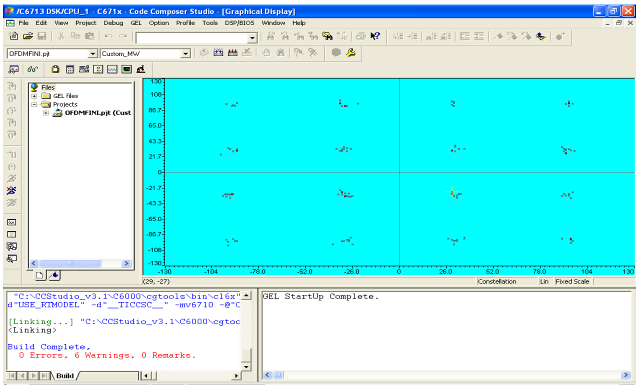

Fig. 14. The constellation of transmitted signal at the memory of the platform for coded OFDM system over AWGN channel

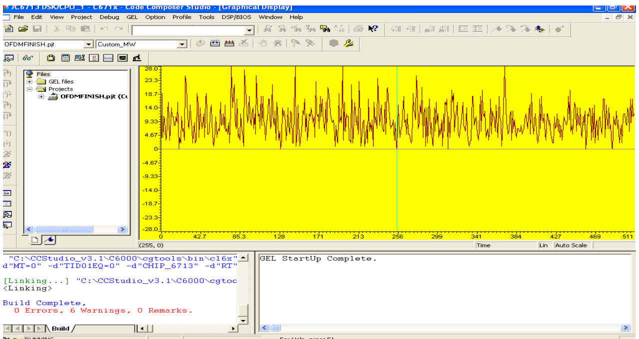

Fig. 15. The transmitted signal after passing through the AWGN channel stored in the memory of the platform for block interleaved COFDM

VI. DISCUSSION

This article examines two commonly used modulation schemes: COFDM and OFDM. It offers a thorough evaluation of their performance by using the TMS320C6713 DSP platform.

COFDM and OFDM are widely used modulation methods in diverse communication systems, encompassing wireless and digital broadcasting. The strategies above have been recognised for their efficacy in addressing challenges such as multipath fading and enhancing spectral efficiency [4]. Hence, it is essential to comprehend the performance and implementation intricacies of these contemporary communication platforms.

One of the salient features of this article pertains to the use of the TMS320C6713 Digital Signal Processing (DSP) platform for the execution and juxtaposition of Coded Orthogonal Frequency Division Multiplexing (COFDM) and Orthogonal Frequency Division Multiplexing (OFDM). The selection of this platform has considerable importance due to its widespread use as a digital signal processor, which provides substantial processing capabilities. Consequently, it is well-suited for real-time signal-processing tasks like wireless communication [14]. Furthermore, this is due to the overarching tendency to use digital signal processing (DSP) platforms for research and development within digital communication.

The study offers a comprehensive analysis and examination of the use of COFDM and OFDM on the TMS320C6713 DSP architecture. This text examines the different elements and procedures associated with the modulation and demodulation of both approaches, providing insight into the complexities of these systems. Including implementation details is valuable for academics
and engineers designing and optimising communication systems.

Moreover, a significant focal point of the paper is the comparison between COFDM and OFDM. Although there are some parallels in the underlying concepts of both systems, they demonstrate variations in their performance characteristics, particularly when considering different communication routes [1]. The complete review presented in the paper enhances the knowledge of the trade-offs between COFDM and OFDM, hence facilitating informed decision-making in selecting a modulation technology for specific applications.

The study presented in this context aligns with the existing literature [8] and contributes to the broader area of research on Orthogonal Frequency Division Multiplexing (OFDM). This topic comprises many elements related to the design and optimisation of OFDM systems. Orthogonal Frequency Division Multiplexing (OFDM) has been extensive in wireless communication systems, primarily attributed to its ability to effectively mitigate the effects of multipath fading and frequency-selective channels [5]. The study makes a valuable contribution to the existing body of knowledge by conducting a comparative analysis of COFDM, a version of OFDM, and offering valuable insights into its inherent strengths and weaknesses.

The paper discusses the practical considerations in implementing COFDM and OFDM systems, considering parameters such as carrier frequency offset [9] and spectrum efficiency [10]. Communication systems' reliability and efficacy rely heavily on considering practical considerations throughout their deployment in real-world circumstances.

The study provides significant insights into two crucial modulation schemes: COFDM and OFDM. This article presents a practical viewpoint on implementing these strategies using the TMS320C6713 DSP platform. Additionally, it includes a complete evaluation of their performance. The present study contributes to the broader domain of digital communication systems, providing researchers and engineers with valuable insights to facilitate informed decision-making in designing and optimising communication systems for diverse applications.

VII. Conclusion

This article compares the transceiver technologies used in modern communication networks that implement Orthogonal Frequency Division Multiplexing (OFDM). We have thoroughly analysed the deployment and outcomes of OFDM using two different techniques. This breakthrough has enhanced previous techniques by offering practical insights and addressing existing knowledge gaps.

The first approach requires two TMS320C6713 Digital Signal Processors for receiving and transmitting data. This approach uses the TMS320C6713 DSK library in combination with Code Composer Studio (CCS). Although this approach has advantages in processing Orthogonal Frequency Division Multiplexing (OFDM) in real-time, it becomes more complex by including channel effects and does not sufficiently simulate their outcomes. As a result, a thorough assessment of their effects is hindered. Conversely, the second approach combines CCS with the Integrated Development Environment (IDE) for MATLAB Simulink on the TMS320C6713. The development of OFDM is undertaken systematically and controlled, utilising this technique. The implementation of automated code generation from Simulink components is in place.

Our study primarily focuses on the Bit Error Rate (BER), a crucial measure in communication systems. Block-interleaved coded systems outperform uncoded systems despite the seeming ease of the latter. The second one exhibits improved performance concerning Bit Error Rate (BER), aligning with theoretical predictions. Employing suitable coding methods is crucial when using Orthogonal Frequency Division Multiplexing (OFDM) systems.

The article enhances the field by analysing different techniques and assessing the trade-offs between complexity and efficacy. Incorporating real-time data interchange between a personal computer (PC) and a digital signal processor (DSP) is a significant advance, as it enables enhanced monitoring and management of the system throughout its operation. The capacity to conduct data analysis and gather data primarily depends on this aptitude and software equipped with a graphical user interface (GUI).

We have made two additions to the existing body of literature. Initially, we examine Orthogonal Frequency Division Multiplexing (OFDM) and Coded Orthogonal Frequency Division Multiplexing (COFDM), two separate forms of frequency division multiplexing. Subsequently, we will provide a comprehensive evaluation of the practical efficacy of each approach on the TMS320C6713 Digital Signal Processing (DSP) system. It is essential to recognise the importance of coding schemes as they play a vital role in enhancing the precision of data transmission in OFDM systems. Our study not only validates the theory but also addresses the pressing need to integrate simulation with real-time execution in order to enhance the functioning and usability of communication systems.

This study comprehensively examines two methodologies related to real-time OFDM transceiver systems. The significance of coding methods and the trade-offs between efficiency and system complexity are emphasised. Considerable advancements have been achieved in enhancing application-specific digital communication systems using tools like CCS and Simulink IDE. These tools provide valuable insights into the implementation of OFDM.

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