A SLIDING MODULATION HOOPING DISCREATE FOURIER TRANSFORM ALGORITHM FOR 4G OFDM WIRELESS COMMUNICATION

Ms. L. NITHYA, Mr.L. KRISHNAKUMAR, Dr.D.SATISHKUMAR, Mr. D. KALEESWARAN

Abstract *— Multiple Input Multiple Output (MIMO) and Orthogonal Frequency Division Multiplexing (OFDM) are the two assuring technologies that offers high data rate as required for the 4G wireless systems. Conventionally OFDM is Fast Fourier Transform (FFT) based system. It uses IFFT (Inverse FFT) blocks in the transmitter and FFT blocks in the receiver. OFDM combined with MIMO gives increased throughput and better system performance and hence FFT based MIMO OFDM systems are widely used in 4G wireless schemes. This Proposed method is the new algorithm of SMHDFT to replace the FFT in 4G communication systems to maintain the high precision and stability. A new Sliding Modulated Hopping Discrete Fourier Transform (SMHDFT) algorithm which is characterized by its merits of high accuracy and constant stability is presented. The proposed algorithm, which is based on the circular frequency shift property of DFT, directly moves the k–th DFT bin to the position and computes the DFT by incorporating the successive DFT outputs with arbitrary time hop. In this method, accumulated errors and potential instabilities, which are caused by the quantization of the twiddle factor, are always eliminated without increasing much computational effort. Comparison of the proposed method is compared with existing 4G method of FFT by the parameters of complexity order, BER & throughput.*

Keywords *— Multiple Input Multiple Output (MIMO), Orthogonal Frequency Division Multiplexing (OFDM), Fast Fourier Transform (FFT), Sliding Modulated Hopping Discrete Fourier Transform (SMHDFT).*

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I. INTRODUCTION

The discrete Fourier transform (DFT) as a keystone in digital signal processing (DSP) is widely used in a large variety of applications, such as spectrum analysis in measurement, spectrum sensing in cognitive radio and multi-carrier transceivers in wireless communication. The fast Fourier transform (FFT) algorithm and the Goertzel algorithm are generally utilized to implement DFT, which calculate one complex DFT spectral bin valve for every input time samples.

However, in some real-time applications where a new DFT spectrum output is obliged to be generated every sample, or every few samples, such sophisticated DFT algorithm cannot meet the requirement of real-time signal processing. The existing system approach is described as the DS-SS technique is the most popular technique for spreading the signal in the form of spectrum. Because of the simplicity with which direct sequencing can be implemented. Below Figure 3.1 shows the basic model and the key characteristics that make up the DSSS wireless communication system.

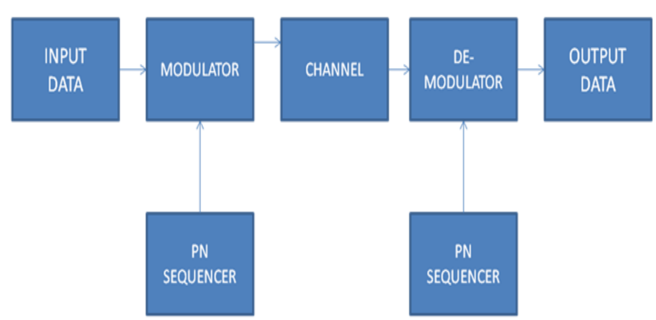

Fig.1 Basic model of DS-SS Communication System

In this type of modulation technique, a pseudo-random noise generator will creates a spread spectrum code or better known as the pseudo-noise (PN) code sequence with the help of chip code. Each of bits from the original input data signal is directly modulated with this PN sequence and can be detected by multiple bit data in the transmitted data signal. On the receiving end, the same PN sequence is then capable of demodulating the spread spectrum data signal to recover the input data signal. Modulated Hopping DFT Algorithm Quantization errors which are introduced twiddle factor may move the pole slightly inside or outside the unite circle. OFDM with Fast Fourier System Using an IFFT at the transmitter does just that it takes multiple independent streams and regards them as being on a different frequency bin.

Spectrum-efficient and scalable elastic optical path network: architecture, benefits, and enabling technologies, Current WDM networks address this mismatch by allowing sub-wavelength granularity connections to be groomed onto a single light path which results in extra cost and power consumption. By allocating multiple wavelengths to a connection if the requested bandwidth is higher than that of a single wavelength, however, such an approach suffers from low spectral efficiency as adjacent wavelengths must be separated by guard bands. OFDM for optical communications, OFDM is a multicarrier modulation technique where data is distributed over multiple orthogonal low-rates. Subcarriers Optical OFDM helps alleviate many of the drawbacks associated with single carrier systems.

II. PROPOSED SCHEME

A new Sliding Modulated Hopping Discrete Fourier Transform (SMHDFT) algorithm which is characterized by its merits of high accuracy and constant stability is presented. The design and implementation of SMHDFT with 4G wireless Communication System to obtain the high efficient Communication signals. The proposed algorithm, which is based on the circular frequency shift property of DFT, directly moves the k–th DFT bin to the position of, and computes the DFT by incorporating the successive DFT outputs with arbitrary time hop. In this method, accumulated errors and potential instabilities, which are caused by the quantization of the twiddle factor, are always eliminated without increasing much computational effort. Comparison of the proposed method is compared with existing 4G method of FFT by the parameters of complexity order, BER, Throughput.

SLIDING DFT AND HOPPING DFT ALGORITHMS

A. SDFT

The k-th spectral bin of -point DFT of signal is computed as

$$X_n(k)=\sum_{m=0}^{M-1} x(q+m)\, W_M^{-km} \quad (4.1)$$

Where $q=n\_M+1$, $0\le k\le M\_1$ and $W_{(M=ej2\pi/M)}$ is the complex twiddle factor. The SDFT featured sample-by-sample processing, computes successive k-th bin DFT output

samples $X_n(k)$ $X_{(n=1)}(k)$ $X_{(n+2)}(k)\_$, from the x(n) time samples which differ only by the first and last samples [8], [9]. It is obvious that the time hop between consecutive DFT outputs is restricted to 1 in SDFT. The recursive process can be expressed as

$$X_n(k)= \sum_{m=0} x(q+m)\, W_M^{km} \quad (4.2)$$

where d(n)=x(n)-x(n-M).

B. HDFT

In HDFT, the SDFT has been extended to more general case by using arbitrary time hopL [10]. Here, we only consider the case , for simplicity of investigation, and the other cases can be easily derived. Then, the relationship between $X_n(k)$and$X_{(n-L)}(k)$ as shown in (4.3) is achieved by continuously substituting$X_n(k)$ into$X_{(n-L)}(k)$ L times in (4.2).

$$X_n(k)=W_M^{Lk}\{X_{(n-L)}(k)+d(n-L+1)+W_M^{-k}d(n-L+1) +W_M^{-k}d(n-L+2)+\cdots+W_M^{-(L-1)k}d(n)\} \quad (4.3)$$

To simplify (4.3), $D_n^L(k)$is defined as the -th bin of the –point updating vector transform (UVT) which can be expressed as [10]

$$D_n^L(k)=\sum_{t=0}^{L-1} d(n-t)\, W_M^{(t-L+1)k} =W_M^{-\{L-1\}k}\sum_{t=0}^{L-1} d(n-t)W_M^{tk} \quad (4.4)$$

Where $0\le k\le M-1$. It must be noticed that there is an inherent phase shift $W_M^{-(L-1)k}$ in the $D_n^L(k)$ which is not related to the dummy variable. Meanwhile, it is also conceivable that there is a remarkable resemblance between the form of UVT and the DFT, and the traditional FFT algorithm can be employed to compute e$D_n^L(k)$. Then, (4.3) can be rewritten as

$$X_n(k)=W_M^{Lk}[X_{(n-L)}(k)+D_n^L(k)] \quad (4.5)$$

The Z-domain transfer function for the k -th bin of the HDFT is

$$H_{HDFT}(Z) = \frac{W_M^k(1-z^{-M})\sum_{t=0}^{L-1}(W_M^k z}{1-W_M^{Lk}z^{-L}}$$
(4.6)

III. MODULATED HOPPING DFT ALGORITHM

It is apparently seen from (4.6) that there is a single pole and zeros settled on the unite circle, and the HDFT is stable from a theoretical point of view. However, in practice, the quantization errors which are introduced by the finite precision representation of the twiddle factor may move the pole slightly inside or outside the unite circle, and results in the potential instabilities and the accuracy deterioration of the HDFT.

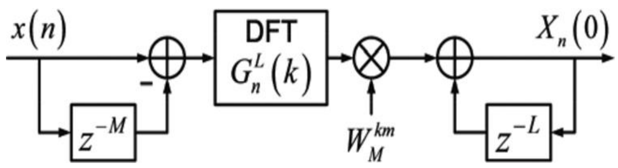

Figure 2. Modulated HDFT structure.

In order to counteract those drawbacks, it must be noticed that the HDFT bin with index k=0 is
X_n (0)=X_(n-L) (0)+D_n^L (0)=X_(n-L) (0)+∑_(t=0)^(L-1)▒〖d(n-t)〗 (4.7)
Since the complex twiddle factor is removed in (4.7), the iterative operation in (4.7) is absolutely stable and does not accumulate errors. Thus, it is conceivable that we can utilize this merit to deal with the inherent drawbacks of HDFT.

A. Modulated HDFT

In mHDFT, the frequency shift property of DFT in (4.8) is adopted to shift the DFT bin with index to the position of k=0 by simply multiplying the input signal x(n) by the modulation sequence W_M^km[7], [12].
x(n).W_M^(k_0 m) □(↔┴DFT) 〖X[(k-k_0)]〗_M (4,8)

The expression of MHDFT is obtained as
X_n (0)=X_(n-L) (0)+W_M^(-(L-1)k) W_M^(-(L-1)k) W_M^km ∑_(t=0)^(L-1)▒〖d(n-t)W_M^(-k(M+t)) 〗 (4.9) It must be pointed out that although the inherent phase shift W_M^(-(L-1)k) in D_n^L (k)is cleared away in (4.7) on the condition of k=0, it is not impacted by the modulation of input signal and cannot be eliminated in (4.9). Due to〖 W〗_M^(-kM)=1, (4.9) can be simplified as
〖 X〗_n (0)=X_(n-L) (0)+W_M^km G_n^L (k) (4.10)

where〖 G〗_n^L (k) is the revised UVT (rUVT).
〖 G〗_n^L (k) =∑_(t=0)^(L-1)▒〖d(n-t)〗 W_M^(-(t+L-1)k) (4.11)
Since the complex twiddle factor is absent from the feedback of the resonator, the pole is precisely fixed on the unite circle. The structure of MHDFT in (10) is depicted in Figure 4.1.

B. Computation of the Revised UVT G_n^L (k)

It is obvious in (11) that the rUVT〖 G〗_n^L (k) resembles the DFT in computation. Several sophisticated FFT algorithms can be used to efficiently compute rUVT. Here, a
radix-2 decimation-in-time (DIT) FFT is employed to implementation of the rUVT〖 G〗_n^L (k).

G_n^L (k)=∑_(t=0)^(L-1)▒〖d(n-t)〗 W_M^(-(t+L-1)k)=A(k)+W_M^(-k) B(k) (4.12)
Where, A(k) = ∑_(p=0)^(L/2-1)▒〖d(n-2p)〗 W_(M/2)^(-(p+L/2-1)k) (4.13)
B(k) = ∑_(p=0)^(L/2-1)▒〖d(n-2p-1)〗 W_(M/2)^(-(p+L/2-1)k) (4.14)

According to (4.12), the -point data sequence d(n) is divided into two L/2 -point sequences, corresponding to the even-numbered and odd-numbered samples of(n) , respectively. Then, the same decimation process can be repeated again and again until the resulting sequences are reduced to one-point sequence. Finally, G_n^L (k) can be easily achieved in terms of the DFTs of those decimated sequences.

IV. BLOCK DIAGRAM

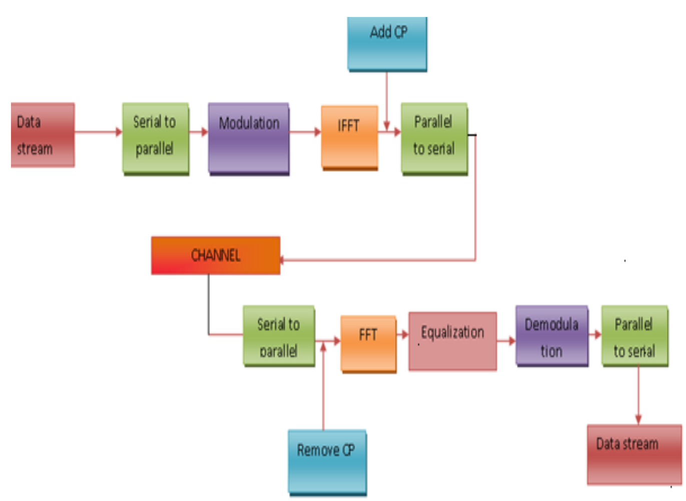

Fig.3 OFDM Structure

Transmitter

The serial-to-parallel (S/P) module converts the incoming high-bit-rate data stream to low-bit-rate parallel blocks of symbols.

The bits are mapped by some type of quadrature amplitude modulation (QAM) or phase-shift keying (PSK) onto complex symbols.

These complex symbols are mapped onto orthogonal carriers and the time-domain OFDM symbols are obtained by inverse fast Fourier transformation (IFFT).

To mitigate ISI between OFDM symbols, a guard time, known as cyclic prefix (CP), is added to each OFDM symbol by copying the end of the block generated by the IFFT to the beginning of the block.

After the addition of the CP, the discrete parallel symbols go through parallel-to-serial (P/S) conversion and digital-to-analogue conversion (DAC) to generate a continuous time domain signal.

Channel

A channel is used to convey an information signal, for example a digital bit stream, from one or several senders (or transmitters) to one or several receivers. A channel has a certain capacity for transmitting information, often measured by its bandwidth in Hz or its data rate in bits per second. Additive white Gaussian noise (AWGN) is a basic noise model used in Information theory to mimic the effect of many random processes that occur in nature.

Receiver

Receiver Module (RM)

At the optical receiver module (RM), the optical OFDM signal detection systems can be classified as direct detection (DD) and coherent detection (CO-D).

To recover data from the orthogonal subcarriers, the serial signal is converted to parallel data blocks, the CP is removed and the OFDM signal is converted back to the frequency domain using forward FFT.

At the receiver side, the information symbols are affected by signal phase and amplitude level shifting caused by chromatic dispersion of the optical channel. Therefore, equalization and forward error correction (FEC) are needed after the forward FFT, and FEC may have to be used. After equalization, each subcarrier is demodulated and data is converted to serial format.

V. SIMULATION RESULTS

The major part of the project development sector considers and fully survey all the required needs for developing the project. Once these things are satisfied and fully surveyed, then the next step is to determine about the software specifications in the respective system such as what type of operating system the project would require, and what are all the necessary software are needed to proceed with the next step such as developing the tools, and the associated operations. Generally algorithms shows a result for exploring a single thing that is either be a performance, or speed, or accuracy, and so on. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g. the behavior) between them.

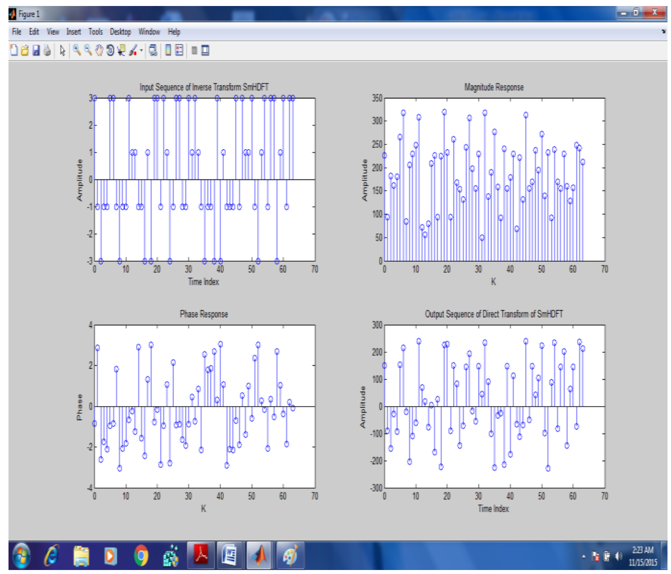

Fig.3 Input, Output SMHD

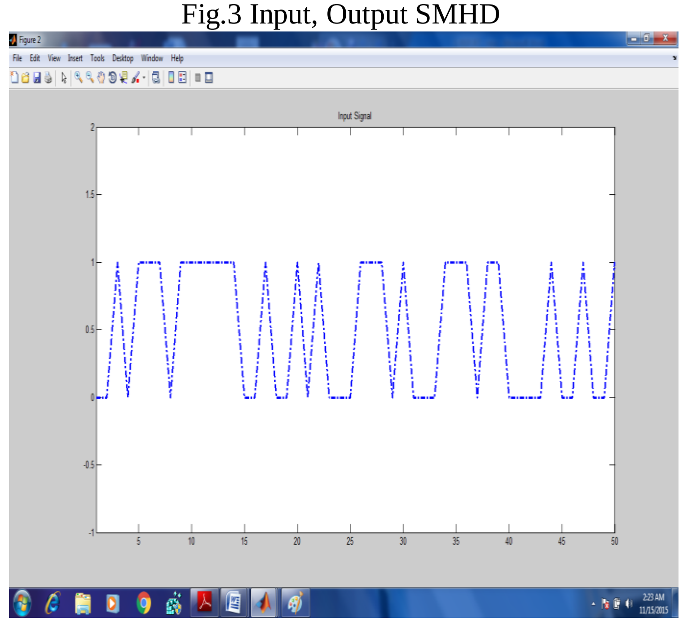

Fig.4 Input Signal

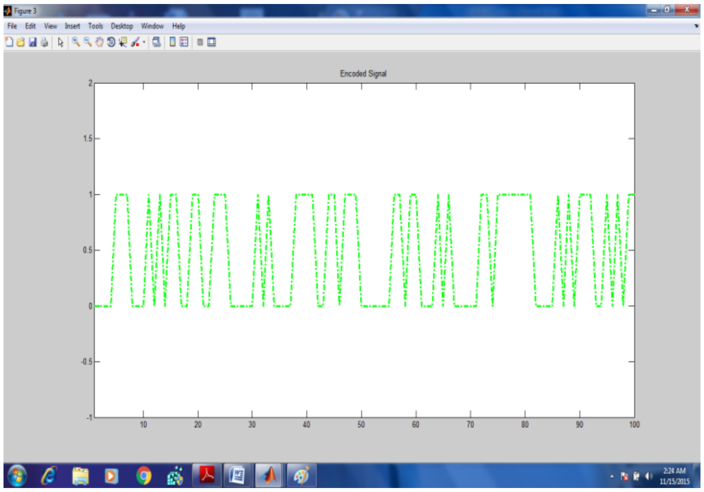

Fig.5 Encoded Signal

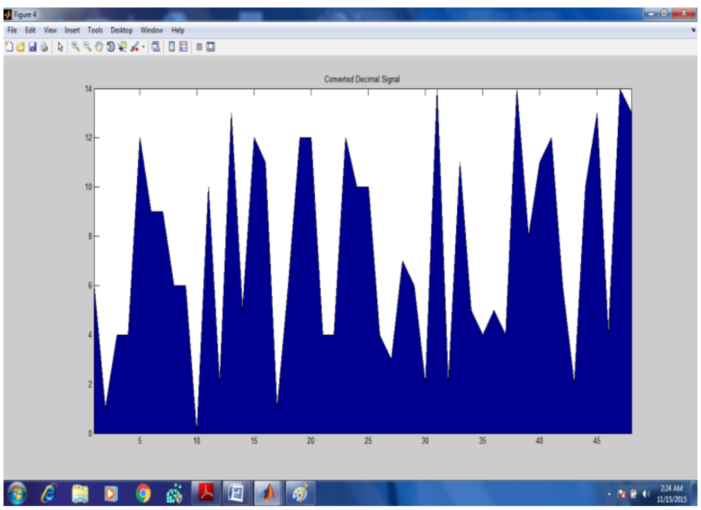

Fig.6 Binary to Decimal Signal

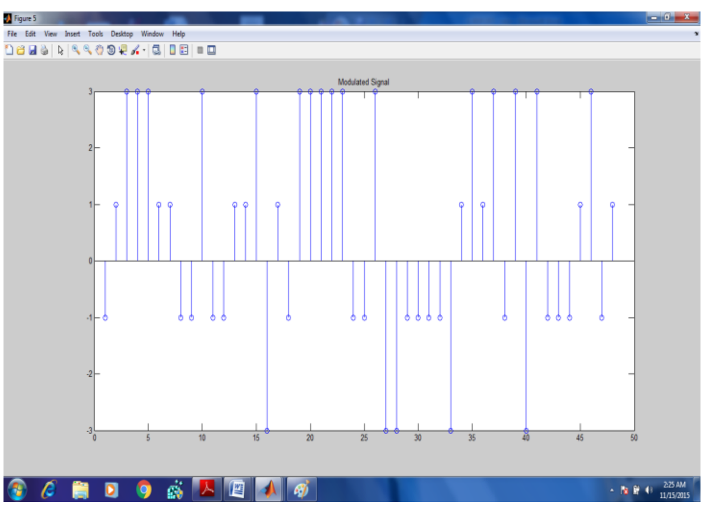

Fig.7 Modulated Signal

VI. CONCLUSION

This Proposed method of SMHDFT algorithm in OFDM communication systems to maintain the high precision and stability. SMHDFT algorithm which is characterized by its merits of high accuracy and constant stability is presented. The proposed SMHDFT algorithm to reduce complexity order, increased throughput and better system performance when compared to the existing FFT method.

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