www.ijecs.in

International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 3 Issue 6 June, 2014 Page No. 6624-6626

A Review paper on compressive modulation in digital communication using OFDM

Lokendra Singh1, Anuj Sharma2
1Post Grad. Scholar, DIT University, Dehradun, India
2Associate Professor, DIT University, Dehradun, India
Kashyap00000@gmail.com
Kashyap00000@gmail.com

ABSTRACT

In the present time bandwidth efficiency is one of the most important parameter to measure different modulation scheme in digital communication. Due to the separation of waveforms of all the existing modulation schemes in time domain it becomes difficult to improve their bandwidth efficiency. Hence it was become very important for researchers to proposed such a scheme that able to improves the bandwidth efficiency of our existing modulation schemes to make them more reliable as per their increasing demands. Latest study in the same field results a new scheme named as Compressive Modulation (CM) which combines Compressive Sensing (CS) with traditional BPSK pattern that leads to highly improved bandwidth efficiency of traditional BPSK. In the current work we are going to use the CS theory with traditional OFDM to make it more bandwidth efficient than traditional one.

Keywords: *Digital communication, Compressive Modulation, Compressive Sensing, BPSK, OFDM.*

1. INTRODUCTION

Digital communication: As the digital communication is backbone of digital age which allows information to be communicated over copper wire, fiber-optic cable, and the air. The first wireless digital communications systems used spark-gap transmitters that used wide spectrum impulses to send single bits. While today's communication systems make efficient use of spectrum to transmit large amounts of data between multiple users. As the number of transmitters rise, researchers will be challenged to make such system which meets the increasing demand of higher data rates with low power consumption. Due to the separation of waveforms of all existing modulation schemes in time domain makes difficult to achieve higher bandwidth efficiency in era of large amount of data. Hence it becomes very important to develop new technique that can improve bandwidth efficiency.

Thus latest work on this field researchers able to proposed such a scheme which was able to dominate over the requirement of higher bandwidth of our existing modulation schemes named as ***Compressive Modulation (CM)***, which combining CS technique with traditional BPSK pattern, and says that information carrying code elements can be aliased in time domain during modulation process and then one can reconstruct the original code stream via optimization algorithm at demodulation point.

Aliasing process: The aliasing process was achieved by first multiplying the code elements by a sinusoidal carrier wave, then adding the current elementary modulated code element with the next which has been shifted forward for a portion of the carrier wave period. Compressing and adding all the code elements provides a time domain aliasing modulated signal.

Compressive Sensing (CS) theory was great achievement in the field of signal processing, which says that it is possible to reconstruct original signal from aliasing measurements. By the CS theory we can capture and represent a compressible signal those signal which are formed by too many samples) at the rate lower than nyquist rate. CS theory is also able to deal with both merely sparse signal (those signal which exactly recovered from highly under sampled measurement) and with noise.

BPSK (Binary Phase Shift Keying):

In this modulation scheme, the phase of carrier wave is used to transmit the digital signal by keeping its frequency and amplitude constant. At the receiver end, the reconstructed signal is in time domain due to which it becomes very difficult to improve its bandwidth efficiency unless we increase the baseband frequency.

Mathematical notation is:

e_{bpsk}= s_o(t)cos $w_c t$ …….(1)

Where, s_o(t) is 100% duty ratio rectangular pulse sequence.

cos w_c t is sinusoidal carrier wave.

Hence, to combat this problem of bandwidth improvement, traditional BPSK pattern is combined with compressive sensing which yields a great change in bandwidth efficiency. The bandwidth of BPSK is at most 10 times and at least 3 times improved.

OFDM (Orthogonal Frequency Division Multiplexing):

Orthogonal Frequency Division Multiplexing (OFDM) is a digital multi-carrier modulation technique that enlarge the concept of single subcarrier modulation by using multiple subcarriers within the same single channel. OFDM is based on the well-known technique of Frequency Division Multiplexing (FDM).

In FDM different streams of information are mapped onto separate parallel frequency channels and each channel is separated by a frequency guard band to reduce interference among the adjacent channels.

OFDM uses large number of closely spaced orthogonal subcarriers that transmits in parallel, instead of transmitting the high data rate stream with a single subcarrier, Each subcarrier is modulated with a conventional digital modulation technique such as 16-QAM etc. at low symbol rate. However, the combination of many subcarriers enables data rates similar to conventional single-carrier modulation schemes with equal bandwidth.

While OFDM is minutely differ from FDM in some ways i.e.:

- Multiple carriers carry the information data streams.
- All the subcarriers are orthogonal to each other.
- A guard time is added to each symbol to reduce the time delay spread and inter symbol interferences.

2. LITERATURE REVIEW

A. Compressive sensing.

G. Baraniuk, IEEE 2007. In this paper, a new method is used to capture and represent compressible signals below the nyqust rate, which employs that non-adaptive linear projection that preserve the structure of signal, then that signal is reconstructed from those projections using optimization process. The result of this paper shows that compressive sensing also applies to sparse or compressible analog signals $x(t)$ that can be represented using only K out of N possible elements from continuous basis $[\psi_i(t)_{i=1}^{N}]$ while ψ_i(t) may have large bandwidth.

B. Introduction to compressive sampling.

J. Candes and B. Wakin, IEEE 2008. In this article two protocols: a) Sparsity and b) Incoherence are used for recovering certain signals and images from far fewer samples. Sparsity tells that information rate of a continuous time signal may be much smaller than suggested by its bandwidth. Incoherence tells that unlike the signal, the sampling/sensing waveforms have an extremely dense representation in ψ. The result of this article shows that by using these protocols it is possible to allow a sensor to very efficiently capture the information in sparse signal without comprehend that signal.

C. Robust uncertainty principles: Exact signal reconstruction from highly incomplete frequency information.

J. Candes, J. Romberg and T. Tao, IEEE 2006. In this paper the problem of reconstruction of signal from partial frequency samples is considered. Researchers said that exact recovery may be obtained by using convex optimization which results to the non-linear sampling theorem and says that any signal made out of ($|T|$) spikes may be recovered by convex optimization from almost every set of frequency having size ($|T| * logN$).

D. Narrowband ultrasonic detection with high range resolution: Separating echoes via compressed sensing and singular value decomposition.

G. Shi, C. Chen, J. Lin, X. Xie, and X. Chen, IEEE 2012. In this paper I have read that narrowband detection has greater potential for obtained high range resolution in comparison of broadband detection. This paper is also using theory of sparse representation and compressed sensing, singular value decomposition is also employed to capture the main features of signals which make this approach robust to moderate signal distortion. The result of this paper is that by using narrowband technique we are able to achieve more stability and accuracy.

E. UWB echo signal detection with ultra-low rate sampling based on compressed sensing.

G. Shi, J. Lin, X. Chen, F. Qi, D. Lin, and Z. Li, IEEE 2008. In this paper a system based on Compressive Sensing (CS) theory was used for sampling the UWB (Ultra Wide Band) echo signal at the rate much lower than Nyquist rate and performs the detection of signal in two different approaches: First, the basis function is constructed using matching rates to achieve sparse signal which is necessary prediction for the CS theory. Second, UWB signal detection system is designed in framework of CS theory, by using matching basis function with analog to information converter. The result of this paper says that UWB echo signal are easily sampled and detected by above system without requiring high-frequency analog to digital converter.

F. Principal component analysis.

In this paper I have read that major principle component are obtained from the principle component analysis (PCA) of low resolution image. The accurate estimate is obtained when PCA recursively performed only on those pixels of image which mainly contribute to the major principal components.

3. CONCLUSION

This study has given the brief introduction about the importance of compressive modulation in our digital communication. The compressive modulation is majorly characterized by compressive sensing. As our all modulation schemes have their limited bandwidth due to which lot of problems arises in our communication field. While compressive modulation is efficiently able to combat this problem of bandwidth efficiency with good robustness in terms of error even in the image processing. Hence, our objective is to develop such a model of OFDM with Compressive Modulation (CM) which may enhance the bandwidth efficiency of traditional OFDM.

4. REFERNCES

[1] ***B. Sklar, Digital Communications-Fundamentals And Applications, 2nd, New Jersey: Prentice Hall, 2011***

.***[2] L. Donoho, "Compressed sensing," IEEE Transactions on Information Theory, vol. 52, no. 4, pp. 1289–1306, Apr. 2006***.

[3] J. Candes and B. Wakin, "An introduction to compressive sampling," IEEE Signal Processing Magazine, vol. 25, no. 2, pp. 21–30, Mar. 2008.

[4] G. Baraniuk, "Compressive Sensing," IEEE Signal Processing Magazine, vol. 24, no. 4, pp. 118–121, Jul. 2007.

[5] J. Candes, J. Romberg, and T. Tao, "Robust uncertainty principles: Exact signal reconstruction from highly incomplete frequency information," IEEE Transactions on Information Theory, vol. 52, no. 2, pp. 489–509, Feb. 2006.

[6] J. Candes and J. Romberg, "Quantitative Robust Uncertainty Principles and Optimally Sparse Decompositions," Foundations of Computational Mathematics, vol. 6, no. 2, pp. 227–254, Apr. 2006.

[7] G. Shi, C. Chen, J. Lin, X. Xie, and X. Chen, "Narrowband Ultrasonic Detection with High Range Resolution: Separating Echoes via Compressed Sensing and Singular Value Decomposition," IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control, vol. 59, no. 10, pp. 2237–2253, Oct. 2012.

[8] G. Shi, J. Lin, X. Chen, F. Qi, D. Liu, and Z. Li, "UWB echo signal detection with ultra-low rate sampling based on compressed sensing," IEEE Transactions on Circuits and Systems II: Express Briefs, vol. 55, no. 4, pp. 379–383, Apr. 2008.

[9] S. Chen, L. Donoho, and A. Saunders, "Atomic decomposition by basis pursuit," SIAM Journal on Scientific Computing, vol. 20, no. 1, pp. 33–61, 1998.

[10] I. Jolliffe, Principal Component Analysis, 2nd, Berlin: Springer- Verlag, 2002.

AUTHOR

Lokendra singh presently lives in Dehradun and completed his Graduation as a B. Tech. graduate in the field of Electronics and communication from Uttar Pradesh Technical University, Lucknow, UP,
India in 2012. He is a post-graduate scholar in the field of Wireless & Mobile Communications from Dehradun Institute of Technology, Dehradun, Uttarakhand, India in 2013. Presently he is working on "OFDM using Compressive Modulation".