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A Review on Robust Image Transmission with OFDM over an AWGN Channel

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ABSTRACT: A new scheme approach is proposed for progressive image transmission over coded Orthogonal Frequency Division Multiplexing (OFDM) system with Low Density Parity Check Coding (LDPC). Trigonometric transforms are used in this scheme for improving the performance of the OFDM systems and reducing the Peak to-Average Power Ratio (PAPR) of OFDM signal. It improves the error resilience ability and transmission efficiency for progressive image transmission over Additive White Gaussian Noise (AWGN) channel. The Set Partitioning In Hierarchical Trees (SPIHT) algorithm is used for source coding of the images to be transmitted. In the proposed scheme the transmit data sequence of the OFDM signal after Inverse Fast Fourier Transform (IFFT) is grouped into in-phase and in-quadrature components, then each component is transformed using either the Discrete Cosine Transform (DCT) or the Discrete Sine Transform (DST). The simulation results show that adding the DST to the system improves the visual quality of reconstructed images and reduces the PAPR of OFDM signal more than the DCT.

KEYWORDS: OFDM, PAPR, SPIHT, LDPC, Trigonometric transforms.

I. INTRODUCTION

OFDM modulation has been adopted by several wireless multimedia transmission standards, such as Digital Audio Broadcasting (DAB) and Digital Video Broadcasting (DVB-T), because it provides a high degree of immunity to multipath fading and impulsive noise. High spectral efficiency and efficient modulation and demodulation by IFFT/FFT are also advantages of OFDM. In the frequency-selective radio transmission channel, all fading and Inter-Symbol Interference (ISI) result in severe losses of transmitted image quality. OFDM divides frequency-selective channel into several parallel non frequency selective narrow-band channels, and modulates signal into different frequencies. It can significantly improve the channel transmission performance without employing complex equalization schemes. It also has broad application prospect in wireless image and video communications. There are still some challenging issues, which remain unresolved in the design of OFDM systems.

a. Background

One of the major problems is high PAPR of transmitted OFDM signals. Therefore, the OFDM receiver detection efficiency is very sensitive to the nonlinear devices used in its signal processing loop, such as Digital-to-Analog Converter (DAC) and High Power Amplifier (HP A), which may severely impair system performance due to induced spectral regrowth and detection efficiency degradation.

SPIHT algorithm:-



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The SPIHT algorithm has been introduced by Said and Pearlman . It is algorithm based on the wavelet transform, and restricts the necessity of random access to the whole image to small sub images. The principle of the SPIHT is partial ordering by magnitude with a set partitioning sorting algorithm, ordered bit plane transmission, and exploitation of self-similarity across different scales of an image wavelet transform. The SPIHT is used for image transmission over the OFDM system in several research works because the SPIHT has a good rate-distortion performance for still images with comparatively low complexity and it is scalable or completely embeddable. To improve the BER performance of the OFDM system, several error correcting codes have been applied to OFDM .

The SPHIT algorithm defines and partitions sets in the wavelet decomposed image using a special data structure called a spatial orientation tree. A spatial orientation tree is a group of wavelet coefficients organized in to a tree rooted in the lowest frequency (coarsest scale) sub band with offspring in several generations along the same spatial orientation in the higher frequency sub band. The SPHIT algorithm consists of three stages: initialization, sorting and refinement. It sorts the wavelet coefficients into three ordered lists: the list of insignificant sets (LIS), the List of Insignificant Pixels (LIP), and the List of Significant Pixels (LSP). At the initialization stage the SPIHT algorithm first defines a start threshold based on the maximum value in the wavelet pyramid, then sets the LSP as an empty list and puts the coordinates of all coefficients in the coarsest level of the wavelet pyramid (Le. the lowest frequency band; LL band) into the LIP and those which have descendants also into the LIS. In the sorting pass, the algorithm first sorts the elements of the LIP and then the sets with roots in the LIS. For each pixel in the LIP it performs a significance test against the current threshold and outputs the test result to the output bit stream.

LDPC codes are a class of linear block codes which provide a reliable transmission for coding performance that is very close to the Shannon's limit and can outperform Turbo codes at long block length but with relatively low decoding complexity. LDPC has been adopted as the DVB-S2 standard. A (N, K) LDPC code can be represented by a very sparse parity-check matrix having M rows, N columns and code rate $R=K/N$, where $K=N-M$ The combination of the high spectral efficiency OFDM modulation technique and LDPC coding will be a good candidate for high speed broadband wireless applications.

The BER performance of the Low Density Parity Check Coding- Coded Orthogonal Frequency Division Multiplexing system (LDPC-COFDM) is influenced by the sub channels which have deep fade due to frequency selective fading. According to this combination, several algorithms were introduced into LDPC-COFDM system to improve the BER by adaptive bit loading and power allocation of each subcarrier. The paper concentrates on two targets reducing the PAPR of the OFDM signal and improving the quality of the reconstructed images. It considers the trigonometric transforms as a way for reducing the PAPR by using the character of the DCT/DST energy focused in the low component.

The data of OFDM signal is modulated by IFFT then using DCT/DST, which can reduce the PAPR. Compared with the means of SLM-OFDM and PTS-OFDM, OFDM system modified by DCT/DST maintain the system orthogonal properties, which will not result in additional noise and need not transmit side information. At the same time, the proposed method reduces the PAPR greatly and the system has character of low complexity hardware.

b. Motivation

There are still some challenging issues, which remain unresolved in the design of OFDM systems. One of the major problems is high PAPR of transmitted OFDM signals. Therefore, the OFDM receiver detection efficiency is very sensitive to the nonlinear devices used in its signal processing loop, such as Digital to Analog Converter (DAC) and High Power Amplifier (HPA), which may severely impair system performance due to induced spectral regrowth and detection efficiency degradation. All fading and Inter-Symbol Interference (ISI) result in severe losses of transmitted image quality. The aim of this project is reduce the PAPR of transmitted OFDM signals, improve the transmitted image quality & The SPIHT coder is chosen as the source coding technique due to its flexibility of code rate and simplicity of designing optimal system.

c. Project Objective

The project concentrates on two targets reducing the PAPR of the OFDM signal and improving the quality of the reconstructed images. It considers the trigonometric transforms as a way for reducing the PAPR by using the character



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Simulation:

Software Tools Used :- MATLAB 2010a

MATLAB Simulation are carried to study the transmission of SPIHT coded images on LDPC COFDM modified by Trigonometric transforms over AWGN channel

II. LITERATURE SURVEY

There are several developed techniques to reduce the PAPR in OFDM systems[3,4] such as clipping[5], companding[6,7], Partial Transmit Sequence[8], (PTS) Selected Mapping (SLM)[9], and coding [10]. The clipping technique is the simplest one that can be used in OFDM systems, but it causes additional clipping noise, which degrades the system performance. An alternative technique to mitigate the PAPR problem is based on signal transformations. This technique involves a signal transformation prior to amplification, then an inverse transformation at the receiver prior to demodulation. In [11] trigonometric transforms were suggested as alternatives for the FFT to reduce the PAPR. The authors in concluded that OFDM systems with trigonometric transforms provide higher PAPR reduction than the standard FFT based system. However, they modified the OFDM symbols before transmission using the PTS. Their results reveal that without PTS, the distribution of PAPR is the same for that conventional one such that the reduction depends on PTS, which makes redundancy in the system.

The SPIHT is used for image transmission over the OFDM system in several research works[13,14] because the SPIHT has a good rate-distortion performance for still images with comparatively low complexity and it is scalable or completely embeddable.

Y. Sun, X. Wang and Liu proposed the paper[13] "A Joint Channel Estimation and Unequal Error Protection Scheme for Image Transmission in Wireless OFDM Systems" in "Multimedia Signal Processing" Journal, IEEE, pp. 380 - 383, 2002 - This orthogonal frequency division multiplexing (OFDM) modulation, adopted by the digital video broadcasting (DVB-T) standard, has been recognized for its good performance for high data rate wireless communications. Therefore, the study of the robust transmission of multimedia data over OFDM systems has attracted extensive research interests. In the past, channel estimation, which is an important aspect in OFDM systems, has not been exploited for multimedia transmission. When using the block training based channel estimation, OFDM data blocks experience unequal decoding error rate due to the imprecision of channel estimation. We use this property to provide unequal error protection (UEP) for transmission of SPIHT coded images. Compared with the systems using pilot training channel estimation schemes, which are recommended in the DVB-T standard, the proposed scheme improves the PSNR of reconstructed images by up to 2 dB.

Gusmo, R. Dinis and N. Esteves[2], proposed the paper "On Frequency Domain Equalization and Diversity Combining for Broadband Wireless Communications" in IEEE Commun. Lett., Vol.51, No.7, 2003. This is concerned with the use of frequency-domain equalization (FDE) and space diversity within block transmission schemes for broadband wireless communications. The expected performance with both multicarrier (MC) and single-carrier (SC) modulations is emphasized, when a cyclic prefix, long enough to cope with the maximum relative channel delay, is appended to each transmitted block. A set of numerical results is presented and discussed, with the help of appropriate, analytical performance bounds which are conditional on a given channel realization. These bounds are used to explain the performance advantage of the SC/FDE option, the benefits of space diversity, and the impact of the criterion for computing the FDE parameters.

C. Yuan Yang and M. Kai Ku[18] proposed the paper, "LDPC Coded OFDM Modulation for High Spectral Efficiency Transmission" Proceedings in ECCSC 2008, 2008. This paper investigates efficient low-density parity-check (LDPC) coded orthogonal frequency division multiplexing (OFDM) modulation schemes for fixed wireless application. We use partially LDPC coded with double gray code labeling technique and Reed-Solomon code with LDPC Coded Modulation (RS-LCM) to achieve better performance than the conventional LDPC bit-interleaved coded modulation (BICM) scheme. RS-LCM scheme outperforms BICM scheme by 0.4 dB at a BER of 10^{-5} .

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S.Wang , J.Dai, C.Hou and X. Liu[14] proposed the paper , " Progressive Image Transmission over Wavelet Packet Based OFDM" Proceedings in Electrical and Computer Engineering 2006 Canadian Conference 2006.A new scheme for progressive image transmission over wavelet packet based orthogonal frequency division multiplexing (WP-OFDM) system is proposed. First, the BER performances of WP-OFDM systems with different Daubechies wavelet as orthogonal basis functions in multipath fading channel are investigated. The results show that there are error floors in the BER curves, so an equalization method is applied to eliminate the error floor. Then in the WP-OFDM system with the equalization method, a joint source channel coding (JSCC) method is introduced to give image encoder output bit streams with different perception importance unequal error protection. Simulation results confirm the effectiveness of our proposed image transmission scheme.

A. Rushdi and J. Tuqan [11] proposed paper,"Peak reduction in Trigonometric Based OFDM System" Proceedings in ACSSC.2007 . A key building block in any OFDM transceiver is the Fast Fourier Transform (FFT) and its inverse. A number of researchers have recently proposed the use of the discrete cosine transform (DCT) and the discrete sine transform (DST), and their inverses as alternative modulating/demodulating bases to improve the BER performance of OFDM schemes while maintaining a low implementation cost. In this paper, we consider the open problem of reducing the peak-to-average power ratio (PAPR) in OFDM systems that deploy these trigonometric transforms. In specific, we show that similar to the FFT case, the complex envelope of a band limited DCT/DST- OFDM signal has a chi-square distribution with one degree of freedom and hence converges weakly to a Gaussian random process as the number of sub-carriers becomes large. Using this result, we then derive closed form expressions for the complementary cumulative distribution functions (CCDF) of each system and show that OFDM systems with trigonometric transforms provide higher PAPR reduction than the standard FFT-based system. Simulation results that compare the CCDFs of the different transforms using the partial transmit sequences (PTS) technique confirm our theoretical findings.

T. Jiang and Y. Wu[3] proposed paper, "An Overview: Peak-to-Average Power Ratio Reduction Techniques for OFDM Signals"2008. One of the challenging issues for Orthogonal Frequency Division Multiplexing (OFDM) system is its high Peak-to-Average Power Ratio (PAPR). In review and analysis different OFDM PAPR reduction techniques, based on computational complexity, bandwidth expansion, spectral spilage and performance. And [4, 5, 6] also some methods of PAPR reduction for multiuser OFDM broadband communication systems.

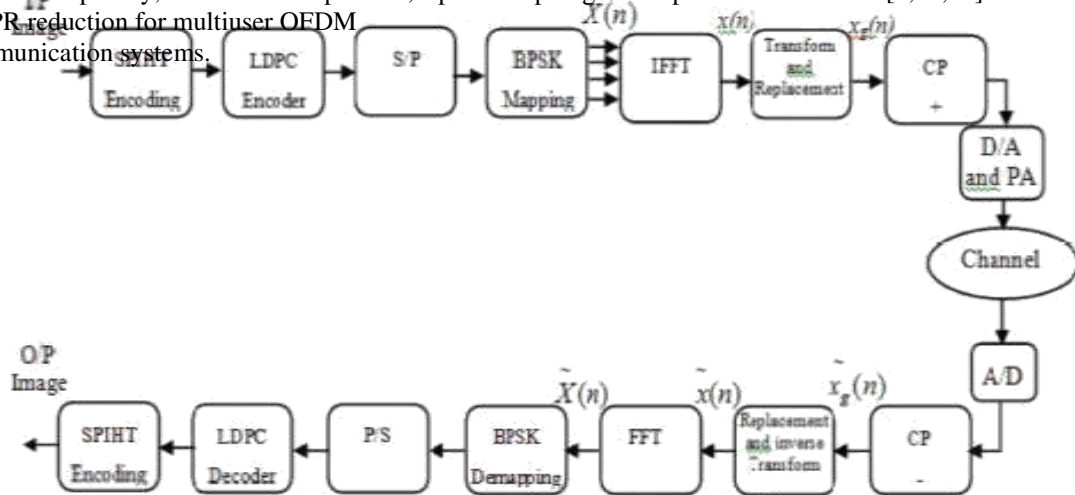


Fig. 1: The LDPC COFDM system model with trigonometric transforms

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III. OFDM SYSTEM DESCRIPTIONS WITH PROPOSED MODIFICATION

The block diagram of the proposed LDPC-COFDM system is illustrated in Fig. 1. As will be shown in the next sections, the proposed modifications will be in the transform and replacement block. The SPIRIT coder is chosen as the source coding technique due to its flexibility of code rate and simplicity of designing optimal system. The SPHIT divides the image stream into several layers according to the importance of progressive image stream. Then the image stream is converted to a binary format. Afterwards the information bits are LDPC encoded at the LDPC encoder. The OFDM considered in this paper utilizes N frequency tones (number of subcarriers) hence the baseband data is first converted into parallel data of N sub channels so that each bit of a code word is on different subcarrier. The N subcarriers are chosen to be orthogonal, Then, the transmitted data of each parallel sub channel is modulated by Binary phase Shift Keying (BPSK) modulation because it provides high throughput and best performance when combined with the OFDM. Finally, the modulated data are fed into an IFFT circuit, such that the OFDM signal is generated. The resulting OFDM signal can be expressed as follows:

Where X_n is a discrete time sample.

The output of IFFT is split into two components; in-phase and in-quadrature. Then, either the DCT or the DST is applied to both components, separately. The first half of samples of the in-phase component after the transform (L_i) is concatenated with the first half of samples of the in-quadrature component after the transform (L_q) to form the new in-phase component. Similarly, the second half of samples of the in-phase component after the transform (H_i) is concatenated with the second half of samples of the in-quadrature component after the transform (H_q) to form the new in-quadrature component.

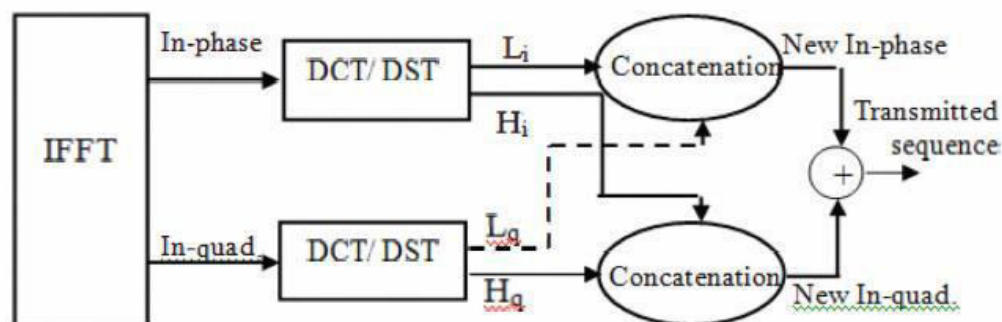


Fig. 2: The trigonometric transform and replacement process.

This sequence after this process can be called x_n with the subscript d referring to the trigonometric transformation process. Each data block is padded with a cyclic prefix (CP) of a length longer than channel impulse response to mitigate the Inter-Block Interference (IBI). The continuous COFDM signal $x(t)$ is generated at the output of the digital to analog (D/A) converter. According to [1], the PAPR of transmitted analog signal can be expressed as follows:

$$PAPR = \frac{\max |x_g(t)|^2}{E[|x_g(t)|^2]}$$

where $E[.]$ is the average power. Generally, the PAPR is considered for a single OFDM symbol, which has a time



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duration T . This duration comprises a number of samples equal to $(N_f + N_g)$, where N_g is the guard interval length. At the receiver, the guard interval is removed and the time interval $[O, T]$ is evaluated. The replacement and inverse transform are then applied to the received samples. Afterwards, the OFDM sub channel demodulation is implemented by using a (FFT) then the Parallel-to-Serial (P/S) conversion is implemented. This received OFDM symbols are demodulated at the demodulator. The demodulated bits are decoded with each LDPC encoded block and data bits are restored. These data are converted into image format, such that SPIHT decoder can be obtained.

IV. FUTURE WORK & APPLICATION

Future work

- I. Video can be transmitted in this proposed system.
- II. SPIHT also offers several possibilities for processing color information and can marginally be found in digital video or 3D image processing (3DSPIHT).
- III. All of these have dimension of 512×512 pixels or 256×256 pixels and were tested by 0.3bpp compression. It can also be modify this parameter for the specific applications.

Application

- I. Wireless image and video communication
- II. Handling the increased spatial resolution of today's imaging sensors and evolving broadcast television for better quality of image i.e. for communication purpose.
- III. SPIHT exploits properties that are present in a wide variety of images. It had been successfully tested in natural (portraits, landscape, weddings, etc.) and medical (X-ray, CT, etc.) images.
- IV. In multimedia image compression and communication.
- V. Video transmission over unreliable network such as Internet or Wireless network suffers from various kinds of adverse condition such as bandwidth fluctuation, burst-error contamination, packet loss, and excessive packet delay due to network congestion.

V. CONCLUSION

The combination of the high spectral efficiency OFDM modulation technique and LDPC coding will be a good candidate for high speed broadband wireless applications. The BER performance of the Low Density Parity Check Coding- Coded Orthogonal Frequency Division Multiplexing system (LDPC-COFDM) is influenced by the sub channels which have deep fade due to frequency selective fading. According to this combination, several algorithms were introduced into LDPC-COFDM system to improve the BER by adaptive bit loading and power allocation of each subcarrier. The efficient LDPC coded OFDM system with trigonometric transforms supporting image transmission using SPIHT compression technique is presented and studied. The effectiveness of the proposed system is investigated through simulations over AWGN channel. It is found that the proposed system must be designed carefully in order to achieve a reduction in the PAPR without degrading the PSNR performance. For LDPC COFDM with rate ($R=0.5$) and rate of SPIHT rate ($r = 1$) the OFDM signal can be reduced by nearly 7dB or 7.25dB by adding the DCT or DST respectively. We also try to obtain the PSNR for the received standard image through internet at different rates. This work will give the performance of the system model using any realtime 256×256 grayscale images.

REFERENCES

- [1] H. Schulze and C. Luders, Theory and Application of OFDM and CDMA Wideband Wireless Communication. John Wiley, 2005.
- [2] Gusmo, R. Dinis and N. Esteves, "On Frequency Domain Equalization and Diversity Combining for Broadband Wireless Communications", IEEE Commun. Lett., Vol. 51, No. 7, July 2003.
- [3] T. Jiang and Y. Wu, "An Overview: Peak-to-Average Power Ratio Reduction Techniques for OFDM Signals", IEEE Transactions on Broadcasting, Vol. 54, No. 2, pp. 257-268, Jun. 2008.
- [4] F.S. Al-Kamali, M. I. Dessouky, B.M. Sallam, F. Shawki and F. E. Abd El-Samie, "Transceiver Scheme For Single-Carrier Frequency Division Multiple Access Implementing the Wavelet Transform and Peak To-Average-Power Ratio Reduction Methods" IET Communications, Vol. 4, No. 1, pp. 69-79, 2010.



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Website: www.ijirccce.com

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- [5] J. Kim and Y. Shin, "An Effective Clipped Companding Scheme for PAPR Reduction of OFDM Signals", Proceedings of the IEEE ICC'08, pp.668-672, 2008.
- [6] T. Jiang, W. Yao, P. Guo, Y. Song and D. Qu, "Two Novel Nonlinear Companding Schemes With Iterative Receiver to Reduce PAPR in Multi-Carrier Modulation Systems", IEEE Transactions on Broadcasting, Vol. 51, No. 2, pp. 268 - 273, Jun. 2006
- [7] F. S. Al-Kamali, M. I. Dessouky, B. M. Sallam, F. Shawki and F. E. Abd El-Samie, "Performance Enhancement of SC-FDMA Systems Using a Companding Technique", Ann. Telecommun., Vol. 65, No.5-6, pp. 293-300, 2010.
- [8] L. Guan, T. Jiang, D. Qu and Y. Zhou, "Joint Channel Estimation and PTS to Reduce Peak-to-Average Power Ratio in OFDM Systems without Side Information", IEEE Signal Processing Letters, Vol. 17, No.10, pp. 883-886, October 2010.
- [9] E. S. Hassan, S. E. El-Khamy, M. I. Dessouky, S. A. El-Dolil and F. E. Abd El-Samie, "A Simple Selective Mapping Algorithm For The Peak To Average Power Ratio In Space Time Block Coded MIMO-OFDM Systems" Proceedings of the International Conference on High Performance Computing, Networking and Communication Systems (HPCNCS-08), 2008.
- [10] T. Jiang and G. Zhu, "Complement Block Coding for Reduction in Peak-to-Average Power Ratio of OFDM Signals," IEEE Communications Magazine, vol. 43, no.9, pp. S17 - S22, Sept. 2005.
- [11] A. Rushdi and J. Tuqan, "Peak reduction in Trigonometric Based OFDM System", Proceedings in ACSSC.2007, pp. 1747 - 1751, 2007.
- [12] Said and W.A. Pearhnan, "A New, Fast and Efficient Image Codec Based on Set Partitioning In Hierarchical Trees", IEEE Trans. Circuits Syst. Video Technol., Vol.6, pp. 243-250, 1996.
- [13] Y. Sun, X. Wang and Liu, K.J.R, "A Joint Channel Estimation and Unequal Error Protection Scheme for Image Transmission in Wireless OFDM Systems", Multimedia Signal Processing, IEEE, pp. 380 - 383, 2002.
- [14] S. Wang, J. Dai, C. Hou and X. Liu " Progressive Image Transmission over Wavelet Packet Based OFDM", Proceedings in Electrical and Computer Engineering 2006 Canadian Conference Conference, pp.950 - 953, 2006.
- [15] R. G. Gallager, "Low Density Parity Check Codes", IRE Trans. Inform. Theory, Vol. IT-8, pp. 21-28, Jan. 1962.
- [16] D. J. C. MacKay, "Good Error-Correcting Codes Based on Very Sparse Matrices", IEEE Trans. Inform. Theory, Vol.45, pp. 399-431, Mar. 1999.
- [17] Y. Li and W.E. Ryan, "Mutual-Information-Based Adaptive Bit-Loading Algorithms for LDPC-Coded OFDM", IEEE transaction on wireless communication, Vol.6, pp. 1670 - 1680, May 2007.
- [18] C. Yuan Yang and M. Kai Ku "LDPC Coded OFDM Modulation for High Spectral Efficiency Transmission", Proceedings in ECCSC 2008, pp. 280 - 284, July 2008.