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Arbitrary Multiplexing Rates For Video Broadcasting In Broadband Wireless Transmission Systems

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Abstract— **In mobile communication system, video streaming applications have been increased rapidly and it demands more bandwidth. The multiplexing-diversity tradeoff is a major problem for the case of video broadcasting systems. In the existing schemes, the transmission is possible only with the integer multiplexing rates. The proposed HCDD scheme is capable of transmitting the non-integer multiplexing rates too. On contrary to the existing system, representing the data transmission on spatial dimension , the proposed scheme provides the benefit of representing the same on subcarrier frequency dimension. In the existing MIMO-OFDM schemes, in which all subcarriers transmit at same rate, the proposed HCDD scheme can support different rates at each subcarrier or for a group of subcarriers. One of the major advantage of HCDD is that the rate of space-time codes can be adjusted flexibly according to the system requirements by assigning r_k to different subcarriers. Also the number of transmitting antennas can also be adjusted flexibly. The proposed HCDD can be applied to systems with only two transmitting antennas. Moreover the proposed scheme has less stringent constraints on channel coherence and is less complex.**

Keywords: MIMO-OFDM, CDD, HCDD, diversitymultiplexing-tradeoff

I. INTRODUCTION

Video transmission plays a significant role in various fields of mobile and wireless communication systems. Traditionally, more bandwidth is required for higher data-rate transmission. Due to spectral limitations, it is impractical or sometimes very expensive to increase bandwidth. In order to achieve high reliability, availability without using additional bandwidth and flexible multiplexing-diversity tradeoff, an advanced diversity technique called HCDD is employed.

If single-carrier modulation is used, the symbol duration reduces with the increase in data rate, and fading of the wireless channels will cause intersymbol interference (ISI). In orthogonal frequency-division multiplexing(OFDM), the channel is divided into many narrow-band subchannels, which are transmitted in parallel to maintain high-data rate transmission and to increase the symbol duration to combat ISI. The capacity of a wireless system can be improved if multiple transmit and receive antennas are used to form multiple-input–multiple-output (MIMO) channels[1].

Cyclic Delay Diversity(CDD) is a popular diversity technique proposed for the MIMO-OFDM systems[2]. With CDD, the OFDM signal is transmitted over different antennas, each of which experiences different cyclic shifts[3]. Thus, extra frequency selectivity can be created at the receiver without changing the receiver design. Combining CDD with the SM-based MIMO can provide both the diversity and multiplexing gains[4]. The combination of spatial multiplexing (SM) with CDD yields Hybrid Cyclic Delay Diversity (HCDD). This provides transmission of the subcarrier in frequency dimension in different data rates. The rate of the space-time codes[5] can be adjusted flexibly. The technique also adds non-integer multiplexing rates. The minimum number of transmitting antennas required for DSTTD or SCDD is four, while HCDD can be applied to systems with only two transmitting antennas. Thus the proposed scheme allows video transmission , with reduced antenna number. It makes the system economic and also provides higher efficiency.

The diversity-multiplexing tradeoff (DMT) provides a theoretical background for multiple-antenna systems and multiple antennas are very important to improve the performance of wireless systems[6]. Compared with the conventional single-antenna channels, the spectral efficiency is higher in MIMO channel. DMT establishes the basis tradeoff between reliability and rate via diversity gain and spatial multiplexing gain which are two types of gains in a MIMO channel. Diversity gain is a measure of reliability, and shows the decay in error probability with increasing signal-to-noise ratio (SNR) while spatial multiplexing gain is related to the transmission rate of the system, and shows the increase in rate with increasing SNR. Most researches put attention on designing schemes to get either maximal diversity gains or maximal spatial multiplexing gains[7]. This proposed scheme considers both maximal diversity gain and maximal spatial multiplexing gain simultaneously.

II. INTRODUCTION TO HCDD

In general, the rate of space-time codes can be assigned to each subcarrier with respect to the number of transmitting antenna Mt. In communication systems, it is very difficult to decode by arbitrarily assigning r_k . Thus the encoding and decoding process are made less complex and flexible by a systematic construction method.

The subcarriers are initially divided to many equal-sized resource blocks, containing Nq subcarriers. The rate associated with the subcarriers in the resource block is managed. The rate of the HCCD code is given by

$$r = \frac{\sum_{p=1}^{P} f_p N_p}{N_q} \tag{1}$$

where Np is the number of subcarriers with rate equal to . And the target rate of HCDD is r_G, then $\{N_1, N_2, \ldots, N_P\}$, should satisfy the following constraints:

$$\begin{cases} f_1 N_1 + f_2 N_2 + \ldots + f_P N_P = r_G N_q \\ N_1 + N_2 + \ldots N_P = N_q \\ N_P \in Z+, \forall_P \end{cases} \tag{2}$$

The algorithm for the code construction of HCDD scheme is shown in Fig 1. One feasible combination from $[N_1, N_2, \ldots, N_P]$ is chosen by the encoder which is applied to all resource blocks. The major advantage is that less information is needed than other construction methods as the decoder needs only the index numbers for the decoding process and no channel state information(CSI) is known at the transmitter.

The decoding process becomes very easy as the receiver knows the transmitted subcarrier combination $[N_1, N_2, \ldots, N_P]$ and each subcarrier multiplexing rate . Then the decoding process is performed by a tone-by –tone basis.

The minimum-mean-square-error (MMSE) detector for the subcarriers with r_k =1 for which $\tilde{H}_k$ is a ($M_r \times 1$) vector is given by,

$$G_k^{MMSE} = \left(\tilde{H}_k^{H} + \frac{1}{SNR} \right)^{-1} \tilde{H}_k \tag{3}$$

The successive interference cancellation (SIC) is achieved for the subcarriers with $r_k \geq 2$ by QR-decomposition (QRD)[8]. The performance can be further improved.

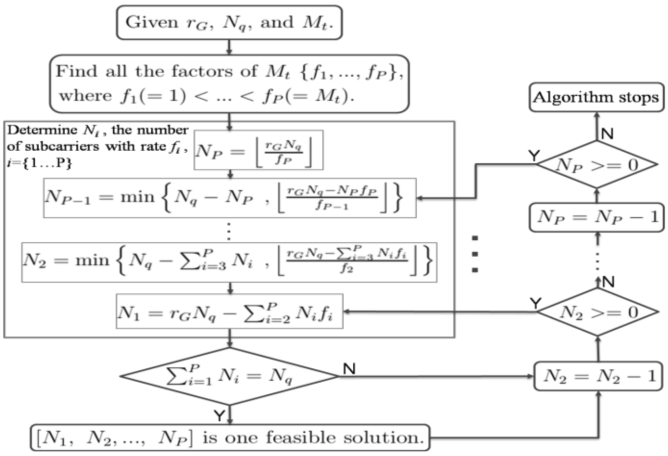

Fig 1. Algorithm for HCDD code construction

III. HCDD TRANCEIVER ARCHITECTURE

The evolution of digital video technology and the continuous improvements in communication infrastructure is propelling a great number of interactive multimedia applications, such as real-time video conferencing, web video streaming and mobile TV[8]. With the introduction of the H.264/AVC video coding standard, certain improvements are achieved in video compression capability[9].

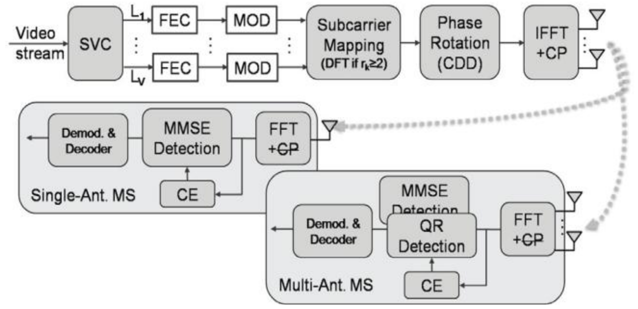

Fig 3. HCDD-SVB transmitter and receiver

SVC(Scalable Video Coding) separates the high-quality video stream into several bit streams forming several layers which are decoded. If the basic layer is decoded correctly then a display of low resolution video is achieved. High resolution video is obtained when all the layers are decoded correctly. As for the receivers with small handheld terminal with single RF chain low resolution video is sufficient .The HCDD technique, is employed so that different layers are transmitted with different diversity gain and multiplexing rates. By using HCDD, the decoding process is easy as the subcarrier combination chosen by the transmitter is already informed to the receiver along with its multiplexing rates by HCDD code construction illustrated in Fig 1. Hence arbitrary multiplexing rates can also be achieved. The signal processing of HCDD-based SVB is illustrated in Fig 3. Thus for small terminals, HCDD- based SVB is simpler, less expensive with better energy efficiency.

IV. SIMULATION RESULTS

Here the performance of diversity schemes are compared. To achieve non-integer diversity-multiplexing tradeoff is the major advantage of the HCDD scheme proposed. This is explained in terms of outage probability and bit error rate as in [10].

A. *Outage Capacity Performance*

The outage capacity of the SM, CDD, HCDD schemes in 2×2 MIMO-OFDM systems are shown in Fig 4. SM and CDD schemes are provided with multiplexing rates of two and one respectively. In contrary the proposed HCDD can chose non-integer value. Here the rate provided is r_G =1.5. Thus the

performance gap in the existing technique is filled by the proposed HCDD scheme. Thus the technique favours less stringent constraints on channel coherence, lower complexity and flexibility on antenna numbers.

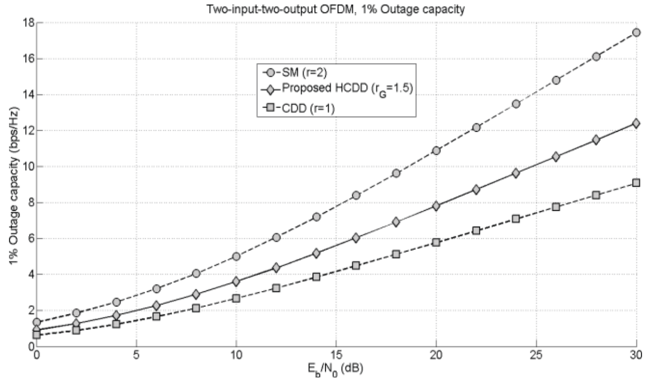

Fig. 4. The 1% outage capacity performance of different transmission schemes in the 2 × 2 MIMO-OFDM systems.

B. *BIT ERROR RATE*

The bit error rate performance of different antenna and multiplexing schemes are shown in Fig 5. The bit error rate with the multiplexing rate r_G =1.25 and r_G =1.33 are analyzed. In general the slope of the BER curve against E/No estimates the diversity gain. Thus for the case of CDD and SM MIMO systems the multiplexing rates are 1 and 2 respectively. The proposed HCDD scheme provides non-integer multiplexing rates that is any rates between 1 and 2 can be achieved.

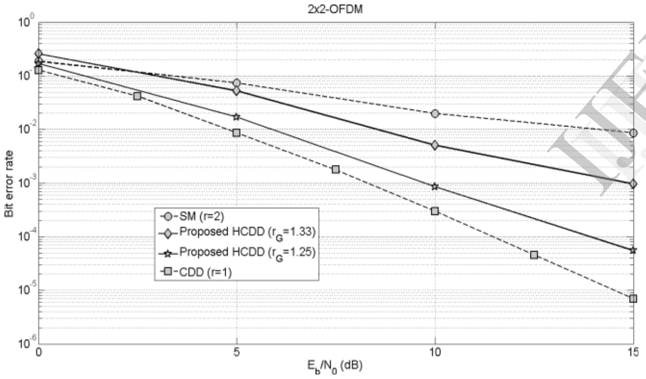

Fig 5 Comparison of bit error rate performance of SM, HCDD, and CDD antenna transmission schemes in the 2 × 2 MIMO-OFDM systems.

TABLE I
BIT ERROR RATE SIMULATION PARAMETERS

Parameter	**Description**
Number of subcarriers(N)	128
Carrier Bandwidth	10MHz
Cyclic Prefix Length	N/4
Channel Model	Flat-fading channel
Channel Code	Convolutional Encoder, Vitervi decoder
Constraint Length	7,[133 171]
Modulation	BPSK
MIMO Receiver	Linear MMSE
Channel Estimation	Ideal Channel Estimation

V. CONCLUSION

, Thus the proposed HCDD scheme can support different rates at each subcarrier or a group of subcarriers inorder to achieve flexible multiplexing and diversity tradeoff in MIMO-OFDM systems. This is explained with respect to the bit error rate and outage capacity performance results. In the combination of HCDD with SVB, the transmitted subcarriers are informed to the receiver thus making decoding process easy and therefore the overall receiver complexity is lower compared with the conventional schemes.

REFERENCES

[1] T. Hwang, C. Yang, G. Wu, S. Li, and G. Ye Li, “OFDM and its wireless applications: a survey,” IEEE Trans. Veh. Technol., vol. 58, no. 4, pp.1673–1694, May 2009.

[2] M. Bossert, A. Huebner, F. Schuehlein, H. Haas, and E. Costa, “On cyclic delay diversity in OFDM based transmission schemes,” in Proc.2002 OFDM Workshop.

[3] Y. J. Kim, H. Y. Kim, M. Rim, and D. W. Lim, “On the optimal cyclic delay value in cyclic delay diversity,” IEEE Trans. Broadcast., vol. 55, no. 4, pp. 790–795, Dec. 2009.

[4] M. I. Rahman, S. S. Das, E. de Carvalho, and R. Prasad, “Spatial multiplexing in OFDM systems with cyclic delay diversity,” in Proc. 2007 IEEE Veh. Technol. Conf. – Spring, pp. 1491–1495.

[5] L. Zhao and V. Dubey, “Detection schemes for space-time block code and spatial multiplexing combined system,” IEEE Commun. Lett., vol. 9, no. 1, pp. 49–51, 2005.

[6] L. Zheng and D. Tse, “Diversity and multiplexing: a fundamental tradeoff in multiple-antenna channels,” IEEE Trans. Inf. Theory, vol. 49, no. 5, pp. 1073–1096, May 2003.

[7] J. T. Wang, “Combined diversity and multiplexing for multiple-input multiple-output system with cochannel interference,” IET Commun., vol. 4, no. 10, pp. 1164–1173, 2010.

[8] S. Jaeckel and V. Jungnickel, “Scalable video transmission in multiantenna broadcast systems,” Proc. 2008 European Wireless Conf.

[9] H. Schwarz, D. Marpe, and T. Wiegand, “Overview of the scalable video coding extension of the H.264/AVC standard,” IEEE Trans. Circuits Syst. Video Technol., vol. 17, no. 9, pp. 1103–1120, Sep. 2007.

[10] A. Dammann and S. Kaiser, “Performance of low complex antenna diversity techniques for mobile OFDM systems,” in Proc. 2001 Int. Workshop Multi-Carrier Spread-Spectrum Related Topics, pp. 53–64.