Efficient Channel Estimation in IDMA Using Number of User Size and Block Lengths

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Abstract: - MULTI-access techniques have been adopted widely for communications in underwater acoustic channels, which present many challenges to the development of reliable and practical systems. In such an environment, the unpredictable and complex ocean conditions cause the acoustic waves to be affected by many factors such as limited bandwidth, large propagation losses, time variations and long latency, which limit the usefulness of such techniques. Additionally, multiple access interference (MAI) signals and poor estimation of the unknown channel parameters in the presence of limited training sequences are two of the major problems that degrade the performance of such technologies.

Keywords - OFDM-IDMA, Channel Estimation, Least Squares (LS) algorithm, Minimum Mean Square Error (MMSE) Algorithm.

I. INTRODUCTION

Since the beginning of the 20th century, technologies have evolved remarkably to provide new methods and products for wireless communications. Especially in the past two decades, wireless communication services were penetrating into our society with an explosive growth rate.

First Generation (1G) Wireless Communication Systems:

The 1G system are characterized by the fact that they are all based on the analog technologies. Some representatives of 1G cellular systems are the Advanced Mobile Phone System (AMPS) in USA, Nordic Mobile Telephone (NMT) in Scandinavia and the Total Access Communication System (TACS) in UK [1]. They are designed to carry voice transmission only. In these systems, each user has a unique frequency band.

Second Generation (2G) Wireless Communication Systems:

The 2G cellular systems are all based on the digital technologies. The most popular 2G standards include three time-division multiple-access (TDMA) standards and one code-division multiple access (CDMA) standard. The Global System for Mobile communications (GSM) is the first operated digital cellular system based on TDMA, whose commercial operation began in 1991 in Europe. The other two TDMA based standards are Interim Standard 54(IS-54) in North America and Pacific Digital Cellular (PDC) in Japan.

Third Generation (3G) Wireless Communication Systems:

The 3G standardshave been developed specially to support high-rate data services such as high-speed internet access, video stream and high quality image transmission. International MobileTelecommunications-2000 (IMT-2000) is the global standard for 3G wireless communications, defined by a set of interdependent International Telecommunication Union (ITU)Recommendations. IMT-2000 provides a framework for worldwide wireless access by linking the diverse systems based networks [4].

Fourth Generation (4G) Wireless Communication Systems:

Even before 3G systems were being deployed, researchers started the investigations on possible techniques for 4G systems. The explicit 4G standard is still not confirmed. In June 2003, ITU approved the recommendation ITU-R M.1645 "Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000" [6].

Interleave Division Multiple Access (IDMA)

Multiuser architectures require some unique characteristic so that each user can be recognized from each other. For CDMA systems, the characteristic feature is to use user-specific signatures and the inter leaver is usually employed to suppress channel impairments. However, as discussed in the previous sections, the high complexity of multiuser CDMA architectures restricts their practical implementation. This section describes the transmission and detection principles of IDMA systems, where the chip-level interleavers are the only means for user separation. The scheme allows slow complexity detection techniques that are applicable to systems with large K in multipath channels. For simplicity, only iterative detection strategies for real channel conditions are considered, but the principle can be easily extended to complex signalling.

II. MULTIPATH CHANNEL MODELS

Radio Channel Characteristics

Mobile radio channels are considered to be the most challenging channels. In cellular systems, the transmitted signal between a base station (BS) and a mobile terminal(MT) suffers from some nearly independent effects including path loss, log-normal shadowing, Doppler shift and multipath propagation. The choice of system architecture and optimization of system parameters for communications are dependent on the channel conditions.

Channel fade statistics characterize the fading process of the channel. A simple and often used approach is obtained from the assumption that there is a large number of scatterers in the channel that contribute to the signal at the receiver side. The application of the central limit theorem leads to a complex-valued Gaussian process for the channel impulse response.

Channel Model in Time Domain

A multipath propagation channel modeled by a tapped delay-line with several non zeros taps is used in this thesis. The fading factor of each tap is Rayleigh distributed random variable. The power profile and time delay profile can be set.

The transmitter structure with K simultaneous users of an IDMA system is depicted. The input data sequence d*k* of user *k* is encoded using an encoder, generating a coded sequence c*k*. The elements in c*k* are then fed to a scramblings with code {+1, −1, +1, −1 ...} and length L. The chip sequence is permuted by a chip-level interleaver I*k*[.] before transmitting on a multiple access channel. These interleavers disperse the coded sequences so that the adjacent chips are approximately.

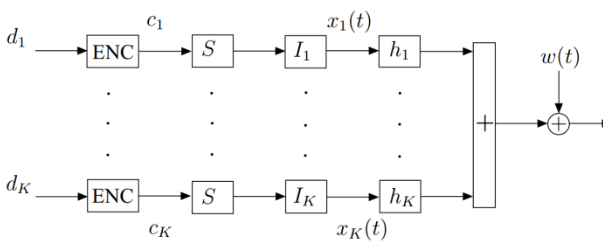

Fig.1.1 System model Transmitter of IDMA

III. PROPOSED METHODOLOGY

The proposed system is explained in this section. The block diagram of the proposed methodology is shown in the Fig. 3.1. The major blocks are firstly the data input and in initial stage Binary Phase Shift Key (BPSK) Modulation of the input data followed by random interleaving and then proceed to transmission channel where data transmit through SUI channel with the addition noises. In next process at the receiver end first random interleaving applied followed by demodulation with BPSK and got the original data at output.

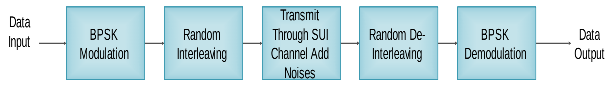

Fig. 3.1 Block Diagram of Proposed System

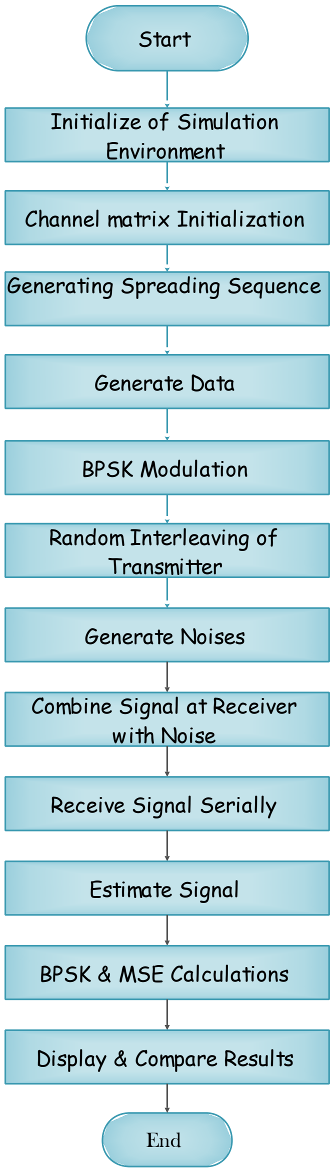

Fig. 3.2 Flow chart of proposed system

The step by step execution of methodology is shown in the flow chart given in Fig. 3.2. The above flow chart given a systematic process of simulation where we start the process with the initialization of simulation environment with different variables and then channel matrix initialization after it generate spreading sequence and generate data. Next proceed to Binary Phase Shift Key

(BPSK) modulation process and modulated the data and send it to random interleaving of transmitter followed by generation of noises which is nearer to real environment and mixed in the transmitting signal. At the receiving end receive signal serially then estimate the received signal and further proceed to BPSK Demodulation and sanded to BPSK and MSE calculations then in last display and compare Results.

IV. SIMULATION RESULTS

The proposed system is discussed and explained in the previous section. In this section the outcomes of simulations performed on the proposed system is discussed. The system is evaluated under different block sizes with IDMA and BPSK modulation. The results is compared for no. of users. The simulation outcomes are shown in below figures.

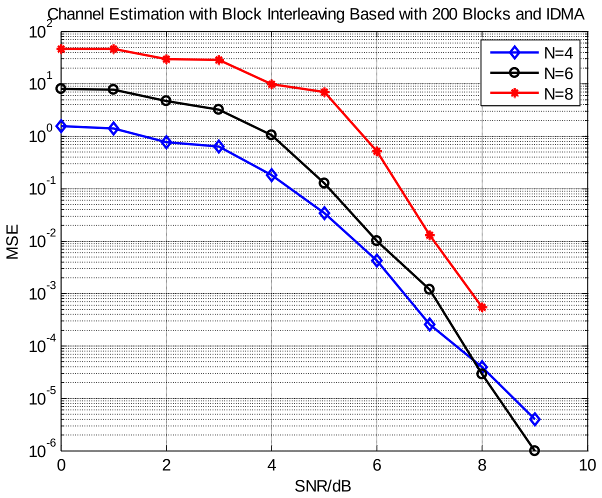

Fig. 4.1 MSE performance of proposed system model with 200 blocks

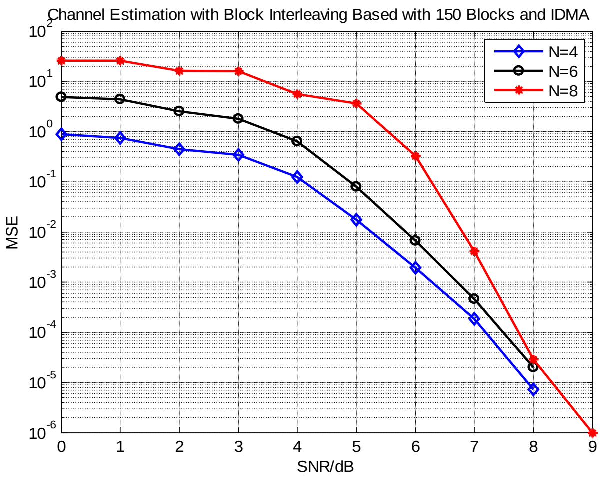

Fig. 4.2 MSE performance of proposed system model with 150 blocks

In Fig. 4.1 to 4.4 the mean square error of the IDMA base proposed channel estimation system with 200 block size is shown where the MSE is compared among different number of users 4, 6 and 8 respectively.

Optimum MSE is $1x10^{-6}$ for 8 users when 200 block size is used and $1x10^{-6}$ for 6 users when 150 block size is used and $1x10^{-6}$ for 8 users when 100 block size is used and $1x10^{-6}$ for 6 users when 50 block size is used with different SNR requirements.

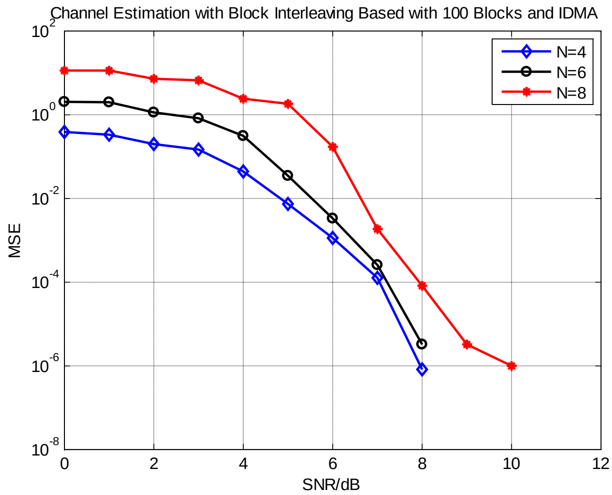

Fig. 4.3 MSE performance of proposed system model with 100 blocks

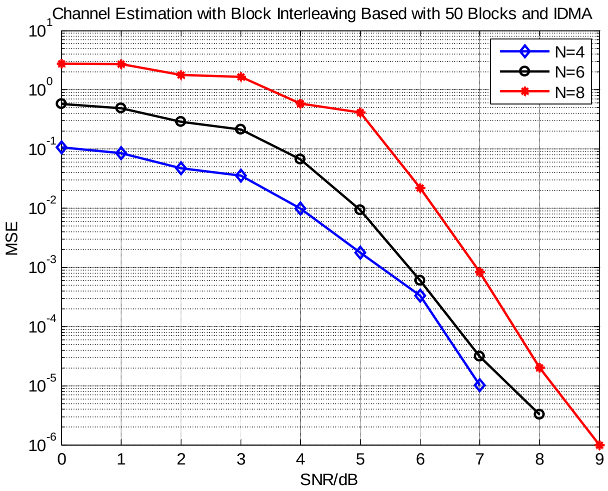

Fig. 4.4 MSE performance of proposed system model with 50 blocks

In Fig. 4.5 to 4.8 the bit error rate of the IDMA base proposed channel estimation system with 200 block size is shown where the MSE is compared among different number of users 4, 6 and 8 respectively.

Optimum BER is $7x10^{-7}$ for 6 users when 200 block size is used and $6.5x10^{-7}$ for 8 users when 150 block size is used and $5.5x10^{-7}$ for 8 users when 100 block size is used and

2×10^{-6} for 8 users when 50 block size is used with different SNR requirements.

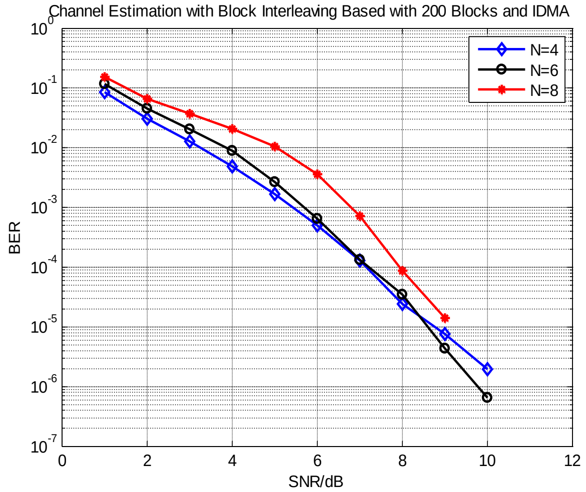

Fig. 4.5 BER performance of proposed system model with 200 blocks

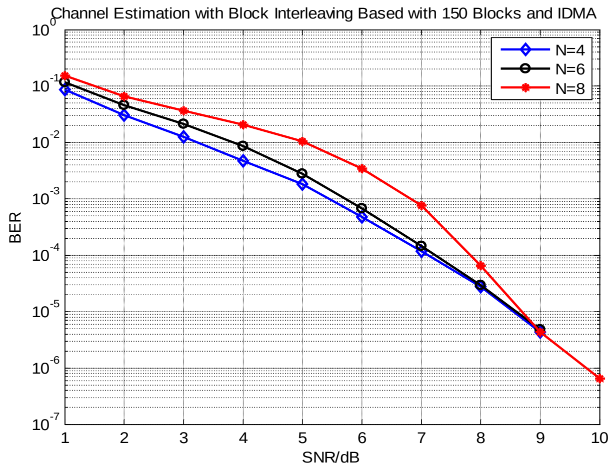

Fig. 4.6 BER performance of proposed system model with 150 blocks

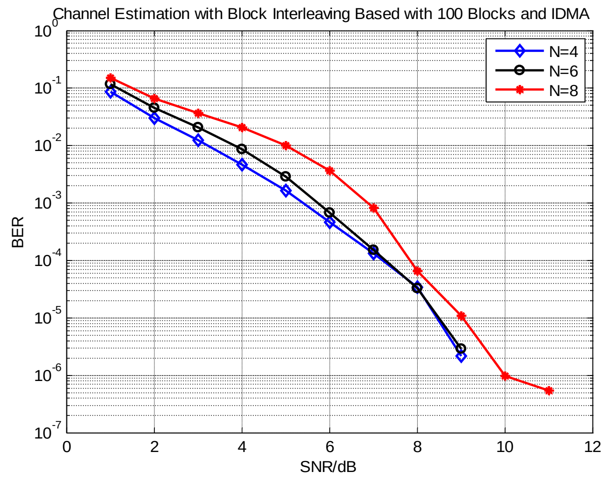

Fig. 4.7 BER performance of proposed system model with 100 blocks

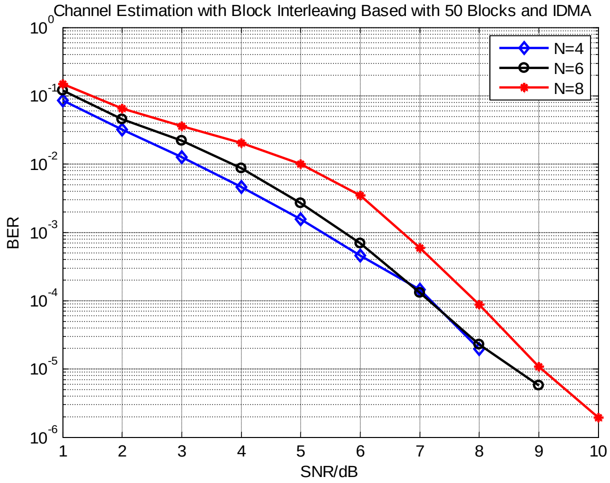

Fig. 4.8 BER performance of proposed system model with 50 blocks

V. CONCLUSION AND FUTURE SCOPE

The simulation outcomes clearly shows the efficiency of the proposed methodology and all explained in the previous sections of paper. From the MSE and BER outcomes the proposed system utilizes lesser signal power than the existing system and has better MSE and BER values. The system can have lots of proposals to enhance the performance further with integration of detection methodologies and digital filtering techniques.

REFERENCES

[1] N. Taşpinar and Ş. Şimşir, "Channel estimation techniques in OFDM-IDMA systems," Wireless Systems within the Conferences on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS-SWS), 2014 2nd International Symposium on, Offenburg, pp. 10-14, 2014.

[2] L. Ping, Q. Guo and J. Tong, "The OFDM-IDMA approach to wireless communication systems," in IEEE Wireless Communications, vol. 14, no. 3, pp. 18-24, June 2007.

[3] I. M. Mahafeno, C. Langlais and C. Jego, "OFDM-IDMA versus IDMA with ISI Cancellation for Quasistatic Rayleigh Fading Multipath Channels," Turbo Codes&Related Topics; 6th International ITG-Conference on Source and Channel Coding (TURBOCODING), 2006 4th International Symposium on, Munich, Germany, pp. 1-6, 2006.

[4] Shidong Zhou, Yunzhou Li, Ming Zhao, XibinXu, Jing Wang and Yan Yao, "Novel techniques to improve downlink multiple access capacity for Beyond 3G," in IEEE Communications Magazine, vol. 43, no. 1, pp. 61-69, Jan. 2005.

[5] P. Wang, J. Xiao and L. P, "Comparison of orthogonal and non-orthogonal approaches to future wireless cellular systems," in IEEE Vehicular Technology Magazine, vol. 1, no. 3, pp. 4-11, Sept. 2006.

[6] Li Ping, Lihai Liu, Keying Wu and W. K. Leung, "Interleave division multiple-access," in IEEE Transactions on Wireless Communications, vol. 5, no. 4, pp. 938-947, April 2006.

[7] J.-J. Van de Beek, O. S. Edfors, M. Sandell, S. K. Wilson, and O. P. Börjesson, “On channel estimation in OFDM systems,” in Proceedings of the 45th IEEE Vehicular Technology Conference, Chicago, Il., Vol. 2, pp. 815-819, July 1995.

[8] S. Coleri, M. Ergen, A. Puri, and A. Bahai, “Channel estimation techniques based on pilot arrangement in OFDM systems,” IEEE Transactions on Broadcasting, Vol. 48, pp. 223- 229, September 2002.

[9] H. Schoeneich and P. A. Hoeher, “Adaptive interleave-division multiple access – a potential air interference for 4G bearer services and wireless LANs,” in Proceedings of 1st IEEE and IFIP International Conference on Wireless and Optical Communications and Networks (WOCN’2004), Muscat, Oman, pp. 179-182, June 2004.

[10] Y. Xie and C. Georghiades, “Two EM-type channel estimation algorithms for OFDM with transmitter diversity,” IEEE Transactions on Communication, Vol. 51, Issue 1, pp. 106- 116, 2003.

[11] H. Doğan, E. Panay ırc ı, and H.A. Ç ırpan, “Iterative channel estimation techniques for uplink MC-CDMA systems,” in Proceedings of the IEEE International Symposiun on Signal Processing and Information Technology, pp. 302-306, 2007.

[12] M. Münster and L. Hanzo, “Parallel-interference-cancellationassisted decision-directed channel estimationfor OFDM systems using multiple transmit antennas,” IEEE Transactions on Wireless Communications, Vol. 4, Issue 5, pp. 2148-2162, 2005.

[13] Peter Hammarberg, and Fredrik Rusek, “Channel estimation algorithm for OFDM-IDMA: complexity and performance,” IEEE Transactions on Wireless Communication, Vol. 11, Issue 5, pp. 1723-1734, May 2012.