Under Water Wireless Communication Using Matlab Simulink

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Abstract - Cellular communication over earth is far different than communication underwaterbecause a single water body like an ocean has different water columns existing throughout its regions. A transmitter-receiver pair developed to work at deep sea level won't work in shallow coastal regions because the properties of water column present between the transmitter-receiver will be completely different and vice-versa. The diversity of water bodies is what makes the implementation of communication link more challenging. As of now Acoustics is the most promisingmethod employed to establish UWC link. But this method is hindered by multipath phenomenon which introduces a large delay spread. This in turn will result in Intersymbol Interference (ISI) consequently degrading the system's performance. Employing OFDM technique will reduce the delay spread. OFDM paired with IDMA provides a superior technique to reduce error bursts in multi-access underwater applications. A Simulink model for IDMA-OFDM is presented in this paper. Its performance was observed on BER graph which displayed a BER v/s SNR plot.

Index Terms-underwater communication, wireless, Orthogonal Frequency Division Multiplexing(OFDM),Interleave Division Multiple Access(IDMA).

I. INTRODUCTION

Presence of large water bodies is what distinguishes our Earth from other planets. Deep seas and oceans have always been a great source of mystery to mankind. Underwater communication has beena topic of great interest since the last decade. It plays a vital role in scientific data collection, environmental monitoring, disaster detection, navigation and other military based applications. There are three main communication media to establish an UWC link viz. RF waves, Acoustic waves and optical waves. Acoustic signals are currently the best candidates for UWC. Establishing an UWC link is quite difficult because of factors like multipath propagation, absorption,scattering, water-salinity, dispersion, physical obstruction, etc. The shallow water acoustic channel is an exceptionally difficult medium for data transmission, and developing reliable communications systems for such surroundings has been a challenge.OFDM is used to encode digital data on multiple carrier frequencies. Here a bit stream is divided into several low bit rate parallel bit streams then each sub-carrier signal is modulated using a suitable modulation scheme at low data rates. This avoids overlapping of signals thus reducing inter carrier interference. OFDM uses IFFT and FFT in its transmitter and receiver side respectively. OFDM has a remarkable ability to cope with severe channel conditions which makes it a suitable candidate for UWC. The low data rates of OFDM enable the signals to be less critical to interference from reflection. IDMA is used as a better alternative to CDMA. Like in CDMA, IDMA does not employ user-specific spreading sequence. Instead bandwidth expansion is fully exploited for forward error correction. IDMA uses iterative chip-by-chip multi-user detection technique which makes the decision of iterative receiver less complex than Rake receiver. These several advantages have led to a surge in its list of applications from DAB, HDSL to VHDSL and many other applications.

II. EXISTING METHOD

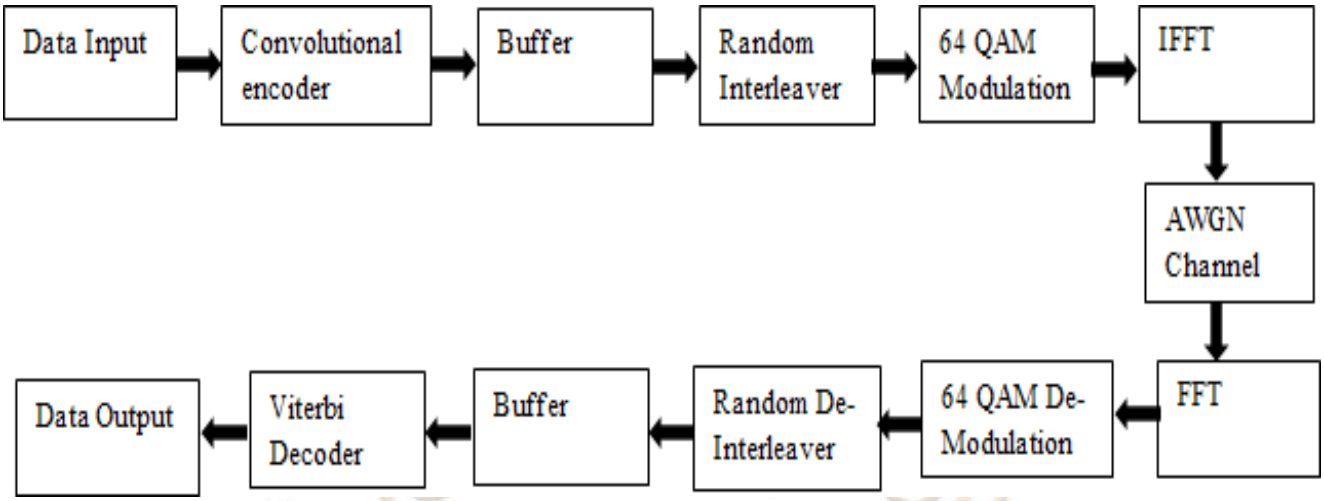

Fig.1 IDMA-OFDM UWC LINK

As can be seen from the block diagram, an underwater communication link basically consists of input signal which is first encoded using a suitable encoder. Here we have used convolutional encoder. After this interleaver operation is performed

64 QAM is the chosen modulation technique. IFFT is performed on the modulated signal. This completes the transmitter part of the communication process. This signal is then transmitted over an AWGN channel. AWGN channel is preferred because of its ease of usage. It produces simple mathematical model which are useful in gaining insight of the underlying behavior of the system.

After passing through the channel the signal reaches the receiver part of the communication system. At receiver, FFT is performed on the signal to convert signal back into frequency domain. 64 QAM Demodulation is used to demodulate the signal. Finally De-interleaving and Decoding process is performed on the received signal and we finally get our desired signal at the output. Here Viterbi decoder is used to perform the decoding operation.

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III. PROPOSED METHOD

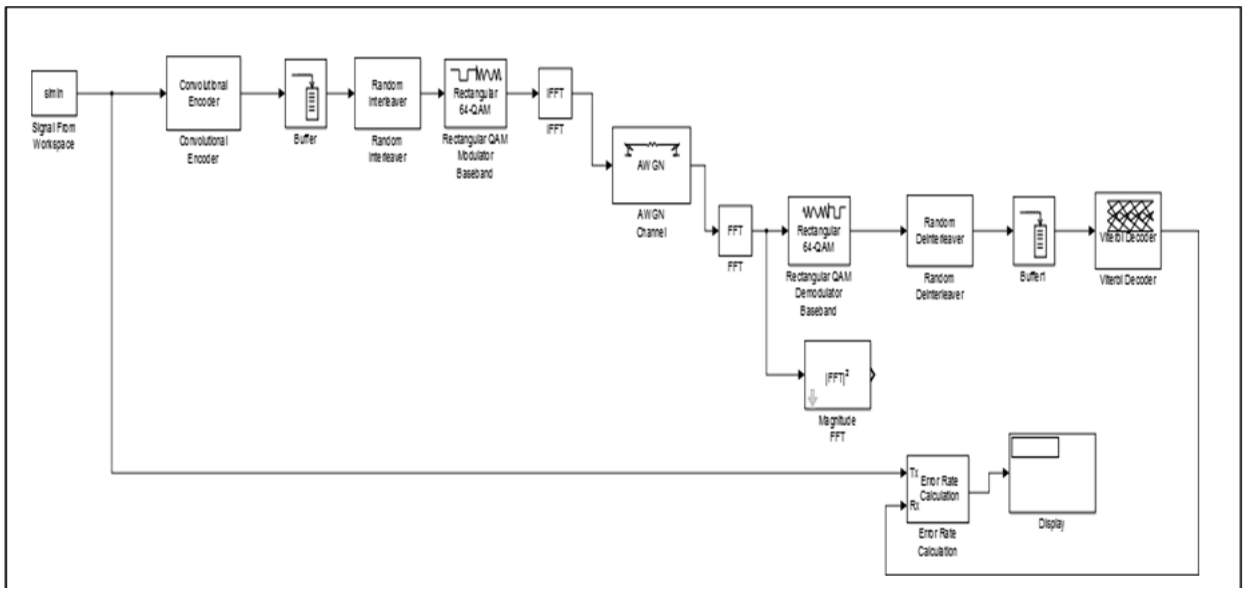


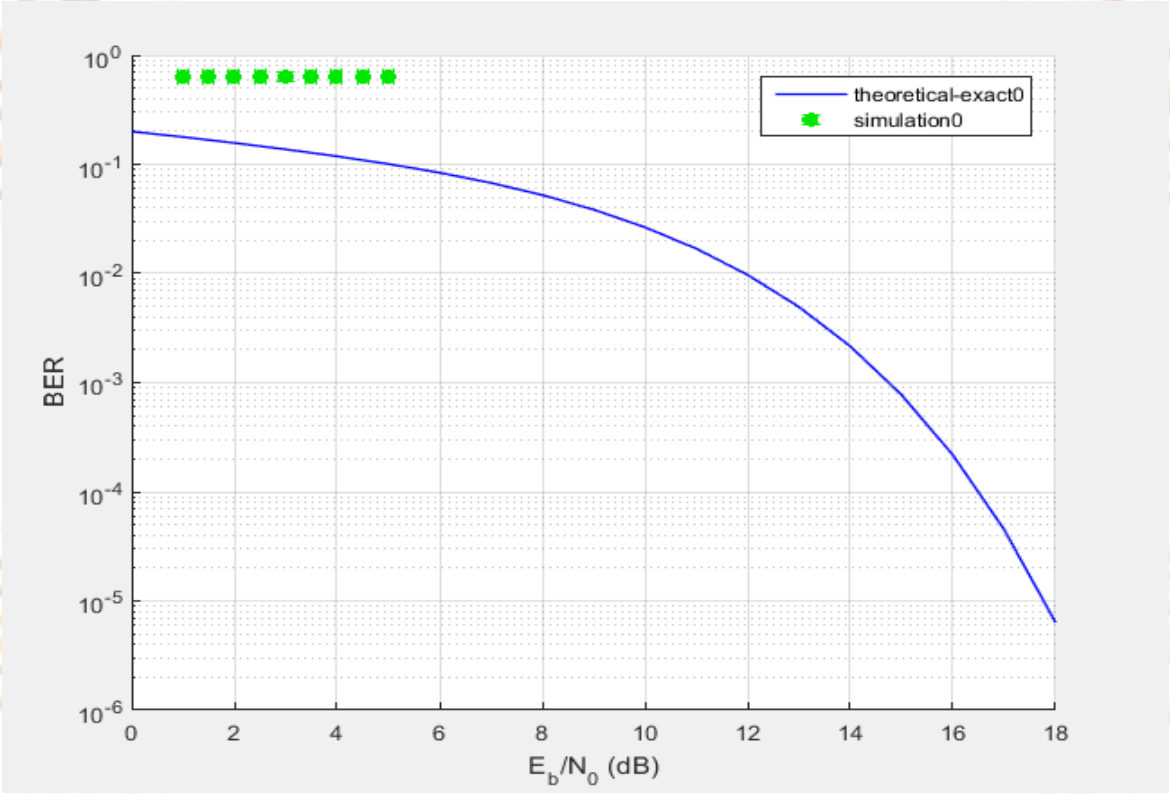
Fig.2 SIMULINK MODEL

To the above shown block diagram. Simulink of Matlab is a graphical tool used for modeling multi- disciplinary communication systems with customizable block libraries of communication block set. It features analysis of data flow and simulation results wart time. The IDMA-OFDM Simulink modelis as follows:

The signal is inputted from Matlab workspace into the Simulink Model. It is encoded using a convolutional encoder which can encode several symbols at a time. Buffer is used to convert data stream into column format which are called frames. Larger the frame size, slower is the frame rate of output data stream. Once the frame rate lessens the signal is given to random interleaver to perform unique permutations on the data sequence. It is interleaved in such a way that only intended receiversmay de-interleave it. 64-QAM modulation is used with user-defined bit-mapping. FFT operation is performed to convert signals from time domain to frequency domain. FFT is preferred over DFT because its computation is relatively less complex. We require frequency domain signals because the signals to be transmitted have to be discrete in nature. This transmitted data stream than passes through AWGN channel.

Although other channels can be used AWGN is the one which is most preferred because it mimics many random processes occurring in nature. It adds white Gaussian noise to the input signal. This noise is independent of the transmit signal. The receiver process is exact opposite of the transmit procedure. IFFT was performed to convert signals back into time domain. FFT magnitude block is used to compute a nonparametric estimate of the spectrum using the period gram method. A Viterbi decoder is used to produce binary symbols at the output. It processes several symbols at a time togive faster performance. Error rate calculation calculates the error by comparing input of transmitter to the input of receiver. It divides the total number of unequal pairs of data elements by the total number of input data elements from one source. Finally a display block was added to see the bit errorrates.

IV. SIMULINK EXPERIMENT ANALYSIS



V. CONCLUSION

Using a convolutional encoder and Viterbi decoder pair to encode and decode the signals we get signals with very less error. As the value of N is increased BER performance improves. Further improvement can be achieved by using advance modulation techniques of higher orders.

This paper proposed an IDMA-OFDM model for establishing an underwater communication link.

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