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Performance analysis of MIMO system using Bit Interleaved Coded Modulation (BICM) and Iterative Decoding (ID)

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1.INTRODUCTION :

Effective transmission in wireless communication systems requires high data rates and high reliability. Communication systems aim to efficiently use limited spectrum and energy to send information bits, while also meeting specific performance criteria regarding Bit Error Rate (BER) and Signal-to-Noise Ratio (SNRFurthermore, appropriate modulation techniques can be selected to enhance the efficiency of the existing spectrum. In simpler terms, it's feasible to send increased data over a set bandwidth by employing more advanced modulation methods. Additional restrictions exist within communication systems. Signal attenuation, multi-path fading, interference, and shadowing are all factors that are involved in this. Numerous methods have been suggested to address these limitations and enhance the reliability of communication. These methods involve utilizing smart antennas, diversity techniques, and error correcting codes to combat the impact of increased noise and fading

When sending information through a channel, the original data is typically changed to a higher radio frequency using modulation. Modulation helps in achieving two significant goals. Initially, multiple channels can be combined simultaneously without causing any interference.

2. OVERALL ARCHITECTURE

The overall architecture of the proposed system has been described in this section. The system consists of various processes such as encoding, modulation and interleaving.

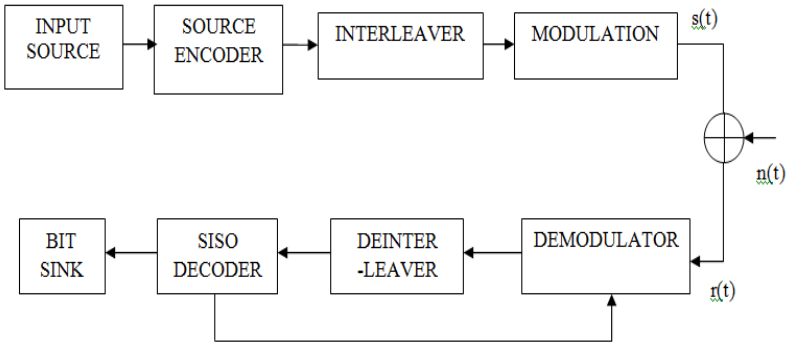


Figure 1: Overall Architecture

The input has been obtained from the input source and they encoded by the source encoder to reduce noise. These encoded bits are interleaved and these interleaved bits are BPSK modulated. There is a bitwise interleaver used between the encoder and modulator hence they are termed as bit interleaved modulation. These modulated bits are thus transmitted over the channel. The mapping process is irregular, where each bit within a codeword has different mapping. While transmitting over the channel some type of noises are added to modulated signal then they are received and noises are removed through the demodulation and decoding process. The combination of encoder and decoder at transmitter and receiver side is to eliminate the noises.

The various modules of the system is given as,
Module 1: transmitter module

Module 2: receiver module

3.TRANSMITTER MODULE DESCRIPTION

The block diagram of the transmitter module includes the various block such as input source, source encoder, interleaver and modulator. The block diagram can be drawn as,

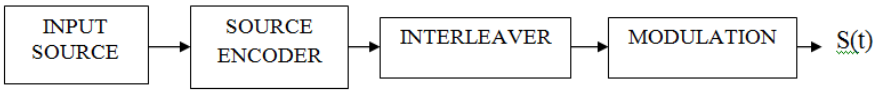


Figure 2: Transmitter Block Diagram

Transmitter block diagram of BICIM-ID system is considered in figure3.1, where the input data bits are generated and they are encoded in source encoder. The encoder is to map the incoming signal and for the decoder is to map the output into an output signal in such a way that the effect of channel noise is minimized. Then these encoded bits are interleaved by bitwise interleaver. Each bit is interleaved in order to avoid to errors. To improve the performance of coding in fading channels, coding is typically combined with interleaving to overcome the effect of burst errors. The size of the interleaver must be large enough so that fading is independent across a received codeword. Slow fading channel requires large interleavers, which in turns can lead to large delay.

The interleaved bits are modulated through BPSK modulation techniques where the constellation is BPSK constellations and mapping is irregular so each bit in the codeword has the separate mapping. After mapping, the signal is transmitted through the channel. While the signal is transmitted over the channel some noise are added to the transmitted signal. Such noise is termed as AWGN. The transmitted signal are represented as s(t).

4. RECEIVER MODULE

The receiver block diagram can be drawn as follows. The receiver includes the various blocks namely; demodulator, SISO decoder, deinterleaver and finally the output are obtained in the sink.

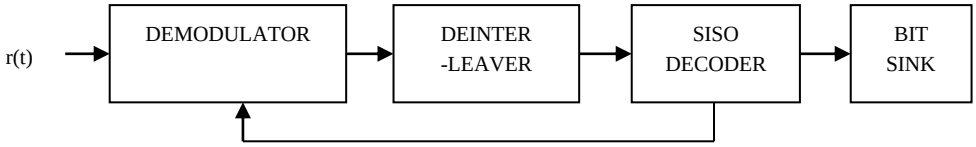


Figure 3: Receiver block diagram

The received signals are demodulated and they are deinterleaved which is followed by decoder to decode the signals. Iterative decoding technique is used at the receiver side in order to recover the original signal from the noisy received signal. The system is said to be iteratively decoding system when there is a feedback of decoded signal to the demodulator. Based on the iterative decision on the receiver side, demapping process is occurred. While transmitting a signal over the channel some noises are added to the signal, they are represented as n(t). The feedback is provided in order to reduce the occurrence of error in the received signal in order to obtain the original signal. The received signal is represented as follows,

$$\mathbf{r(t) = s(t) + n(t)}$$

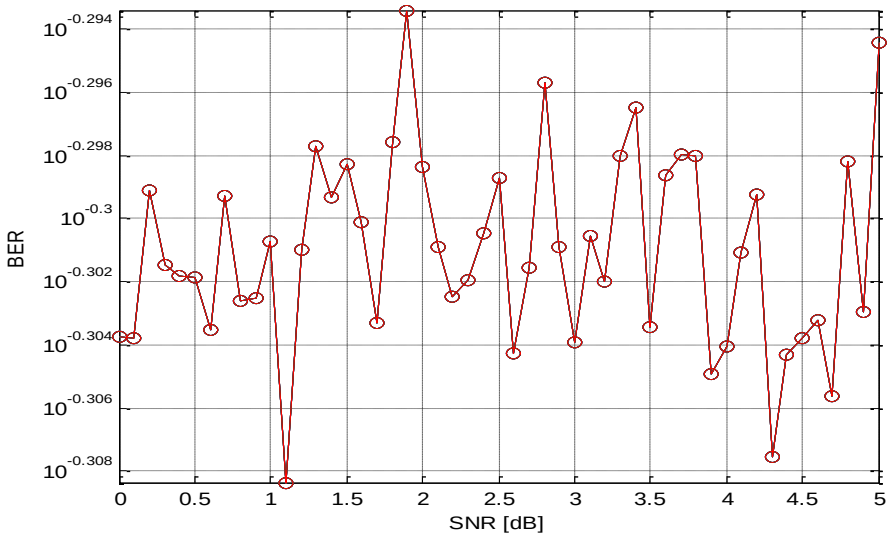
RESULT :

The following provides the comparison between the Hierarchical Modulated Bit Interleaved Coded Modulation-Iterative Decoding with the Bit Interleaved Coded Irregular Modulation- Iterative decoding. These results obtained based on their simulation results and the various techniques used in the system.

Proposed system

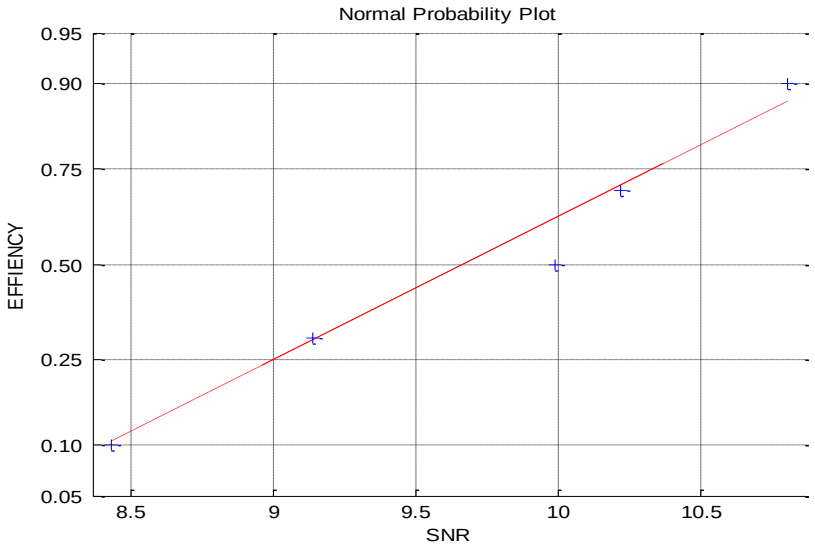
- The system is Bit Interleaved Coded Irregular Modulation with Iterative Decoding.
- The mapping is irregular.
- Modulation used is BPSK modulation.
- Bit error rate is around $10^{0.3}$
- Efficiency is about 90%

The graph correspond to BER versus SNR bit interleaved coded irregular modulation.



In order to improve the performance of the system the BER should be reduced .for BICIM-ID system BPSK modulation has performed. Here BER is reduced when compared to BICM-ID system.

The graph has been thus plotted between SNR and efficiency.



The system performance has been improved by improving the efficiency of the system. Here the efficiency of BICIM-ID system is around 90%. This efficiency is thus higher than the efficiency of BICM-ID system.

CONCLUSION :

Based on the simulation result, the performance and efficiency of BICIM-ID has been improved when compared to BICM-ID system. The performance improvement has been improved by varying the modulation technique and also by using the different mapping for each bit within codeword. The BICIM-ID system offers a promising possibility to adapt the transmission system to the channel quality, the complexity and error rate requirements. BICIM is well suited for the combination with bit loading and power loading schemes if additional channel knowledge is available at the transmitter. The additional complexity of BICIM is very low. The performance of the system can be improved in terms of the efficiency improvement as well as reduction in the bit error rate. By combining different mappings, the convergence behavior of the iterative decoding and demapping procedure can be optimized. Instead of designing new mappings for different applications, a large variety of mapping characteristics is obtained by the combination of only two mappings, namely Gray mapping and a mapping optimized for iterative demapping and decoding. Based on the simulation result, the performance of BICIM-ID system has been improved when compared to the BICM-ID system.

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