Genetic Algorithm-Based Performance Enhancement for Turbo-Coded OFDM Systems

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ABSTRACT
The internet text massage traditional phone call the demand for bandwidth both from service provider and end user five race for communication system required signal power and channel brand with the power spectral bit to noise power density. SNR Per bit give BER rate which required for modulation and there is decoding at the receiver acceptable cam be obtained by to use of error control coding which essential for add redundancy to the transmitted data. The error control coding is used for reduce the transmit power and antenna size or increase data rate. The error control coding can be applied deferent variety in the form block code. Convolution code or turbo code sach coding challenge the Shannon limit this is very useful for high communication.

Keywords: Free Distance, Convolutional Code Capacity, Rate, BER, Optimal Code, EA, Random Keys Encoding, Non Trivial Optimization

I. INTRODUCTION
In the modern world the link between people has become as important as ever. Whether being the Internet, text messages or the traditional phone call, the demand for bandwidth both from service providers and end-users yields a never ending race for communication system developers. When considering communication system design, two primary parameters are available for the designer, being transmitter signal power and channel bandwidth. Together with the power spectral density of the noise, these parameters determines the bit-to-noise power density, SNR per bit Eb/N0 from what the BER1 is governed with respect to the chosen modulation scheme. Thus when high throughput is desired the use of high order modulation schemes is applied, but the Eb/N0 needs to be sufficiently high for the decoding at the receiver to be successful. This can be achieved by transmitting at a higher power level. However the transmitter signal power is limited in mobile communication networks, as the mobile terminals has limited power and the basestations limits their transmit power as they are part of a cell network, where the need for low interference with other basestations is crucial. Hence high order modulation schemes are only possible if the transmit power is sufficient. However acceptable data quality can be obtained by the use of ECC2 , which essentially adds redundancy to the transmitted data. This creates a more robust data package when coping with the challenges in the medium between transmitter and receiver. Hence error-control coding can be used to reduce the transmit power or antenna size, or increase data rate, as it reduces the requirement between noise and signal energy for a desired BER. In communication protocols, error-control coding can be applied in many different varieties but mainly FEC3 is used in the form of block codes, convolutional codes or Turbo Codes. Such coding challenges the Shannon limit, that states a bound for a reliable data rate at given channel and transmission parameters. This is illustrated by figure,, where the principle of applying redundancy to the bit stream causes the SNR4 per bit requirement to lower, when considering the same BER. One very effective way of obtaining a high coding gain is to apply Turbo Coding., Glavieux and Thitimajshima where the principles of clever encoding and the use of iterative decoding closely approaches the Shannon limit. This has shown to be a very useful tool in the battle for high communication throughput and is thus used in modern standards.

II. THE TURBO DECODER
Since a Turbo Code trellis would have a very large number of states (due to the interleaver), a normal decoder would be hugeInstead, perform an iterative decoding processThis requires some changes to the normal decoder – instead of making a "hard" decision, it needs to make a "soft" decision

III. DECODER ALGORITHMS
Normal decoding algorithms (i.e. Viterbi algorithm) find the most likely sequence of bits that was transmitted.In a turbo decoder, want to find the likelihood of each bit. This serves as the *a priori* probability or the reliability of each bit, to use as input to the next decoder Optimal MAP (Maximum a Priori) – BCJR (Bahl, Cocke, Jelinek, Raviv)

Simpler - SOVA (Soft Output Viterbi Algorithm) – lose roughly .7 dB coding gain

Performance

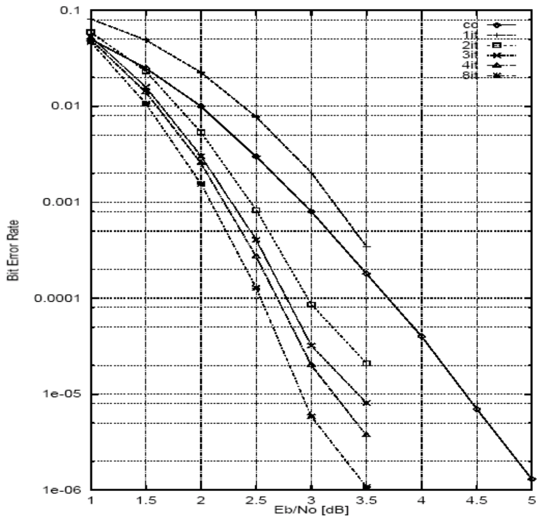

Figure 3.1: BER for rate 1/2 turbo codes, 200 bit interleaver, QPSK modulation, AWGN channel.

IV. INTERLEAVER EVALUATION

As noted earlier, the performance of a turbo code can be evaluatedby the means of bit error rate, i.e. the ratio of the number ofincorrectly decoded bits to the number of all bits transmittedduring some period. Unfortunately, it is rather hard to compute the BER for a turbo code and the simulations can be for larger interleavers very inaccurate. The error floor of a C(n,k) code can be analytically estimated: To estimate BER, the following code properties must be known dfree = the free distance, i.e. the minimum number of different bits in any pair of code words. Nfree = the free distance multiplicity, i.e. the number of input frames generating code words with dfree.Wfree = the information bit multiplicity, i.e. the sum of the hamming weights of the input frames generating the code words with dfree. There are several algorithms for free distance evaluation. Garello et al. presented an algorithm designed to effectively compute free distances of large interleavers with unconstrained input weight based on constrained subcodes. This work introduces interleaver optimization driven by algebraical estimation of maximum dfree evaluated using analytical approach.

V. GENETIC ALGORITHM

Genetic Algorithms Genetic algorithms are probably the most popular and wide spread member of the class of Evolutionary Algorithms (EA). EAs form a group of iterative stochastic search and optimization methods based on mimicking successful optimization strategies observed in nature . The essence of EAs lies in their emulation of Darwinian evolution, utilizing the concepts of Mendelian inheritance for use in computer science. Together with fuzzy sets, neural networks, and fractals, evolutionary algorithms are among the fundamental members of the class of soft computing methods. EAs operate with a population of artificial individuals (also referred to as items or chromosomes) encoding possible problem solutions. Encoded individuals are evaluated using a carefully selected objective function which assigns a fitness value to each individual. The fitness value represents the quality (ranking) of each individual as a solution to a given problem. Competing individuals explore the problem domain towards an optimal solution Genetic Algorithms (GA) introduced by John Holland and extended by David Goldberg, are a widely applied and highly successful EA variant. Evolutionary principles are in GA implemented via iterative application of so called genetic operators: the mutation, the crossover and the selection. Mutation and selection can be found on more evolutionary techniques while crossover is significant for genetic algorithms. Many variants of the standard generational GA have been proposed. The main differences lay mostly in particular selection, crossover, mutation, and replacement strategies .Genetic algorithms have been successfully used to solve non-trivial multimodal optimization problems. They inherit the obustnessofemulatednaturaloptimization processes and excel rin browsing huge, potentially noisyproblem domains.Theirclearprinciples,easeofinterpretation, intuitive and reusable practical use and significant results made genetic algorithms the method of choice In this chapter, general information to the reader is provided related to digital communication system. Later a brief detail about various communication systems is also provided. Error Correction Codes (ECC), Turbo Codes (TC) and their importance will also be discussed.

VI. DIGITAL COMMUNICATION SYSTEMS

In general, there are three main components in digital communication system

- Transmitter
- Channel
- Receiver

Digital Communication System.
Receiver
Transmitter
Channel
Transmitter

Any data that is sent in a system is through the transmitter. basic transmitter consists of various sub-sections, including the following:.

- Source
- Source Encoder
- Channel Encoder
- Modulator

Channel
Transmitter
The source produces digital source data that is to be transmitted to the receiver section. For a perfect communication system, it is ensured that the source data is obtained without any errors at the output of the receiver. The source data is encoded in the source encoder. In this process a redundant bits are removed from added to the source information to create a more efficient data stream .Thedecoder reverses the encoding
Source
Source
Encoder
Channel
Encoder
Modulator

process, which will be explained later in the receiver. The channel encoder encodes according to the channel through which the data is transferred. It may be though air, linked wire, coaxial cable etc. Later the information is modulated such that the original data can be recovered, when the data is transferred through the channel. Modulation techniques used among the following are; amplitude modulation, phase modulation, or frequency modulation. When data is sent through channel, it is affected by various error sources. These error sources will be explained in the next section.

VII. CHANNEL

Data from the transmitter to the receiver is sent through a channel. This channel could be; free space, linked wire, or co-axial cable. When data is sent and passed through the channel various external noise sources affect the data and modulate the original information. To avoid this, the transmitter modulates the data so that the original information is not modified or lost.

Receiver

A receiver consists of

- Demodulator
- Channel Decoder
- Source Decoder
- Source Data

Channel Receiver

The demodulator is used to remove the original information from the modulated carrier signal. The decoder detects or corrects errors in the information using the redundant bits to recover the source data The demodulator in the presence of noise attempts to recover the correct channel symbol .Error Correction Codes In a digital communication system, the channel causes errors in the transmitteddata. These errors are corrected by error correction codes "Error correction codes can be viewed as one-to-one mapping of set of message input sequences to the discrete alpha beta of output sequence called code-words" Block codes and Trellis codes are the two categories of Error Correction Codes

Demodulator

Channel

Decoder

Source

Decoder

Information

received

Block Codes

Block codes consist of are fixed length source symbols. If the encoder transmits n total bits to communicate k source bits, then code is referred to as an (n, k), with bit rateThe original k data block is determined from the received n block code in the decoder.The errors are detected in the decoder depending on the complexity of the code. Reed Solomon Codes (RSC) are a good example of a block code. Generating Turbo Codes A Turbo Code (TC) is a combination of two constituent codes separated by an interleaver .For this example, the bit rate is where the input k = 2 and output n = 3. A rectangular type of interleaver is used to arrange the data in irregular fashion. A good example is given in . As seen in the figure an interleaver is between the main input and the lower encoder. The output of the interleaver or the input of the lower encoder is arranged in different order than the input of the upper encoder but the data is same. An interleaver is made up of an M x M matrix, which is written row by row and read column wise as noted in

VIII. APPLICATION: TURBO CODES FOR WIRELESS MULTIMEDIA

Multimedia systems require varying quality of service.Latency

Low latency for voice, teleconferencing

Bit/frame error rate (BER, FER)

Low BER for data transmission.

The tradeoffs inherent in turbo codes match with the tradeoffs required by multimedia systems.Data: use large frame sizes

Low BER, but long latency Voice: use small frame sizes Short latency, but high

IX. REFERENCES

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