Volume : 1 | Issue : 4 | April 2012 ISSN - 2250-1991

Research Paper Electronics and Communication

Comparative Analysis on Various Coded Cooperaative Networks

* Pallavi Ingle

* B-5, Amantran Society, Arohi Club Road, Ghuma, Bopal, Ahmedabad. -38508

ABSTRACT

Cooperative networking between wireless users has been proposed as a means to provide transmit diversity and also, due to some disadvantages such as MIMO, fading, size, cost etc., in the face of this limitation. Using various cooperative transmission protocols such as AF and DF, which are used at the relay, improves the quality of signal and solves the problem of bad performance at low SNR. In this paper the different coded cooperative network such as AF and DF are analyze using Convolution and Turbo coding on the basis of BER and SNR rating.

SUMMERY

Thus it is concluded that the convolution and turbo codes which are compare on the basis of BER and SNR rating shows that turbo code performs better than convolution code and also turbo code shows better performance on low SNR

Keywords : MIMO, Cooperative network, AF, DF

1 .INTRODUCTION

Cooperative communication allow single wireless device to share their antennas during transmission and to form spatial diversity environment and virtual MIMO system. Cooperative diversity can increase the reliability of wireless networks by lessening the effect of fading. In this paper we study the performance of wireless cooperative networks by measuring the probability of error of a cooperative system using Convolutional and Turbo coding.

2. COOPERATIVE NETWORK

2.1 Amplify and Forward Method

Amplify-and-forward is conceptually the most simple of the cooperative signaling methods. Each user in this method receives a noisy version of the signal transmitted by its partner. As the name implies, the user then amplifiess and retransmits this noisy signal (see Figure 2.1). The destination will combine the information sent by the user and partner and will make a final decision on the transmitted symbol. Nevertheless, amplify-and- forward is a simple method that lends itself to analysis, and therefore has been very useful in furthering the understanding of cooperative communication systems.

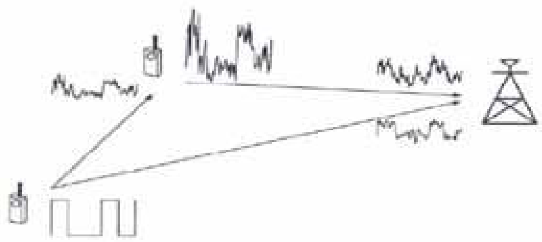

Figure 2.1: Amplify and Forward Method

2.2 Decode and forward Method

Nowadays a wireless transmission is very seldom analogue and the relay has enough computing power, so Decode and Forward is most often the preferred method to process the data in the relay. The received signal is first decoded and then re-encoded. So there is no amplified noise in the sent signal, as is the case using Amplify and Forward protocol. There are two main implementations of such a system.The relay can decode the original message completely. This requires a lot of computing time, but has numerous advantages. If the source message contains an error correcting code, received bit errors might be corrected at the relay station. Or if there is no such code implemented a checksum allows the relay to detect if the received signal contains errors. Depending on the implementation an erroneous message might not be sent to the destination. But it is not always possible to fully decode the source message. The additional delay caused to fully decode and process the message is not acceptable, the relay might not have enough computing capacity or the source message could be coded to protect sensitive data. In such a case, the incoming signal is just decoded and re-encoded symbol by symbol. So neither an error correction can be performed nor a checksum calculated.

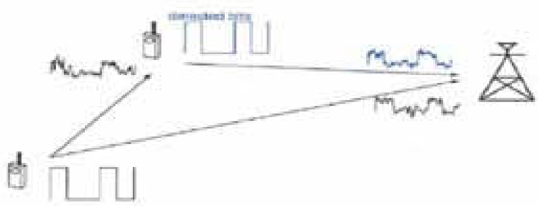

Figure 2.2: Decode and Forward Method

3. CODED COOPERATION

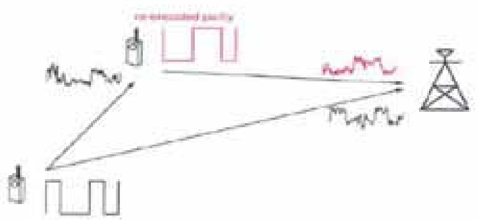

Figure 3.1 Coded Cooperation

In coded cooperation, cooperative signaling is integrated with channel coding. The basic idea behind coded cooperation is that each user tries to transmit incremental redundancy for its partner. Whenever that is not possible, the users automatically revert back to a non-cooperative mode. The transferred data is a random bipolar bit sequence which is either modulated with Binary Phase Shift Keying (BPSK) or Quadrature Phase Shift Keying (QPSK). The cooperative transmission protocols used in the relay station are either Amplify and Forward or Detect and Forward. These protocols describe how the received data is processed at the relay station before the data is sent to the destination .In general; various channel coding methods can be used within this coded cooperation framework. For example, the overall code may be a block or convolution code, Turbo code or a combination of both. Thus, it can be summarized from the above discussion that cooperative communication with channel coding has better BER performance i.e., 10^{-2} then the one without channel coding i.e.,10^{-1}.In this paper cooperative communication with various codes like convolution code, Turbo code are explained.

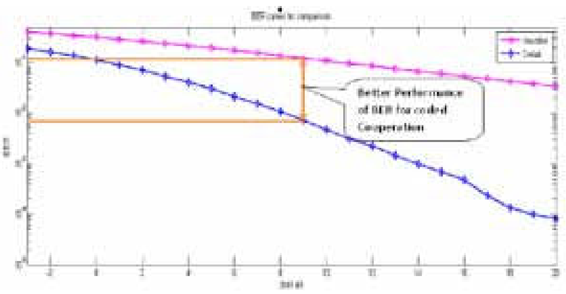

Figure 3.2: Comparisons between cooperative communication with channel coding and without channel coding

3.1CONVOLUTIONAL CODING

3.1.1 Cooperative communication with Convolutional coding

In this scheme, each codeword of the source node is partitioned into two frames that are transmitted in two phases. In the first phase, the first frame is broadcast from the source to the relays and destination. In the second phase, the second frame is transmitted on orthogonal sub channels from the source and relay nodes to the destination. Each relay is assumed to be equipped with a cyclic redundancy check (CRC) code for error detection. Only these relays (whose CRCs check) transmit in the second phase. Otherwise, they keep silent. At the destination, the received replicas (of the second frame) are combined using maximal ratio combining. The entire codeword, which comprises the two frames, is decoded via viterbi algorithm. For cooperative channel coding, finite block lengths N has been considered for cooperative. The Coded cooperative scheme system model for convolutional coding is considered as shown in the figures below.

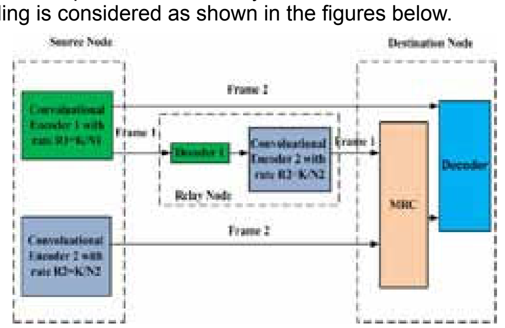

Figure 3.1.1: Block Diagram of cooperative communication with Convolutional coding

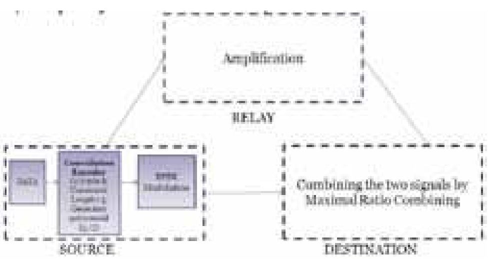

Fig 3.1.2 System model for AF

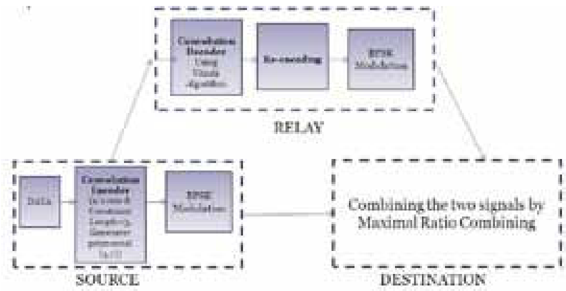

Fig 3.1.3 System model for DF

Assume slow or quasi-static fading that is each link has a constant fading level for N symbols. Use of the cyclic redundancy check (CRC) is commonly used for error detection in wireless communication systems. Excluding the CRC, in a non-cooperative System each terminal sends N coded bits per frame. In order to cooperate, S multiplexes these N bits properly and only sends half of its coded bits. If the original channel code had rate R, this corresponds to an effective coding rate of 2R. These bits are received by both the destination and the partner. The partner decodes these N1 bits and detects whether there are any errors using the CRC. If the partner has the correct information, it re-encodes and sends the additional N2 coded bits S did not transmit. Otherwise, S is informed and it continues its transmission of the remaining N2 coded bits. The destination waits until the end of the frame and combines both observations to decode the information bit stream. Assuming the destination estimates the current fading level every N1 bits, there is no need to notify it as to whether the partner received the information correctly or not.

3.1.2 TURBO CODE

Turbo codes were presented in 1993, by C. Berrou and since then these codes have received a lot of interest from the research community as they offer better performance than any of the other codes at very low signal to noise ratio. Turbo codes achieve near Shannon limit error correction performance with relatively simple component codes.

Applications of Turbo codes:

_ WLAN (Wireless LAN)
_ Image Processing
_ Digital Video Broadcasting
_ Microwave link communication to combat fading
_ Satellite communication for FEC.

Turbo coding is a forward error correction (FEC) scheme. Iterative decoding is the key feature of turbo codes. Turbo codes consist of concatenation of two convolutional codes. Turbo codes give better performance at low SNRs.

3.1.2.1Turbo Encoder and Decoder

In the basic configuration of turbo encoder two convolution encoders are used along with an interleaver. Generally, as a basic encoder RECURSIVE CONVOLUTIONAL ENCODER (RSC) is used. If the component encoder is not recursive, the unit weight input sequence (0 0 0...1 0 0...) will always generate a low weight codeword at the input of the second encoder for any interleaver design. In other words, interleaver would not influence the output codeword weight distribution if the component encoders were not recursive.However, it the component encoders are recursive; a weight -1 input sequence does not yield the minimum weight codeword out of encoder. The encoded output weight is kept finite only by trellis termination, a process that forces the coded sequence to terminate in such a way that the encoder returns to zero state. These two convolutional encoders can be connected in either parallel or serial configuration. The function of the interleaver is to spread bits in time domain. So, if there is a deep fade or noise burst in the channel then the important bits from the block of source data are not corrupted at the same time. Also the pairing of low-weight codeword from one encoder with low weight codeword from the other decoder can be avoided by proper design of interleaver.In a typical communication receiver, a demodulator is often designed to produce soft decisions which are then transferred to a decoder. With Turbo codes, where two or more component codes are used and decoding involves feeding outputs from one decoder to the input of other decoders in an iterative fashion Soft Input Soft Output(SISO)decoder is used. The coded cooperative system model for Turbo coding is as follows-

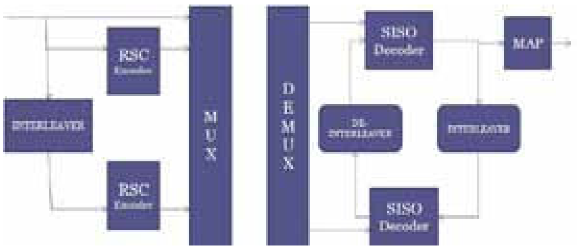

Fig 3.1.2.1: Turbo Encoder and Decoder

4. Simulation result

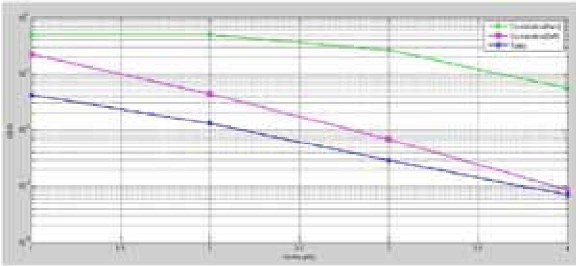

Fig4.1: Comparison between Convolution and Turbo code

Here in simulation result the convolution and turbo codes are compare on the basis of BER and SNR rating and it is observed that turbo code is better than convolution code also turbo code shows better performance on low SNR

Conclusion

This paper has shown the possible benefits of a wireless transmission using cooperative diversity to increase the performance. The diversity is realized by building an ad-hoc network using a third station as a relay. The data is sent directly from the base to the mobile or via the relay station. In cooperative network the best results are obtain by using BPSK or QPSK modulation technique. Thus it is concluded that the convolution and turbo codes which are compare on the basis of BER and SNR rating shows that turbo code performs better than convolution code and also turbo code shows better performance on low SNR

REFERENCES

[1]Kaur Gurpreet and Bhattacharya Partha Pratim (2012), “A Survey on cooperative diversity and its applications in various wireless networks” International Journal of Computer Science & Engineering Survey (IJCSES) Vol.2 [2] Ping Hu, Kenneth W. Shum and Chi Wan Sung (2008),”To Decode or To Amplify: Mix and Match for the Two-Way Two-Relay Network” Dept. of Electronic Engineering City University of Hong Kong Kowloon, Hong Kong [3] Todd E. Hunter, Shahab Sanayei, and Aria Nosratinia “The Outage Behavior of Coded Cooperation” Multimedia Communications Laboratory, the University of Texas at Dallas Richardson, TX 75083-0688, USA [4] Michael R. Souryal “Performance of amplify-and-forward and decode-and-forward relaying with turbo codes” National Institute of Standards and Technology Wireless Communication Technologies Group Gaithersburg, Maryland [5] Rui Lin (2011),”Cooperative Communication System Using Distributed Turbo Codes” at the University of Canterbury, Christchurch, New Zealand [6] S. Tang, J. Cheng, C. Sun, R. Suzki, and S. Obana, (2008) “Turbo network coding for efficient and relaible relay," in Proc. ICCS.