

# BER ANALYSIS BASED ON CONVOLUTION CODED OFDM FOR DIGITAL IMAGE AND SPEECH TRANSMISSION

M.Geethika (M.tech)<sup>1</sup>

G.Rajender(M.Tech)<sup>2</sup>

<sup>1</sup>Vijay rural engineering college nizamabad, Telangana, INDIA.

<sup>2</sup>Vijay rural engineering college nizamabad, Telangana, INDIA.

[mailaram.geethika@gmail.com](mailto:mailaram.geethika@gmail.com)<sup>1</sup> [graj.247@gmail.com](mailto:graj.247@gmail.com)<sup>2</sup>

## ABSTRACT

Orthogonal frequency division multiplexing (OFDM) supports wide range of high speed applications and has ability to provide data rate up to 100MBPS. Coded OFDM has ability to provide high performance along with low computational complexity. Although in literature, concatenated convolutional coded OFDM has designed for effective BER analysis but it is designed for Digital audio broadcasting application only. In this work, a novel framework is proposed based on audio and digital images using convolutional coded OFDM scheme for BER analysis. Finally experimental results provide equipped performance along with minute computational complexity.

**Keywords:** Coded OFDM, Convolutional coding, BER analysis, Efficiency

## I. INTRODUCTION

The telecommunications' industry is in the midst of a veritable explosion in Wireless technologies. Once exclusively military, satellite and cellular technologies are now commercially driven by ever more demanding consumers, who are ready for seamless communication from their home to their car, to their office, or even for outdoor activities.

With this increased demand comes a growing need to transmit information wirelessly, quickly, and accurately. To address this need, communications engineer have combined technologies suitable for high rate transmission with forward error correction techniques. The latter are particularly important as wireless communications channels are far more hostile as opposed to wire alternatives, and the need for mobility proves especially challenging for reliable communications. For the most part, Orthogonal Frequency Division Multiplexing (OFDM) is the standard being used throughout the world to achieve the high data rates necessary for data intensive applications that must now become routine.

Orthogonal Frequency Division Multiplexing (OFDM) is a Multi-Carrier Modulation technique in which a single high rate data-stream is divided into multiple low rate data-streams and is modulated using sub-carriers which are orthogonal to each other. Some of the main advantages of OFDM are its multi-path delay spread tolerance and efficient spectral usage by allowing overlapping in the frequency domain. Also one other significant advantage is that the modulation and demodulation can be done using IFFT and FFT operations, which are computationally efficient.



### III. CHANNEL CODING

#### A) Convolution Encoding & Viterbi Decoding

A convolutional encoder comprises of a M-stage shift register with "k" inputs, endorsed associations with "n" modulo-2 adders and multiplexer that serializes the yields of the adders. Here the encoder chose has  $k=1$ , ie; the info succession touches base on a solitary information line. Subsequently the code rate is given by  $r = 1/n$ . In an encoder with a M stage shift enroll, the memory of the coder approaches M message bits and  $K = (M+1)$  movements are required before a message bit that has entered the movement register can at long last exit. This parameter K is alluded to as the imperative length of the encoder.

The channel coding utilized for standard DAB comprises of code rate  $\frac{1}{2}$ , memory 6, convolutional code with code generator polynomials 133 and 171 in octal organization [2]. For Spot lower code rates give better execution. Subsequently in this work, encoder with code rate= $\bar{w}$  is chosen. One such convolutional encoder is appeared in Fig. 2. The quantity of registers=6. Consequently the imperative length  $K=7$ . Generator Polynomials are 171, 133 and 115 in octal organization. Reproduction is done for different estimations of limitation length and generator polynomials, which are given in Table-III.

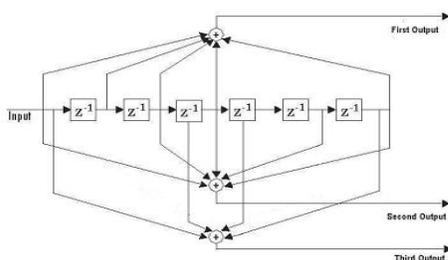


Figure 2: A rate  $\bar{w}$  convolutional encoder with constraint length,  $K=7$

#### B) Parallel Concatenated Convolution Turbo Coding & Decoding

Parallel Concatenated Convolutional turbo code (PCC turbo code) comprises of two or more Recursive Systematic Convolutional (RSC) coders working in parallel [8]. The reason for interleaver is to offer each encoder an irregular variant of the data bringing about equality bits from each RSC that are free.

On the receiving side there are same number of decoders as on the encoder side, each working on the same information and an independent set of parity bits.

In this work, to give same code rate to turbo encoder as on account of convolutional encoder, a parallel connection of two indistinguishable RSC encoders are utilized which gives a code rate of  $\bar{w}$ . One such turbo encoder is appeared in Fig. 3, where the quantity of registers in each RSC encoder=2. Henceforth the limitation length  $K=3$ . Generator polynomials are 7 and 5 in octal arrangement. The number 7 indicates the input polynomial.  $\Lambda$  is the arbitrary interleaver. Reenactment is completed for different estimations of requirement length, generator polynomials and input polynomials, which are given in Table-III.

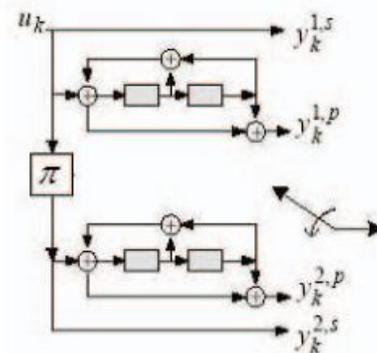


Figure 3: A rate  $\bar{w}$  turbo encoder with 2 parallel recursive systematic convolutional encoders, each with constraint length,  $K=3$

The inputs are data bits and called  $u_k$ . The yields are code bits. Of these, the yield of first encoder,  $y_{k1, s}$  is known as the precise piece, and it is the same as the information bit. The second yield bit,  $y_{k1, p}$  is the principal equality bit which is recursive deliberate piece. An interleaver, indicated by  $\Lambda$ , is put in the middle of the two encoders to guarantee that the information got by the second encoder is measurably autonomous. The third yield bit,  $y_{k2, p}$  is the second equality bit which is additionally a recursive deliberate piece. The fourth yield  $y_{k2, s}$  is deterministically reshuffling adaptation of  $y_{k1, s}$ , which is not transmitted.

For decoding, the Viterbi Algorithm is not suited to generate the A-Posteriori-Probability (APP) or soft decision output for each decoded bit. Here Maximum-A-Posteriori (MAP) algorithm is used for computing the metrics. Block diagram of turbo decoder is shown in Fig. 4.

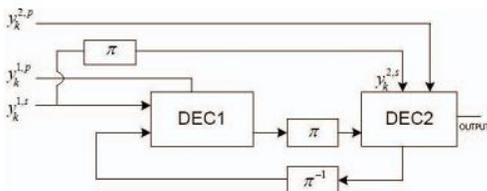


Figure 4: Turbo decoder – Block Diagram

In Fig. 4, DEC1 and DEC2 are 2 APP decoders.  $\Lambda$  and  $\Lambda^{-1}$  are random interleaver and deinterleaver respectively [14]. The symbol vector sent for each time are described by  $y_k=(y_{k1, s}, y_{k1, p}, y_{k2, p})$ . The goal is to take these and make a guess about the

transmitted vector and hence code bits which in turn decode  $u_k$ , the information bit.

## IV. APPLICATIONS

- DAB - OFDM forms the basis for the Digital Audio Broadcasting (DAB) standard in the European market.
- ADSL - OFDM forms the basis for the global ADSL (asymmetric digital subscriber line) standard.
- Wireless Local Area Networks - development is ongoing for wireless point-to-point and point-to-multipoint configurations using OFDM technology.
- In a supplement to the IEEE 802.11 standard, the IEEE 802.11 working group published IEEE 802.11a, which outlines the use of OFDM in the 5GHz band.

## V. RESULTS

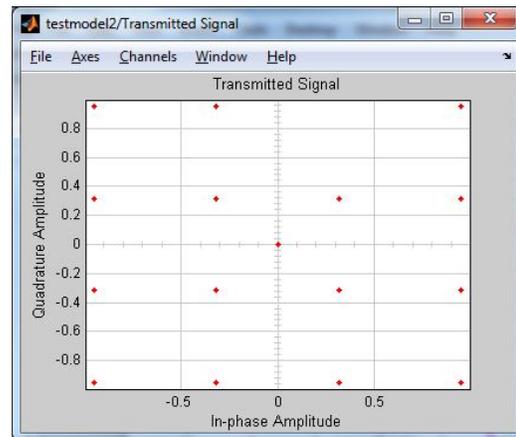


Figure 5: Transmitted Signal

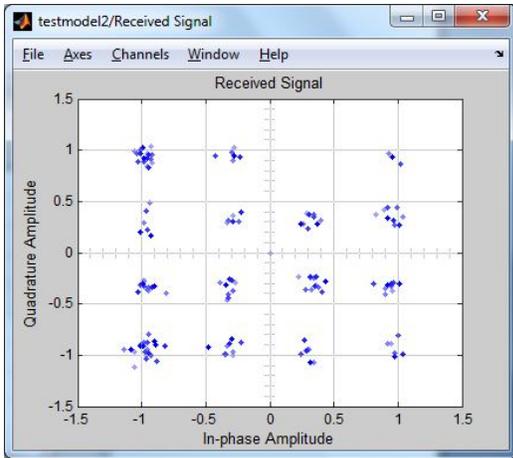


Figure 6: Received Signal

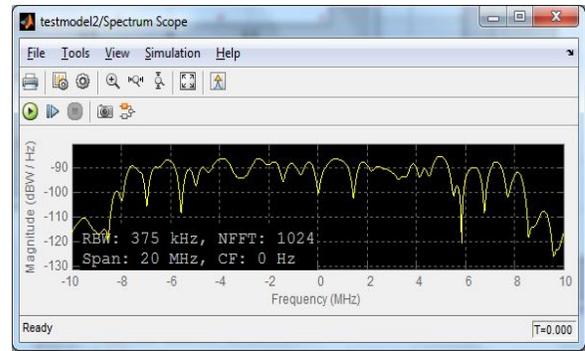


Figure 9: Frequency spectrum

## VI. EXTENSION WORK

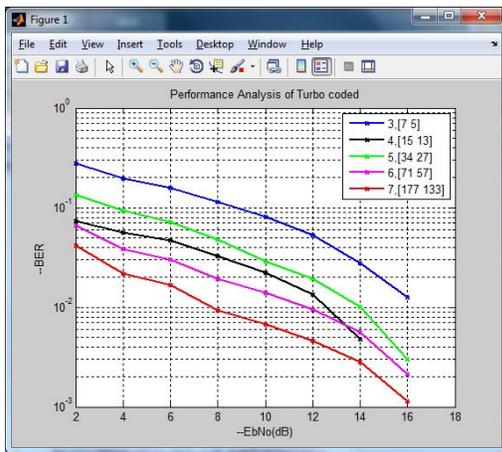


Figure 7: Performance Analysis Of Turbo Codes

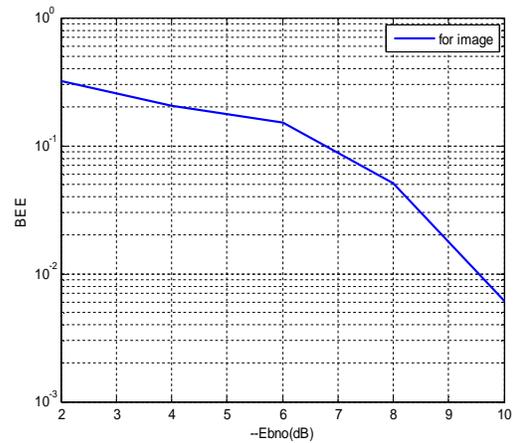


Figure 10: BER analysis for IMAGE

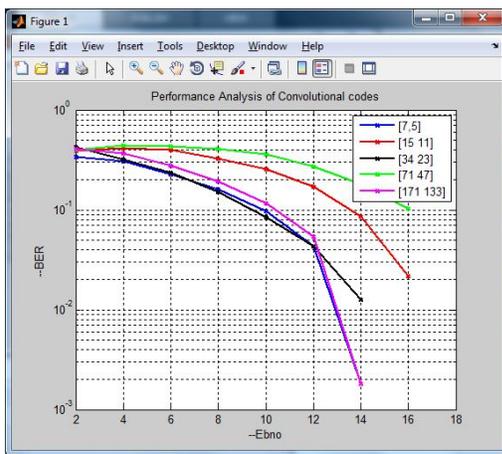


Figure 8: Performance Analysis Of Convolutional Codes

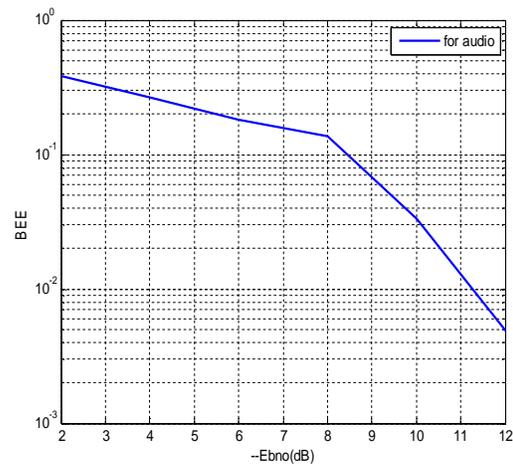


Figure 11: BER analysis for SPEECH

## VII. CONCLUSION

In this paper, the BER (Bit Error Rate) performances of Turbo & Convolutional coding is evaluated by varying different modulation scheme using AWGN & Rician channel. It has been deduced that the turbo coding provides better performances in AWGN as compared with Convolutional code & Convolutional coding provides better performances in Rician as compared with Turbo code. Turbo cod shows remarkable power efficiency in AWGN for low BER & also it operates at very low SNR. . The advantage of employing turbo coding in adaptive OFDM is revealed by comparing their performance with Convolutional code transmission system. A better adaptation algorithm is used to improve BER performance. This algorithm utilizes the average value of the instantaneous SNR of the subcarriers in the sub-band as the switching parameter. The simulation results show an improved BER performance in AWGN channel for turbo coded adaptive OFDM system rather than Convolutional code. Although in literature, concatenated convolutional coded OFDM has designed for effective BER analysis but it is designed for Digital audio broadcasting application only. In this work, a novel framework is proposed based on audio and digital images using convolutional coded OFDM scheme for BER analysis.

## REFERENCES

- [1] Wolfgang Hoeg, Thomas Lauterbach, "Digital Audio Broadcasting-Principles and Applications of Digital Radio", John Wiley & Sons, Ltd. England, 2003.
- [2] Henrik Schulze, Christian Luders, "Theory and Applications of OFDM and CDMA", John Wiley & Sons, Ltd. England, 2005.
- [3] Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, Inc. England, 2001.
- [4] Bernad Sklar, "Digital Communications–Fundamentals and Applications", 2nd Edition Pearson Education (Singapore) Pte. Ltd., 2001
- [5] Zimmerman G., Rosenberg M. and Dostert S., "Theoretical Bit Error Rate for Uncoded and Coded Data Transmission in Digital Audio Broadcasting", Proc. IEEE International Conference on Communications, Vol. 1, pp. 297-301, June 1996.
- [6] Thomas May and Hermann Rohling, "Turbo Decoding of Convolutional Codes in Differentially Modulated OFDM Transmission System", Proc. IEEE 49th Vehicular Technology Conference, Vol. 3, pp-1891-1895, July 1999.
- [7] Hanjong Kim, "Turbo Coded Orthogonal Frequency Division Multiplexing for Digital Audio Broadcasting", Proc. IEEE International Conference on Communications, Vol. 1, pp. 420-424, 2000.
- [8] A. Burr, "Turbo-Codes: The Ultimate Error Control Codes?", Electronics & Communication Engineering Journal, Vol. 13, pp. 155-165, August 2001.
- [9] R. Maerkle and C-E. W. Sudenberg, "Turbo Codes for Hybrid In Band On Channel Digital Audio Broadcasting", Porc. IEEE Global Telecommunication Conference, Vol. 2, pp. 941-945, 2001.
- [10] Yan Li, Sumei Sun, "Design of Bit-Interleaved Turbo Coded Modulation in OFDM-Based Wireless

LAN Systems”, Proc. 4th International Workshop on Mobile and Wireless Communications Network, pp. 549-553, 2002.

[11] Lukas M. Gaetzi and M. O. J. Hawkafor, “Performance Prediction of DAB Modulation and Transmission Using Matlab Modeling”, Proc. IEEE International Symposium on Consumer Electronics”, pp. 272-277, September 2004.

[12] Hector Uhalte Bilbao, “Digital Transmission System Simulation”, Linkoping Institute of Technology, Master Thesis August 2004.

[13] Seong Chul Cho, Jin Up Kim, Kyu Tae Lee and Kyoung Rok Cho, “Convolutional Turbo Coded OFDM/TDD Mobile Communication System for High Speed Multimedia Services”, Proc. Advanced Industrial Conference on Telecommunications, pp. 244-248, July 2005.

[14] Ibrahim S. Raad and Mehmet Yakan, “Implementation of A Turbo Codes Test Bed in the Simulink Environment”, Proc. of the Eighth International Symposium on Signal Processing and its Applications, Vol. 2, pp. 847-850, August 2005.

[15] Jorge Ortin, Paloma Garcia., Fernando Gutierrez and Antonio Valdovinos, “Performance Analysis of Turbo Decoding Algorithms in Wireless OFDM Systems”, IEEE Transactions on Consumer Electronics, Vol. 55 pp. 1149- 1154, 2009.

[16] Mohammadnia-Avval M., Chris Snow C and Lutz Lampe, “Error-Rate Analysis for Bit-Loaded Coded MIMO-OFDM”, IEEE Transactions on Vehicular Technology, Vol. 59, pp. 2340-2351, 2010