

# The Enhanced Procedure for Memory Diminished Turbo Decoding

M PRASANTHI<sup>1</sup>, K JAYARAM KUMAR<sup>2</sup>

<sup>1</sup>PG Student, Department of ECE, Godavari Institute of Engineering and Technology, Rajahmundry, Andhra Pradesh, India.

<sup>2</sup>Assistant Professor, Department of ECE, Godavari Institute of Engineering and Technology, Rajahmundry, Andhra Pradesh, India.

**Abstract-** Next Iterative Initialization (NII) metric compression technique has been introduced in our work for reducing or relaxing the turbo decoder storage demand. Since work that was done previously, will store all metric values therefore memory requirement is very high but when it comes to our proposed novel method, it will store range of values. i.e. indexes of maximum and minimum values. The enhanced method not only decrease storage need but also provide faster response. This novel compression method will also facilitate hardware friendly recovery realization that was implemented by utilizing the simple multiplexing network. If we evaluate with the previous work, the proposed work will diminish the required storage bits by more than 40%. Whereas, facilitating the acceptable error-correcting performance within practical Implementation.

**Keywords-** Turbo codes, memory compression, channel codes, practical communication system, Very large-scale integration design (VLSI).

## I. INTRODUCTION

As we know that turbo codes are one of the finest and most reliable error correction codes. Turbo codes will facilitate optimal bit error rate[1]. Due to this reason, the turbo codes are utilized in various communication systems and wireless communication systems. To get better decoding throughput turbo codes to have most reliability compared to other codes. And these Turbo codes are well defined in current wireless standards[2]. In 3gpp LTE- advanced specifications for an instance, the definite code length of 6144 bits with the code rate of 0.96[2].in order to lessen the loss of performance within high code word rate decoding, the Next Iteration-Initialization (NII) procedure is widely adopted on behalf of backward recursion initialization replacing the procedure of traditional dummy computation[6]-[9].

Though, the regular technique of Next Iteration-Initialization (NII) needs supplementary memories on behalf of storing every final backward state of on-going iteration that indicates the subsequent iteration confidence level of subsequent iteration. If the procedure of sliding window is utilized on behalf of practical realization, the number of metrics of Next Iteration-Initialization needed to be stored increases extremely with reference to window boundaries number[8]. In order to eradicate such overhead issues, one has to adopt novel idea, the procedure called static compression scheme will resolve

such overhead problems by providing transfer function of dedicated to encoding the next iterative initialization metric into three or four bits. At the same time, the most advanced research will also facilitate the dynamic scaling on behalf of encoding the Next Iteration Initialization (NII) metrics[9]. But past procedures need large quantity of storage bits because of every state metrics need to be collected after a specific process of compression.

## II. IMPLEMENTATION OF NEXT ITERATION INITIALIZATION (NII) METRIC COMPRESSION MODEL

### A. The Architecture of Conventional Turbo Decoding

Figure.1. is the generalized architecture of turbo decoding with reference of soft-input soft-output decoders. In this decoder, the decoding will have done in two phases

- Initial phase
- Interleaved phase.

Here within the Figure 1, the sequence of input Log-likelihood Ratio (LLR) of bits of systematic as well as the parity bits are indicated as  $\Lambda_s$  (or  $\Lambda_s^1$ ) &  $\Lambda_{p1}$  (or  $\Lambda_{p2}^1$ ), respectively. Here within this symbol the superscript I indicate the order of sequence associated to interleaved phase with reference to the Log-likelihood Ratio (LLR) as well as the priori information. i.e. Information of extrinsic  $\Lambda_e$  (or  $\Lambda_e^1$ ), which will be opposite phase priori information after getting into interleaver (or else de-interleaver). Within these two phases, they are exclusive in time, only one soft-in soft-out decoder is accepted within practice on behalf of realizing the process of time-interleaved.

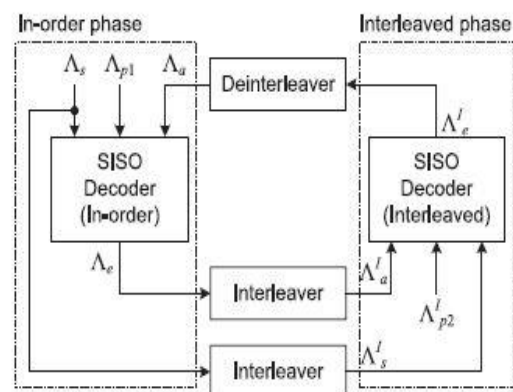


Fig.1: Architecture of Generalized Turbo decoding

**B. Technique of Sliding-Window with NII metric compression**

On behalf of turbo decoders, the technique of sliding window has been widely adopted in order to diminish the internal buffer size[6]. Figure 2. Demonstrate the procedure of decoding on behalf of n-bit codeword allied with w-bits sliding window. With reference to the algorithm of Maximum-a-posteriori (MAP) decoding, every sliding must process state metric recursively with direction of forward by utilizing the subsequent branch metrics. On behalf of reliability,  $i^{th}$  trellis corresponding  $k^{th}$  forward metrics entitled as  $\alpha_i(0), \alpha_i(1), \dots, \alpha_i(k-1)$ . Within the backward recursion that will process every trellis extrinsic information as well as the subsequent state metric within backward direction. As alike of state metric of forward,  $i^{th}$  trellis corresponding backward metric represented as  $\beta_i(0), \beta_i(1), \beta_i(2), \beta_i(3) \dots \beta_i(k-1)$ . As earlier of commencing the backward recursion, it is very essential to initialize properly the initial confidence level of every backward state.

In order to diminish the storage requirement produced by the scheme of next iteration initialization, the procedure of static encoding has been widely adopted. Within this procedure dedicated transfer function has been implemented and this transfer function resists the next iteration initialization metric to the power of two. The figure 3(a) showed up the 3-bit encoding transfer function, that will maps the Next Iteration Initialization metric into values of seven encoded values.

When compared to the scheme of conventional NII metric, the storage bits within 3-bit static compression has been greatly diminished. The calculation of number of stages is given as

- Number of Stages =  $6 \times (k-1) \times N/w$

Every Metric of next iteration initialization must be compared with the reference value, but that requires the numerous evaluations as showed up in figure 2(b). in more exactly every state metric must be evaluated with the values of six reference levels as well as the evaluation values are utilized on behalf of producing the 3-bit compression metric of NII are read from the memory of NII and sucked into the network of recovery to reconstruct the backward recursion initial values. Similar to the advance work was done in recent time dynamic algorithm on behalf of each NII metric[8]. But it needs the numerous storage bits and equipment of hardware to facilitate the acceptable performance of bit error rate, which consume more power. Here noted one is previous work is with reference to independent compression of every state metric. As every k-1 actual state metric must be encoded as well as stored within the memory of NII metric, the diminishment within the memory bits is restricted by the nature. At the same time, the algorithm which was proposed will consider the range of values of NII metric to make storing data in reliable format.

**III. ENHANCED PROCEDURE –UTILIZING NII METRIC COMPRESSION**

**NII Metric Compression Proposed Model**

**Memory-Reduced NII Metric Compression:**

Within the turbo decoder, the algorithm of max-log-MAP decoding is widely utilized because of simple max operation replacing the complex max operation with the algorithm of Maximum-a-posterior decoding that was mainly emphasize on path of trellis having better compatibility, it is essential to know the reliable states at the process of initializing of every sliding window[7]. dissimilar to previous work storing the values of every state metric, the proposed method only store the state metric range and it is denoted as  $\Delta_x$ ,

Here,  $\Delta_x$  = difference between the state values of maximum and minimum among the backward state metric the forward state metric having the width of  $W_x$  it has the greater possibility to compress the  $\Delta_x$  less than the 'd' for every metric. So, this possibility must be done without affecting the challenges the bit error rate performance. After having the series of experimental trials, it is concluded that the eight bits are sufficient to symbolize the  $\Delta_x$ , when we compare previous work actual state metric requires greater than twelve bits for their representation in order to resist the overflow within the system of Long Term Evaluation (LTE). At the decoding end of recovery process, one has accumulated the information without error. For this purpose, the hint indexes for the maximum as well as the minimum states of metric has been stored to make decoding process easier. The indexed values are represented as  $I_x^{MAX}$  as well as  $I_x^{MIN}$ . when it comes to conceptual way, the suggested method offers the greater reliability as well as the precise computation of information for compressing with least compensation in terms of accuracy for every state metric. The proposed method was made

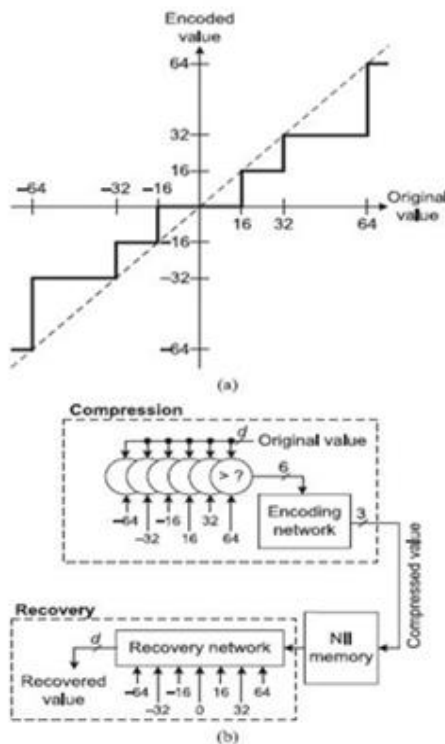


Figure 2 (a) 3-bit static NII Metric Compression Transfer function (b) process of Encoding and Decoding

effective without diminishing the capabilities of error correcting and at the same time the number of storage bit has, been reduced greatly. If sliding window size is thirty the two then the total number of turbo codes will be 6145-bit but our proposed compression technique the total number of turbo codes has been adjusted to 5377 bits on behalf of information of NII, that was six times a reduced amount of standard algorithm[8].

A. RTL Schematic

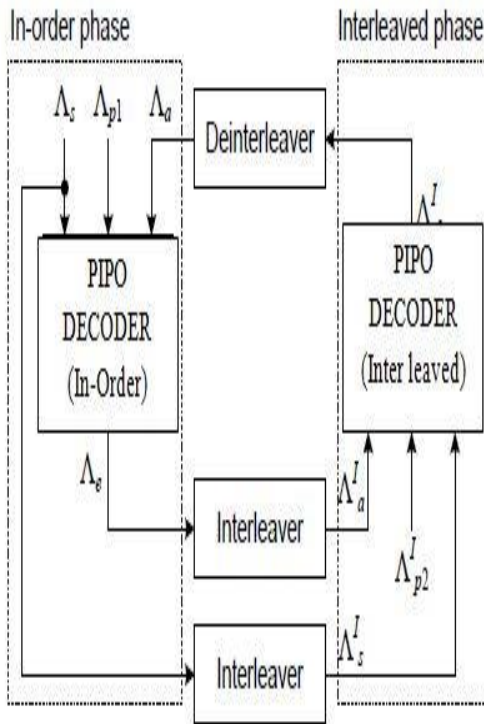


Figure 1 The modified turbo decoding architecture

IV. EXPERIMENTAL RESULTS

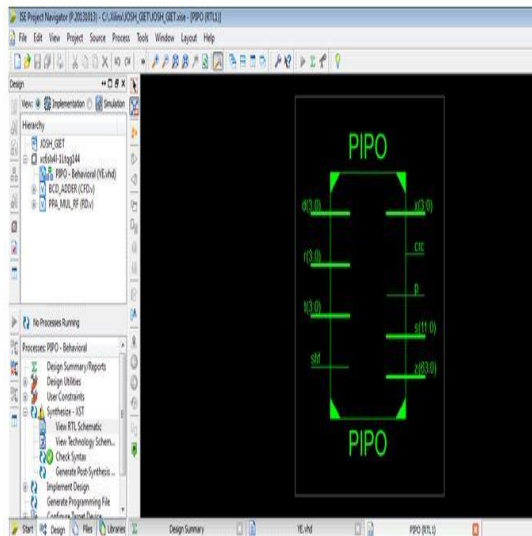


Fig.2: Implemented Schematic Block

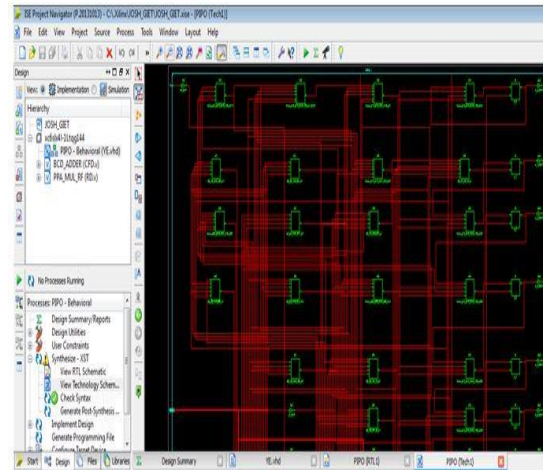


Fig.3: Proposed Technology Schematic

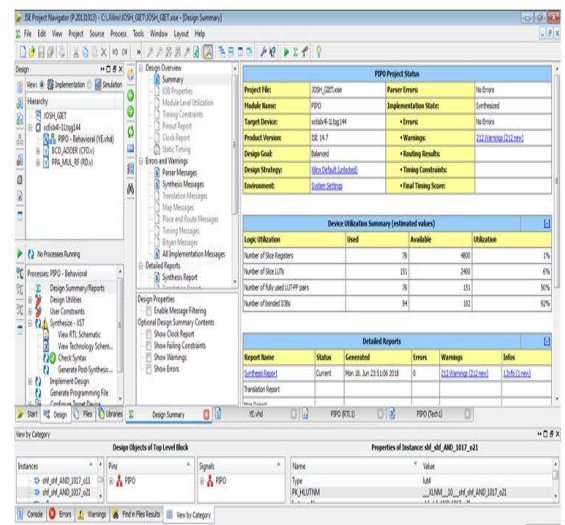


Fig.4: Design Summary

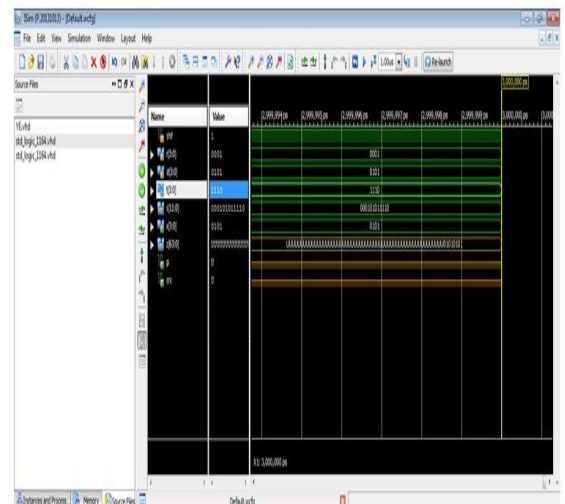


Fig.5: Timing Diagram

## V. CONCLUSION

The novel NII metric compression scheme has been implemented on behalf of diminishing the turbo decoder memory demands. In our work we proposed the recovery strategy, which is hardware friendly when we evaluate with the work of previous method. At the same time, the proposed compressed procedure diminishes the required bits of storage by more than 40% and facilitating the adequate error-correcting performance needed within practice.

## VI. REFERENCES

- [1]. C.Berrou,A.Glavieux,P.Thitimajshima,“Near Shannon limit error correcting coding and decoding: Turbo codes,” in Proc. IEEE Int. Conf.Commun., 1993, pp. 1064–1070.
- [2]. Berrou, C., Adde, P., Angui, E., and Faudeil, S., "A Low Complexity Soft-Output Viterbi Decoder Architecture", ICC'93, page 737-740, May 1993. Conquering the MAP 79
- [3]. Berrou, Glavieux, A., and Thitimajshima, P. "Near Shannon Limit Error Correcting Coding and Decoding: Turbo Codes", IEEE International Conference on Communications (ICC'93), Vol. 2/3, pp. 1064-1071, Geneva, Switzerland, May 1993.
- [4]. GSM (Global System for Mobile Communications). Official web site available at <http://www.gsmworld.com>. 2003.
- [5]. IEEE. STD 802.11a - 1999, part 11; Wireless LAN Medium: Access Control (MAC) and Physical Layer (PHY) Specifications, 1999.
- [6]. Robertson, P.; Villebrun, E.; Hoeher, P. A Comparison of Optimal and Sub-Optimal MAP Decoding Algorithms Operating in the Log Domain. In: IEEE International Conference on Communications, 1995. p. 1009-1013.
- [7]. Viterbi, AJ. Error bounds for Convolutional Codes and an Asymptotically Optimum Decoding Algorithm. IEEE Transactions on Information Theory, v.13, p.260-269, 1967.
- [8]. Ryan, W. "A Turbo Code Tutorial". Available at <http://www.ece.arizona.edu/~ryan>. 1997.
- [9]. Hokfelt, J., Carl Fredrik Leanderson, Ove Edfors and Torleiv Maseng. Distance Spectra of Turbo Codes Using Different Trellis Termination Methods. International Symposium