PERFORMANCE ANALYSIS OF BELIEF PROPAGATION POLAR CODE DECODER

KARTHICK C
Assistant professor, Dept of ECE, Sathyabama Institute of Science and Technology OMR Road, Chennai, India
karthivlsi13@gmail.com

VINO T
Assistant professor, Dept of ECE, Sathyabama Institute of Science and Technology OMR Road, Chennai, India
vinodhevan@gmail.com

BABJI T
Student, Dept of ECE, Sathyabama Institute of Science and Technology OMR Road, Chennai, India

NAVEEN P
Student, Dept of ECE, Sathyabama Institute of Science and Technology OMR Road, Chennai, India

Abstract: Attributable to their ability accomplishing execution and low encoding and interpreting intricacy, polar codes have gotten noteworthy consideration as of late. Successive cancellation decoding (SCD) and belief propagation decoding (BPD) are two mainstream approaches for disentangling polar codes. SCD, in spite of having less computational intricacy when contrasted and BPD, experiences long inertness because of the serial idea of the SC calculation. BPD, then again, is parallel in nature and is more alluring for low-dormancy applications. Nonetheless, because of the iterative idea of BPD, the required inertness and vitality dispersal increment straightforwardly with the quantity of emphasis. In this paper, we propose a novel plan in light of sub-factor diagram solidifying to lessen the normal number addition the normal number of cycles required by BPD, which specifically converts into bring down inactivity and vitality dissemination. Besides, the equipment design for the proposed plot is created and contrasted and the best in class BPD executions for (1024,512) polar codes.

Keywords: Li-Fi transmission, Transmitter chip, receiver chip, Android application, prolific cable.

1. INTRODUCTION

Distinctive limit moving toward codes, for example, Turbo codes [1] and low-thickness equality check (LDPC) codes [2], have been planned and utilized for quite a while in applications, for example,
remote correspondence and information stockpiling, to accomplish high information rates. As of late, the principal provable limit accomplishing codes called polar codes, were developed by Arikan [3]. Being the principal group of codes known to accomplish the channel limit with unequivocal development, polar codes have pulled in a great deal of consideration since their innovation. Polar codes have been demonstrated to accomplish the limit with respect to twofold info symmetric memory less channels [3] and additionally discrete and constant memory less channels [4]. In addition, an express development strategy for polar codes has been given, and it is demonstrated that they can be proficiently encoded and decoded with many-sided quality O(n log n), where n is the code length. Various translating strategies have been proposed for polar codes [5] [2], and among these, successive cancellation decoding (SCD) and conviction engendering interpreting (BPD) are the two most famous techniques. Because of the serial idea of the calculation, SCD experiences long idleness, despite the fact that it requires less calculation as contrasted and BPD. A few strategies have been proposed to lessen the idleness of SC decoders to accomplish a high throughput [6]. In addition, list translating and stack disentangling, which depend on SCD, have been proposed to enhance the mistake rectifying execution for polar codes with short code lengths [1]. Then again, polar BP decoders [5] have the natural favorable position of parallel preparing. Along these lines, contrasted and their SC partners, polar BP decoders are more appealing for low-idleness applications. Be that as it may, because of their iterative nature, the required inertness and vitality dissemination of BP decoders increment directly with the quantity of cycles. The necessity of countless outcomes in high calculation many-sided quality, and subsequently makes BPD less algorithm its SC partner. To diminish the region cost, as of late a memory effective BP decoder was proposed by Sha et al. [2] in light of consolidating two neighboring phases of a BPD factor chart. To diminish the calculation many-sided quality, another deciphering technique, called delicate cancelation (SCAN) disentangling, was proposed in [2]. By limiting the delicate data proliferation plan for the unraveling procedure, the computational intricacy of SCAN is much lower than that of BPD. Be that as it may, not quite the same as BPD, the SCAN task is serial in nature, prompting an any longer disentangling dormancy.

2. METHODOLOGIES

In this paper, we go for the plan of a low- dormancy polar codes decoder, and thus, we focus on the parallel BPD execution. To address the issues of the vast number of emphases and high calculation multifaceted nature inalienable in BP decoders, Yuan and Parhi [9] proposed a G-network based early ceasing plan (named G-lattice BPD, for future reference), which depends on the idea that iterative decoders ordinarily unite before achieving a settled most extreme number of cycles. The G-framework based halting measure is utilized to stop the calculation if union has been come to. It is accounted for in [1] that the vitality utilization is lessened by 33% when contrasted and BPD without a halting model (named benchmark BPD, for future reference), and a coded throughput of 9.1 Gb/s (the data throughput of 4.55 Gb/s) is accomplished at 3.5 dB. Another early halting technique in view of the understanding of three sequential hard choices was presented by Park et al. in [7],[9]. They proposed a twofold section design (named twofold segment BPD, for future reference) for BPD of a (1024, 512) polar code and accomplished a coded throughput of 4.68 Gb/s. The early end conspire empowers the proposed design to be more vitality proficient and decreases the dormancy for the deciphering activity.

To additionally lessen the calculation many-sided quality of BP decoders, in our past work [5], we proposed a technique in light of the joining of the subfactor-charts, which is come to at a considerably prior stage. Obtaining a thought from SCD, a portion of the subfactor-diagrams are checked amid every cycle, and in the event that they have united, they are a standout amongst the most prevalent subjects in data hypothesis and have pulled in a ton of consideration. A few deciphering techniques are accessible for disentangling polar codes [6], SCD and its variations and BPD are two famous strategies. SC decoders experience the ill effects of long inertness because of the serial idea of the SC calculation. In any case, the SC calculation requires less calculation when contrasted with BPD. In light of this property, a few high-throughput ease SC decoders were accounted for in [7]. Another preferred standpoint of the SC calculation is its capacity to accomplish great blunder redressing execution for long code lengths For short code length, in light of the SCD, the rundown deciphering or stack translating technique likewise accomplish great mistake rectifying execution [1] [5]. Then again, polar BP decoders [6] have the inherent favorable position of parallel preparing. Along these lines, contrasted and their SC partners, polar BP decoders are more appealing for low-idleness applications. For iterative decoders, (for
example, polar BP decoders), the required inertness and vitality dispersal increment straightly with the quantity of cycles. Notwithstanding, the requirement for countless influences BP decoders to experience the ill effects of high calculation many-sided quality, and thus polar BP decoders are still not as appealing as their SC partners. To this end, another unraveling strategy, called delicate cancelation (SCAN) disentangling, is proposed in [2],[3]. By limiting the delicate data proliferation plan for the disentangling procedure, the computational unpredictability of SCAN is much lower than that of BPD. Be that as it may, unique in relation to BPD, the SCAN task is serial in nature, prompting an any longer translating inertness. Subsequently, going for the low-idleness polar codes decoder, we focus on the BPD in this work. separation width of arbitrarily created standard diagrams. Luczak and McDiarmid[1]-[9] additionally think about the base separation width of diagrams produced by a conveyance unique in relation to our own. Besides, our examination is of arbitrary bipartite charts, instead of irregular standard diagrams. Also, our outcome makes just powerless presumptions on the hub degree circulation, without requiring a degree-normality supposition, rather than past work.

3. EXISITNG SYSTEM

Various interpreting techniques have been proposed for polar codes, and among these, progressive cancelation unravelling (SCD) and conviction engendering translating (BPD) are the two most prevalent strategies. Because of the serial idea of the calculation, SCD experiences long idleness, in spite of the fact that it require less calculation as contrasted and BPD. A few techniques have been proposed to decrease the idleness of SC decoders to accomplish a high throughput. Also, list disentangling and stack translating, which depend on SCD[10], have been proposed to enhance the mistake redressing execution for polar codes with short code lengths. Then again, polar BP decoders have the natural preferred standpoint of parallel handling. Along these lines we should get number of iterations contrasted and their SC partners, polar BP decoders are more alluring for low-idleness applications. In any case, because of their iterative nature, the required idleness and vitality dispersal of BP decoders increment straight with the quantity of emphases.

![Fig.1. Block Diagram Of successive cancellation and belief propagation decoder](image)

The necessity of an extensive number of emphases brings about high calculation many-sided quality, and consequently makes BPD less alluring than its SC partner[10]. To decrease the region cost, as of late, a memory productive BP decoder was proposed by Sha et al. in light of consolidating two neighbouring phases of a BPD factor chart[10]. To decrease the calculation multifaceted nature, another translating technique, called delicate cancelation (SCAN) deciphering, was proposed. altogether less memory for putting away log-probability proportions (LLRs) as contrasted and the SCAN decoder, and by wiping out [10]

4. PROPOSED SYSTEM

Polar Codes and Belief Propagation Decoding: Polar codes are direct square codes in view of the wonder of channel polarization, in which singular channels are recursively consolidated and part, to such an extent that their common data inclines toward either I or 0. At the end of the day, some of these channels turn out to be totally clamor free, while the others turn out to be totally loud[9]. Moreover, the portion of silent channels inclines toward the limit of the basic twofold symmetric channels. CSFG Freezing Concept: The proposed BP disentangling plan depends on a CSFG solidifying idea to accomplish bring down multifaceted nature. At a specific cycle t, if a CSFG at arrange j can
accurately unravel its relating constituent code, it is solidified and no message passing or refreshing inside the CSFG will be required in the resulting emphases. The subtle elements of how to check whether a CSFG can be solidified will be displayed later. At the point when the unravelling achieves a specific stage, its CSFGs are checked for solidifying.

In the event that the CSFG can’t accurately unravel its constituent code, at that point it can’t be solidified and the message passing and refreshing are executed by the PEs at that stage. From that point forward, we move to the following stage and check the meeting of the relating CSFGs. When we move to the following stage, the quantity of CSFGs is multiplied. This solidifying checking system proceeds from stage to arrange until the finish of the BPD. Fig demonstrates the SCD planning tree and the factor diagram of then=8 polar code. We can see that the best CSFGs at the distinctive stages relate to the initial few subtrees that came about because of the profundity first traversal of the SCD planning tree. CSFG Freezing Criterion: MLD depends on thorough pursuit, and consequently has a colossal computational unpredictability. To lessen the unpredictability, a novel checking measure is proposed to effectively discover the MLD consequence of the constituent code.

![Fig. 2. Correspondence between SCD scheduling tree and BPD factor graph. (a) Subtrees in SCD graph (bottom)](image)

5. WORKING PRINCIPLE

Polar codes have gotten much consideration from data scholars on account of their ability accomplishing property fig 3. Progressive cancelation (SC) [1] and conviction proliferation (BP) [2] calculations are the two primary translating approaches for polar codes. Be that as it may, to date the useful uses of polar codes are blocked by their long disentangling inertness and constrained blunder rectifying execution issues. Earlier examinations have proposed answers for beat these issues at both calculation and VLSI execution levels. In [3-5], SC list (SCL) calculation and its variations were proposed to enhance the execution of polar codes. In the meantime, [6-10] introduced a few ways to deal with lessen the deciphering idleness of SC and SCL decoders. Moreover, upgrades in deciphering execution of BP calculation were accounted for in [1-7]. In any case, even with the utilization of the above endeavours, polar codes have not in any case met the prerequisites of short inactivity and enhanced disentangling execution with short basic way delay. In view of our current advance on early ceasing criteria for a BP decoder, in this paper we propose another BP-SC half and half translating plan. Unique in relation to a L-estimate SCL decoder, the proposed half breed decoder just comprises of one pre-processing BP decoder and one SC decoder.
Fig. 3. Polar Codes

With the assistance of pre-processing BP decoder, the normal unravelling inertness of whole interpreting is altogether diminished. Then again, the de noised channel data yield from the pre-processing BP decoder can likewise enhance the mistake revising execution of the SC part decoder Therefore, the whole half breed decoder accomplishes a substantially shorter interpreting idleness with enhanced unravelling execution. For (1024, 512) polar codes, fig 2 simulation diagram comes about demonstrate that the proposed approach prompts no less than 0.2dB pick up contrasted with a traditional BP decoder with a similar most extreme number of cycles for the whole SNR locale. What's more, the proposed decoder likewise accomplishes 0.2dB increase over the BP decoder with a similar most pessimistic scenario inertness in the high SNR locale. Also, contrasted with a customary SC decoder, the proposed approach prompts a 0.2dB pick up in the medium SNR district with substantially less normal disentangling dormancy. Besides, we likewise build up the low-many-sided quality bound together equipment design of the half and half decoder, which can execute SC and BP calculations on a similar equipment.

Fig. 4. Simulation Diagram of Polar Codes

Carry skip Adder is a viper usage that enhances the postponement of a swell convey with little exertion contrasted with different adders This will skirt the convey to conquer the deferral and zone and power. Besides, the equipment design for the proposed plot is created and contrasted and the best in class BPD executions for (1024, 512) polar codes. An interpreting throughput of 13.9 Gb/s is accomplished alongside a 60% 73% change in vitality lessening and two times increment in equipment proficiency when contrasted and the current BPD usage. The proposed engineering of this paper investigation the rationale size, territory and power utilization utilizing.

6. RESULT

By using Verilog Xilinx software we simulated our proposed one by taking clock pulse as high and time period as 100us that we check in the simulated output
Fig. 6. Output Waveform

Fig. 7. Block diagram of Polar Codes

Table 1. Performance Comparison

| Analysis          | Existing method | Proposed method |
|-------------------|-----------------|-----------------|
| Power consumption | 0.0020 watts    | 0.0018 watts    |
| Time delay        | 7.523 ns        | 6.378 ns        |
| Frequency range   | 190.63 MHz      | 156.783 MHz     |
| Memory usage      | 411 MB          | 352 MB          |

7. CONCLUSION

This paper introduces a half and half unravelling plan for polar codes. With the utilization of link of BP and SC decoders the half and half decoder can at the same time accomplish great blunder amending and equipment execution. This paper explores the execution of stochastic SC polar code decoder. Different potential methodologies that can enhance translating execution are Analyzed and examined. It is demonstrated that the stochastic SC decoder accomplishes comparable blunder remedying execution to its deterministic partner. This work makes ready for future VLSI plan of stochastic polar decoders.

REFERENCES

[1] C. Berrou, A. Glavieux, and P. Thitimajshima, “Near Shannon limit error – Correcting coding and decoding: Turbo codes” in Proc IEEE Int. Conf. Commun.(ICC), vol. 2. May 1993, pp. 1064, 1070.
[2] R. G. Gallager, Low-Density Parity-Check Codes”. Cambridge, MA, USA: MIT Press, 1963.
[3] E. Arikan,” Channel polarization : A method for constructing capacity achieving codes for symmetric binary input memoryless channels”. IEEE Int. Theory, vol. 55, no. 7, , pp. 3051 3073, Jul. 2009.
[4] E. Sa, So’glu E. Telata, , and E. Arikan, “Polarization for arbitrary discrete memoryless channels,” in Proc. IEEE Inf. Theory Workshop (ITW), Oct. 2009, pp. 144-148.

[5] A. Alamdar- Yazdi and F.R. Kschischang, “A simplified successive cancellation decoder for Polar Codes,” IEEE Commun. Lett., vol. 15, no 12, pp 1378-1380, Dec. 2011.

[6] C. Leroux, I. Tal, A. Vardy, and W. J. Gross, Hardware architectures for successive cancellation decoding of Polar codes,” in Proc. IEEE Int. Conf. Acoust., Speech, Signal Process. (ICASSP), May, 2011, pp. 1665-1668.

[7] C. Leroux, A. J. Raymond, G. Sarkis, and W. J. Gross, “A Semi Parallel Successive-Cancellation decoder for polar codes,” IEEE Trans., vol 61, no 2, pp. 289-299, Jan. 2013.

[8] Y. Fan and C. Y. Tsui, “An efficient partial – sum network architecture for semi-parallel polar codes decoder implementation.” IEEE Trans Signal Process., vol. 62, no. 12, pp. 3165-3179, Jun 2014.

[9] G. Sarkis and W.J. Gross, “Increasing the throughput of polar decoders,” IEEE Commun. Lett., vol. 17, no. 4, pp. 725-728, Apr. 2013.

[10] Karthikeyan S., Karthic C., Shibu Prasath S.V. “Human tracking system for victims trapped from collapsed building” ARPN Journal of Engineering and Applied Sciences, 2016.

[11] Subudhi, J., Karthic C, “Implementation of vedic divider on RSA cryptosystem”. ICIIIECS 2015 - 2015 IEEE International Conference on Innovations in Information, Embedded and Communication Systems.. 2015.

[12] Kumaresan, R., Senthilkumar, S., Karthic, C. “Biometric high secure and cost effective finger vein authentication system for ATM” ARPN Journal of Engineering and Applied Sciences, 2015.