A Soft Decision Decoding Algorithm for Communication Systems

Yong-Geol Shim

Department of Electronics Engineering, Dankook University,
119, Dandae-ro, Dongnam-gu, Cheonan,
Chungnam, 330-714, Korea
ygshim@dankook.ac.kr

Abstract. The aim of this study is to design a soft decision decoding algorithm for communication systems. In this paper the decoding algorithm is defined and discussed. Research results show that the soft decision decoding algorithm gives high capability of correcting errors and reduced decoding complexity.

Keywords: Soft decision decoding, block code, channel coding.

1 Introduction

The aim of this study is to design a soft decision decoding algorithm for communication systems. In this paper the soft decision decoding algorithm is defined and discussed. Research results show that the soft decision decoding algorithm gives high capability of correcting errors and reduced decoding complexity.

Information theory enables us to compute, at least in principle, the highest rate at which reliable communication over the channel is possible. This rate is called the channel capacity. Once channel capacity is computed for a particular set of system parameters, it is the task of the communication link designer to devise coding and modulation strategies that approach this capacity [1], [2]. The proofs of the fundamental theorems of information theory indicate that Shannon limits can be achieved by random code constructions [3] using very large block lengths. While this appeared to be computationally infeasible in terms of both encoding and decoding, the invention of turbo codes provided implementable mechanisms for achieving just this.

2 Soft Decision Decoding

The estimation derives optimal non-coherent receivers using the framework of composite hypothesis testing [4], where we choose between multiple hypotheses when there are some unknown parameters in the statistical relationship between the observation and the hypotheses. In the case of non-coherent communication, the unknown parameter is the carrier phase.

IST 2013, ASTL Vol. 23, pp. 33 - 35, 2013

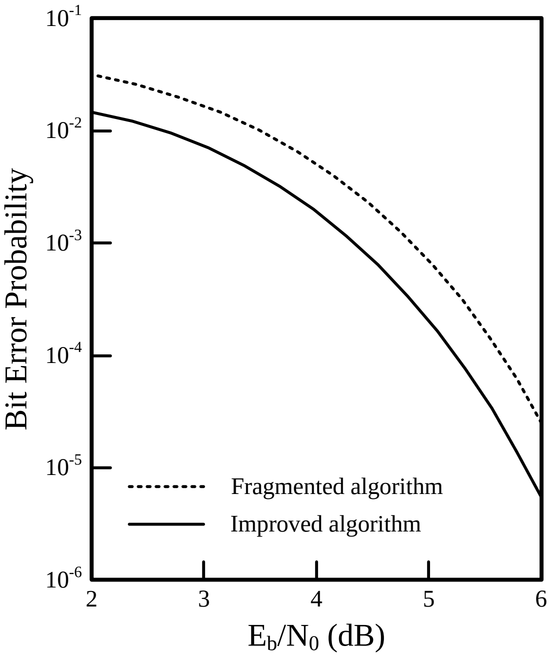

Fig. 1. Bit error probability of the (24, 12, 8) extended Golay code.

Let us consider the effect of the delay in complex baseband. We can write the passband signal as

$$u(t-\tau) = s(t-\tau) + \mathrm{n}(t-\tau) \tag{1}$$

where the carrier frequency is typically very large [5], [6]. The remaining K columns of G form the next N - K columns of G arranged in the order of decreasing associated reliability values. The above process defines a second permutation function, such that

$$H_{n2} = \eta_n[\mathrm{H}_1] = h_2[\lambda_1[\mathrm{G}]]\ C = \lambda_1\ \mathrm{D}\,. \tag{2}$$

Rearranging the components according to the permutation, we obtain the sequence.

3 Experimental Result

In this section, we present the performance of the proposed soft decision decoding algorithm. Fig. 1 depict the error performances of the (24.12.8) extended Golay code.

We observe a close match between the theoretical and simulated results. For the (24.12,8) extended Golay code, order-3 reprocessing achieves the practically optimum error performance. We also simulated the optimum decoding and found no difference in error performance between the order-1 reprocessing and the optimum decoding. The error performance curves of order-4 reprocessing and optimum ML decoding overlap with each other. There is a small performance degradation with order-l reprocessing.

4 Conclusion

The operations on the down-converted complex baseband signal are made using DSP, which can, in principle, implement any desired operation on the original analog signal with arbitrarily high fidelity, as long as the sampling rate is high enough and the analog-to-digital converter has high enough precision. The sampling rate is usually chosen to be an integer multiple of the symbol rate. The sampling rate is usually chosen to be an integer multiple of the symbol rate signaling with moderate excess bandwidth, sampling preserves all the information in the analog received signal.

References

1. P. P. Pande, et. al., "Performance Evaluation and Design Trade-offs for MP-SoC Interconnect Architectures”, IEEE Trans. Computers, vol. 54, no. 8, (2005)
2. B. Li, Y. -Z. Yin, Y. Zhao and Y. Ding, "A CPW-fed triple-band antenna with a Π-shaped slot for WLAN and WiMAX applications", Proceeding of the Cross Strait Quad-Regional Radio Science and Wireless Technology Conference, (2011)
3. M. Al-Husseini, Y. Tawk, A. El-Hajj and K. Y. Kabalan, "A low cost microstrip antenna for 3G/WLAN/WiMAX and UWB applications", Proceedings of Advances in Computational Tools for Engineering Applications, (2009)
4. W. J. Dally and B. Towles, "Route packets, not wires: On-chip interconnection networks", Proceedings of DAC 2001, (2001).
5. R. Caso, A. A. Serra, M. Rodriguez-Pino, P. Nepa and G. Manara, "A wideband slot-coupled stacked-patch array for wireless communications", IEEE Antennas and Wireless Propagation Letters, vol. 9, (2010).
6. S. Santi, et. al., “On the Impact of Traffic Statistics on Quality of Service for Networks on Chip”, Proceedings of ISCAS´05, (2005)