Topics in Coding, Cryptography and Information Security

Editors:

Mohammad Umar Siddiqi
Sigit Puspito Wigati Jarot
Othman Omran Khalifa

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Chapter 6

Zigzag Codes:
High Rate Low Complexity Iterative Codes

Sigit P.W. Jarot

6.1. Introduction

This chapter discusses Zigzag codes, new concept of error correction codes that have been attracting a lot of research activities in wireless communication, considered as a promising alternative to widely used turbo codes or LDPC codes. Zigzag codes have been originally proposed by Li Ping et.al [1] in 2001.

Turbo code has been considered as one of the most powerful codes, and has been officially chosen as one of the optional or mandatory error correction codes in many wireless communication standards. However, the high decoding complexity of the turbo codes is still an issue today, particularly for the wireless systems that much less complex than cellular systems, such as UWB, WSN, and so forth. On the other hand, one of the key advantages that make zigzag codes very attractive is their low complexity in encoding as well as decoding, in addition to its good performance in high code rate.

The basic of zigzag codes will be introduced in Section 6.2. It includes explanation about the encoding and decoding schemes, the structure of zigzag codes, as well as how the complexity can be reduced, as compared to other coding schemes. Since concatenation is crucial in improving the error correction capabilities of zigzag codes, the role interleaving among encoders becomes very important. Section 6.3 discusses concatenation and interleaver issues, including some approaches of designing the multiple interleavers of zigzag codes. Section 6.4 provides discussions about H-ARQ schemes based on zigzag codes.

Section 6.5 presents simulation results of zigzag codes in 3GPP typical urban channel, as well as its comparisons with turbo codes, in terms of throughput performance, in various bandwidth, mobile speed as well as number of H-ARQ retransmissions. Finally the summary is provided in Section 6.6.

6.2. Zigzag Codes

This section explains the basic of zigzag codes encoding and decoding process, based upon [1]. The K information bits are arranged in a data array $D = \{d(i,j)\}$ of size $\times J$. Parity check bit $p(i)$ for each i-th row of the D array is computed recursively. The parity bits are chosen such that each segment on the graph contains an even number of ones.