A shortening pattern selection method of shortened Polar codes

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ABSTRACT

In order to improve transmission reliability and flexible cooperation in optical communication, Polar codes have become a research hotspot. Aiming at the problem that the length of Polar codes is limited, we generate an auxiliary matrix by bit-reversal permutation, and then select the shortening bits from the matrix, so that the shortened Polar codes can be obtained conveniently.

INTRODUCTION

Optical communication in data center needs to ensure high reliability, low latency and low complexity. Polar codes, as a major new development in the field of channel coding in recent years, is the only error-correcting codes that can be mathematically proved to reach the Shannon capacity limit.

As the code length of Polar code is affected by the fundamental matrix in its generation matrix, the available Polar code length can only be a power of 2, so the inability to generate Polar codes with flexible code rates is a major problem in the current study of Polar codes.

PROPOSED METHOD

A (N, K) shortened Polar code is generated from a (N_m, K_m) mother Polar code with $N = 2^{\lceil log_2^N \rceil}$and $K_m = K$. The shortening set is given by $S = N_m - N$, and then the S bits of the shortening bits correspond to the codeword bit x_s is also set to 0. The general shortening mode of Polar codes in the third type is shown in Fig. 1.

We use bit-reversal permutation in the mother Polar code sequences, then group the sequences after bit-reversal permutation by the rules presented in the follows, so that we can get an auxiliary matrix.

The auxiliary matrix gathers the bits of high reliability together in its bottom right corner for shortening. By using the auxiliary matrix, we can select the proper bits and improve the performance of BER and FER. At the same time, it has a low computational complexity, which can avoid consuming huge computing resources.

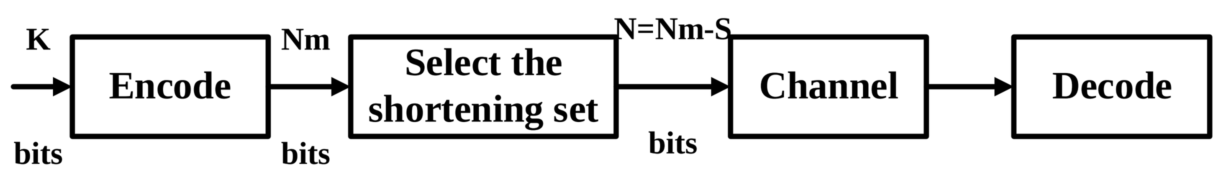

Figure 1.General shortening mode of Polar codes

SIMULATION

The results in Fig.2 and Fig.3 show that our proposed shortened Polar code has a gain of about 0.5dB when BER reaches 10^{-3}compared with the shortened code in [5]. Our proposed code also outperforms the other two codes in [4] and [7] by up to 0.2dB for the same BER and FER.

The results in Fig. 3 show that our proposed shortened Polar code outperforms the shortened code in [5] about 0.3dB and outperforms the other two codes in [4] and [7] by up to 0.2dB for the same BER and FER.

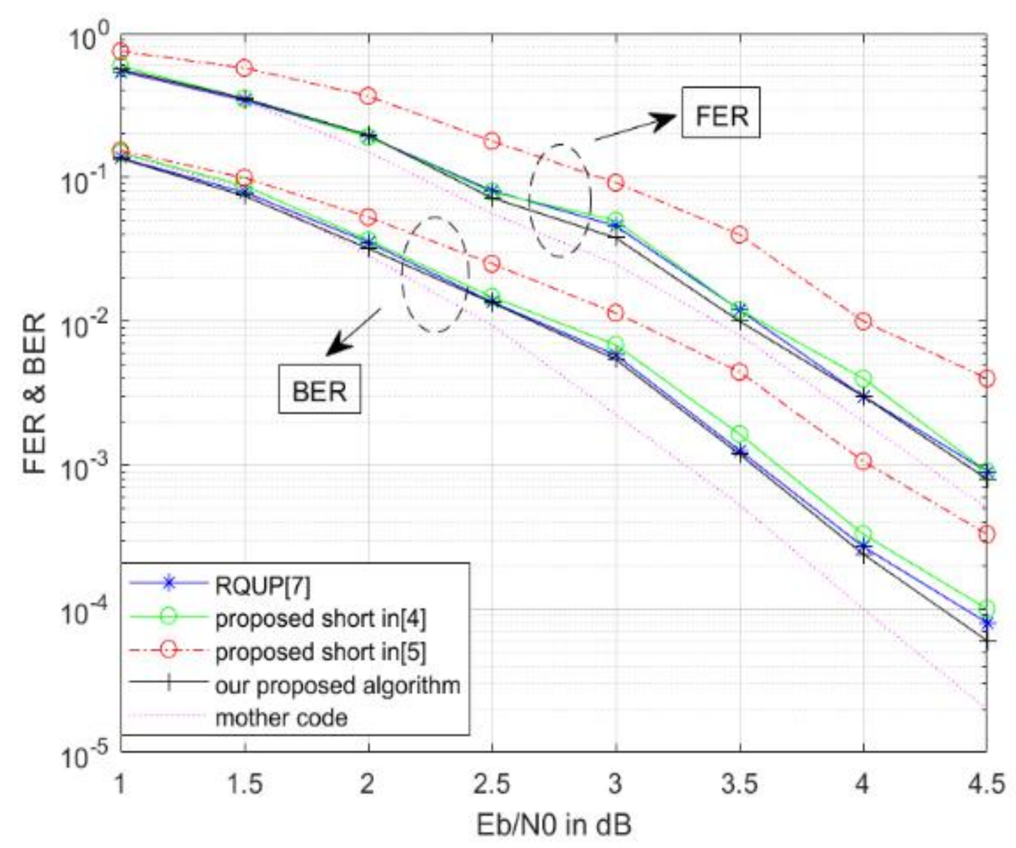

Figure 2. BER and FER performances of proposed shortened Polar code N=200 K=100

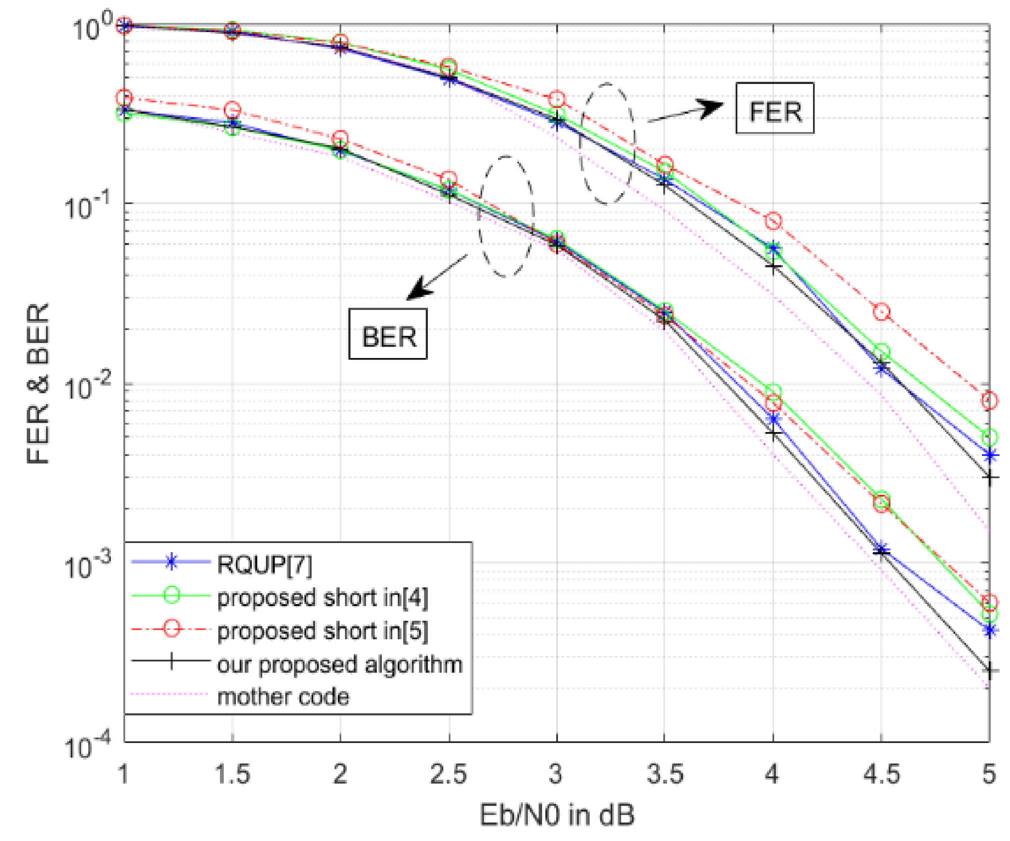

Figure 3. BER and FER performances of proposed shortened Polar code N=200 K=160

CONCLUSION

In this paper, we propose a shortened pattern method to construct shortened Polar codes which is based on the channel polarization index, then by bit-reversal permutation and auxiliary matrix. The simulation results show that the proposed shortened Polar codes have a better performance than the conventional shortened codes.

Acknowledgment

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