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Code design for run-length control in visible light communication

Key words: Visible light communication; Run-length limited codes; Finite-state machine; Minimum Hamming distance

Corresponding author: Zong-yan LI
E-mail: lizongyan@cumt.edu.cn
ORCID: https://orcid.org/0000-0001-8089-5921

Introduction

- In this paper, we propose a new high-rate RLL coding scheme to achieve flicker mitigation.
- A set-partitioning mapping algorithm is proposed for n-bit binary codeword sets.
- Furthermore, we propose a high-coding-gain RLL coding scheme by reducing the number of input information bits or increasing the number of codeword bits in the output.

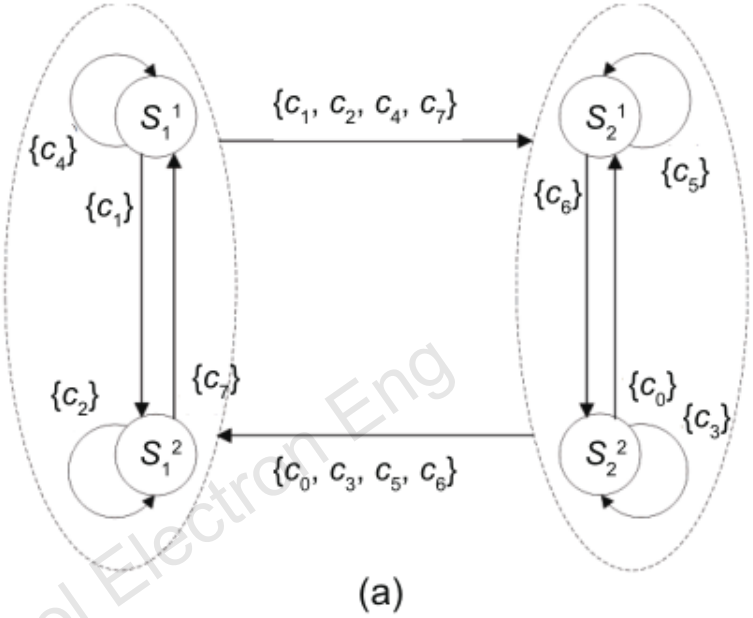
Method

1. Stage 1: design the codeword sets such that $d_{\min}^{0} < d_{\min}^{1} < d_{\min}^{2}$.

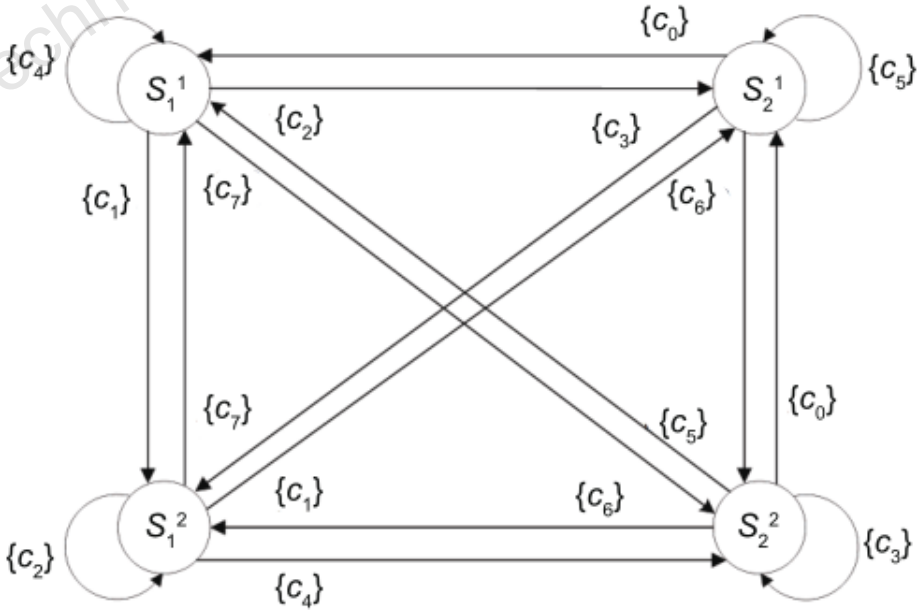
2. Stage 2: based on the results of stage 1, design the FSM for RLL codes with $d_{\min} = 3$ and small state number.

FSM of RLL codes

FSM of rate 2/3 RLL codes with $d_{\min} = 3$ and N = 4: (a) splitting $S1$ and $S2$ into two states; (b) four states connected by the codeword subset with $d_{\min} = 3$.



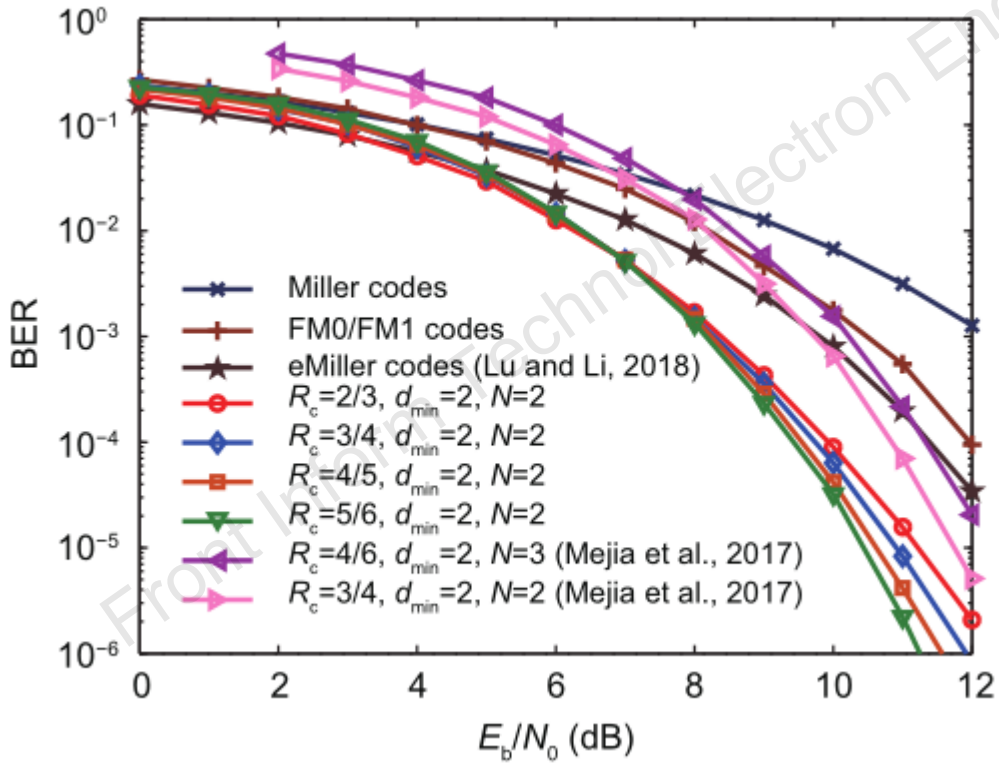
(a)



(b)

Major results (1)

BER comparison with Viterbi algorithm



BER comparison with Viterbi algorithm

Major results (2)

BER comparison of RLL codes with different code rates

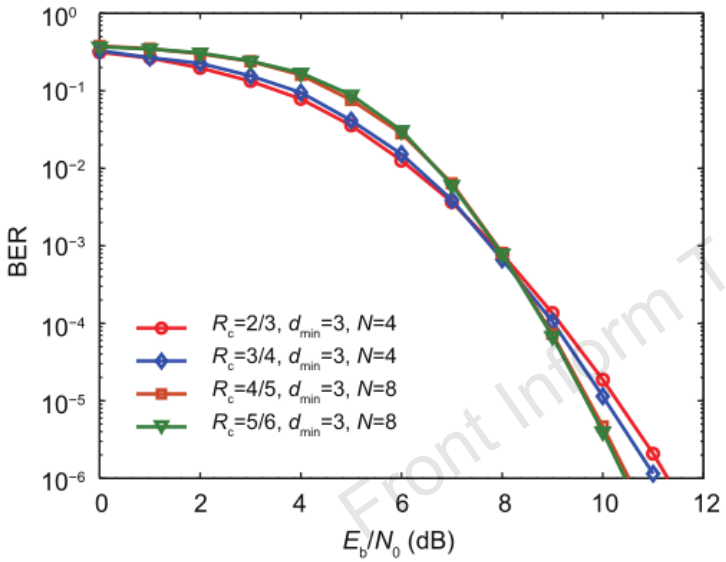


Fig. 25 BER comparison of RLL codes with different code rates with $d_{\min} = 3$

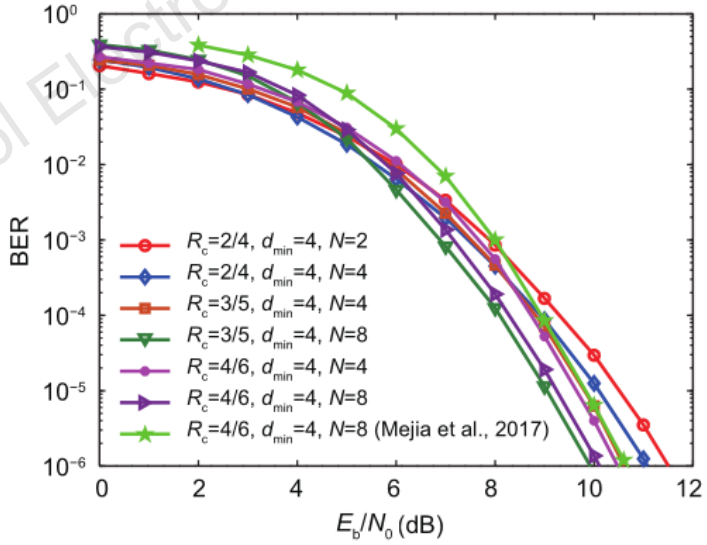


Fig. 26 BER comparison of RLL codes with different code rates with $d_{\min} = 4$

Conclusions

- The state splitting method and codeword-set partitioning criterion have been introduced in the design of two FSMs based on the FSM of high-rate RLL codes with $N = 2$.
- The first RLL code has been proposed to improve the coding gain.
- Other RLL codes were proposed to enhance the coding gain based on the first scheme.
- Simulation results established that the various proposed coding schemes achieved superior error performance to existing codes.