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Rate-Distortion Analysis of Structured Sensing Matrices for Block Compressive Sensing of Images

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Abstract

Block compressive sensing (BCS) is a highly promising method for image/video encoding in resource-constrained applications. The computational cost of CS encoder depends on the nature of sensing matrices. Popular random Gaussian and Bernoulli sensing matrices not only demand high encoding complexity but yield poor rate-distortion performance. In contrast, structurally random matrix (SRM) and binary permuted block diagonal matrix (BPBD) help to reduce the encoder complexity drastically. Since transmission cost is much higher than computational cost, it is necessary to evaluate the compression efficiency of these matrices. In this paper, we provide the rate-distortion performance analysis of BCS based imaging system using SRM and BPBD matrices to investigate the choice of sensing matrix for compression and energy efficient CS encoder. Through both theoretical and experimental analysis, it is established in this work that the CS measurements using SRM are Laplacian distributed while that using BPBD matrices retain statistical information of the original images. This finding motivates the use of fixed Huffman coding and fixed length coding with these structured sensing matrices which help to reduce the encoder complexity without causing much deterioration to compression efficiency. Thus our work demonstrates a promising direction towards the realization of an inexpensive encoder.

Keywords: Block compressive sensing, rate-distortion performance, SRM,

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