Signal Reconstruction Performance under Quantized Noisy Compressed Sensing

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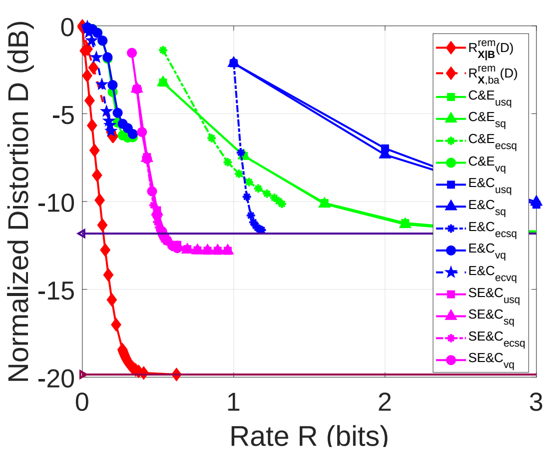
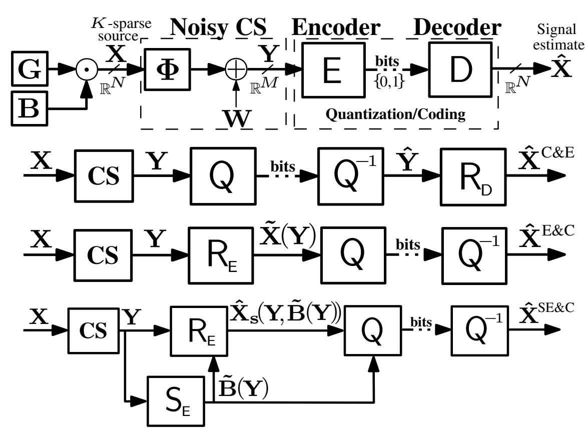
Compressed sensing (CS) [Candes, Donoho, Romberg, Tao et al. in 2006] is an effective joint sampling and compression paradigm to reduce energy consumption for acquiring sparse signals in low-power sensor applications. Since quantization is inevitable in practice, we study rate-distortion (RD) performance of various single-sensor CS schemes for acquiring sparse signals via quantized/encoded noisy linear measurements. The paper combines and refines the recent advances of quantized CS (QCS) algorithm designs and theoretical analysis into a unified framework with empirical performance comparison. Practical quantizer based QCS methods relying on 1) compress-and-estimate, 2) estimate-and-compress, and 3) support estimation (containing several novelties) strategies are developed. Their RD performance is numerically compared to several theoretical limits relying on remote source coding.

Simulation results show that when scalar quantization is used, the proposed adaptive compression of the support set and estimated magnitudes is an effective strategy. When (entropy-constrained) vector quantization (ECVQ) is used, the estimate-and-compress strategy, as supported by the theory, is the best one. Accordingly, our recently proposed ECVQ based estimate-and-compress method is numerically shown to approach the compression limit of the QCS – the remote RDF.





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