Lossy Computing of Correlated Sources with Fractional Sampling

Xi Liu, Osvaldo Simeone, Elza Erkip

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This paper considers the problem of lossy compression for the computation of a function of two correlated sources, both of which are observed at the encoder. Due to presence of observation costs, the encoder is allowed to observe only subsets of the samples from both sources, with a fraction of such sample pairs possibly overlapping. The rate-distortion function is characterized for memoryless sources, and then specialized to Gaussian and binary sources for selected functions and with quadratic and Hamming distortion metrics, respectively. The optimal measurement overlap fraction is shown to depend on the function to be computed by the decoder, on the source statistics, including the correlation, and on the link rate. Special cases are discussed in which the optimal overlap fraction is the maximum or minimum possible value given the sampling budget, illustrating non-trivial performance trade-offs in the design of the sampling strategy. The trade-off between the average distortion and the worst-case distortion is then studied. Finally, the analysis is extended to the multi-hop set-up with jointly Gaussian sources, where each encoder can observe only one of the sources.

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