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Large Deviations Analysis of Variable-Rate Slepian-Wolf Coding

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Abstract

We analyze the asymptotic performance of ensembles of random binning Slepian-Wolf codes, where each type class of the source might have a different coding rate. In particular, we first provide the exact encoder excess rate exponent as well as the decoder error exponent. Then, using the error exponent expression, we determine the optimal rate function, namely, the minimal rate for each type class needed to satisfy a given requirement on the decoder error exponent. The resulting excess rate exponent is then evaluated for the optimal rate function. Alternating minimization algorithms are provided for the calculation of both the optimal rate function and the excess rate exponent. It is thus exemplified that, compared to fixed-rate coding, larger error exponents may be achieved using variable-rate coding, at the price of a finite excess rate exponent.

Index Terms

Slepian-Wolf coding, method of types, error exponents, excess rate exponent, alternating minimization, source uncertainty.

I. Introduction

The problem of distributed encoding of correlated sources has been studied extensively since the seminal paper of Slepian and Wolf [22]. This paper addresses the case, where a memoryless source $\{(X_i, Y_i)\}$ needs to be compressed by two separate encoders, one for $\{X_i\}$ and one for $\{Y_i\}$. In a nutshell, the most significant result of [22] states that if $\{Y_i\}$ is known at the decoder side, then $\{X_i\}$ can be compressed at