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Source Coding Exponents for Zero-Delay Coding with Finite Memory

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ABSTRACT

Fundamental limits on the source coding exponents (or large deviations) performance of zero-delay finite-memory (ZDFM) lossy source codes are studied. Our main results are the following: For any memoryless source, a suitably designed encoder that time-shares (at most two) memoryless scalar quantizers is as good as any time-varying fixed-rate ZDFM code, in that it can achieve the fastest exponential rate of decay for the probability of excess distortion. A dual result is shown to apply to the probability of excess code-length, among all fixed-distortion ZDFM codes with variable rate. Finally, it is shown that if the scope is broadened to ZDFM codes with variable rate *and* variable distortion, then a *time-invariant* entropy-coded memoryless quantizer (without time-sharing) is asymptotically optimal under a "fixed-slope" large deviations criterion (introduced and motivated here in detail) corresponding to a linear combination of the code-length and the distortion. These results also lead to single-letter characterizations for the source coding error-exponents of ZDFM codes.