

Zero-Delay and Causal Single-User and Multi-User Lossy Source Coding with Decoder Side Information*

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Abstract

We consider zero-delay single-user and multi-user lossy source coding with decoder side information. The zero-delay constraint translates into causal (sequential) encoder and decoder pairs as well as the use of instantaneous codes. For the single-user setting, we show that optimal performance is attained by time sharing at most two scalar encoder-decoder pairs, that use zero-error side information codes. Furthermore, we show that if either the encoder or decoder are restricted a-priori to be scalar, the performance loss compared to an unrestricted system cannot be compensated by the other component and the other component can be scalar as well, even if the zero-delay constraint is lifted. We also demonstrate that, at least in some cases, there is no performance loss (compared to classical arbitrary delay system) from the restriction to sequential decoders. Finally, we show that the multi-terminal source coding problem can be solved in the zero-delay regime and the rate-distortion region is given.

1 Introduction

The classical source coding theorems and their converse counterparts provide fundamental limits which are usually asymptotic in the sense that they can be achieved by systems that introduce delay (imposed by operating on blocks)

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