

Successive Refinement for the Wyner-Ziv Problem and Layered Code Design

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Driven by a host of applications, distributed source coding (DSC) has assumed renewed interest in recent years. Wyner-Ziv coding (WZC), which deals with the rate-distortion problem with side information available only at the decoder, is one case of DSC.

In this paper, we focus on successive refinement of the Wyner-Ziv problem described in [1]. Similar to the problem in classic source coding, a successive refinement coding scheme for the Wyner-Ziv problem consists of multi-stage encoders and decoders where each decoder uses all the information generated from previous encoding stages and the side information, which could be different from stage to stage. We call such a scheme successively refinable if the rate-distortion pair associated with any stage falls on the same Wyner-Ziv rate-distortion curve given the corresponding side information. It was shown in [1] that if the side information for all stages are identical, the jointly Gaussian source with squared error distortion measure is successively refinable. We extend successive refinability from jointly Gaussian source to the more general type of sources that the difference between the source and the side information is Gaussian and independent of the side information. As a by-product, we give an alternative proof that the Wyner-Ziv problem for these sources has no rate loss, where this statement was recently shown in [2]. We then propose a layered (successive) coding scheme using nested scalar quantization and Slepian-Wolf coding of bit planes based on LDPC codes for the type of sources described above. Moreover, when ideal Slepian-Wolf coding is assumed, we show that our scheme is practically successively refinable, i.e., there is no performance loss due to layering. For the jointly Gaussian source, our layered coder performs 1.33 to 2.83 dB from the Wyner-Ziv bound for rates ranging from 0.47 to 5.65 bits per sample.

The full paper is available at <http://samuel.ee.tamu.edu/publication.htm>.

References

- [1] Y. Steinberg and N. Merhav, "On successive refinement for the Wyner-Ziv problem," submitted to *IEEE Trans. Information Theory*, March 2003.
- [2] S. Pradhan, J. Chou, and K. Ramchandran, "Duality between source coding and channel coding and its extension to the side information case," *IEEE Trans. Inform. Theory*, pp. 1181–1203, May 2003.