A Video Codec Based on R/D-Optimized Adaptive Vector Quantization

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Vector quantization (VQ) is known to be an optimal compression method for a stationary and ergodic source, provided that arbitrarily large vector dimension and codebook size are employed. In practical VQ encoding schemes of images and video sequences, hardly one of these assumptions is fulfilled; the dimension and codebook are limited in size and, perhaps the worst, video sources are not stationary. Therefore, adaptive VQ (AVQ) schemes have been developed that adapt the vector quantizer to the source during the encoding. Lately AVQ-coders have been combined with rate-distortion (R-D) techniques to improve the coding performance [1].

In this poster we present a new AVQ-based video coder for very low bitrates. To encode a block from a frame, the encoder offers three modes: 1. A block from the same position in the last frame can be taken, 2. the block can be represented with a vector from the codebook or 3. a new vector, that sufficiently represents a block, can be inserted into the codebook. For mode 2 a mean-removed VQ scheme is used. The decision how blocks are encoded and how the codebook is updated is done in an R-D optimized fashion. The codebook of shape blocks is updated once per frame. First results for an implementation of such a scheme have been reported in our previous paper [2]. Here we extend the method to incorporate a wavelet image transform before coding in order to enhance the compression performance. In addition the rate-distortion optimization is comprehensively discussed. Our R-D optimization is based on an efficient convex-hull computation [3]. This method is compared to common R-D optimizations that use a Lagrangian multiplier approach.

In the discussion of our R-D method we show the similarities and differences between our scheme and the generalized threshold replenishment (GTR) method of Fowler *et al.* [1]. Furthermore, we demonstrate that the translation of our R-D optimized AVQ into the wavelet domain leads to an improved coding performance. We present coding results that show that one can achieve the same encoding quality as with comparable standard transform coding (H.263). In addition we offer an empirical analysis of the short- and long-term behavior of the adaptive codebook. This analysis indicates that the AVQ method uses the vectors in its codebook for some kind of *long-term* prediction.

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