Adaptive Vector Quantization—Part II: Classification and Comparison of Algorithms

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In this poster presentation, we review prominent examples of adaptive-vector-quantization (AVQ) algorithms from prior literature and develop a classification of these algorithms. Well known theorems from rate-distortion theory suggest two approaches to the nonadaptive vector quantization (VQ) of a stationary, ergodic random process. These two nonadaptive-VQ approaches have, in turn, inspired two general types of AVQ algorithms for the coding of nonstationary sources. In *constrained-distortion* AVQ algorithms, the algorithm limits the distortion to some maximum value and then attempts to minimize the rate subject to this distortion constraint. *Constrained-rate* AVQ algorithms do the opposite, limiting the rate to be less than or equal to some maximum value and attempting to produce a coding with the smallest distortion.

In theory, both these constrained-distortion and constrained-rate approaches to AVQ are capable of optimal coding of stationary sources, assuming an asymptotically infinite codeword dimension. However, in practice, one is often faced with nonstationary sources as well as a limited vector dimension. Consequently, it has been recognized in recent literature that neither approach is sufficient by itself—AVQ algorithms should ideally monitor both rate and distortion simultaneously to ensure that each updating of the local codebook is performed in a manner that is favorable to the rate-distortion performance of the algorithm. This observation has led to the introduction of a third category of AVQ algorithms; these *rate-distortion-based* algorithms minimize rate-distortion cost functions.

In this poster, we discuss each of the three categories of AVQ algorithms in detail and mention notable algorithms found in each category. Afterwards, we summarize the discussion with an algorithm taxonomy. Finally, we present experimental results for several prominent AVQ algorithms on an artificial nonstationary random process. Our results suggest that, one, the class of rate-distortion-based algorithms is capable of coding performance superior than that of other algorithms, particularly for low-rate coding, and, two, that complex, batch coding algorithms (which have traditionally been a popular approach to AVQ) are not as competitive as simpler, online algorithms.

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