

New Methods for Trellis Source Coding at Rates Above and Below One

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Summary—Earlier trellis source coding methods [1] are extended to rates above and below one. The new schemes have in common a code design based on branch correlation, a large reproducer alphabet, and an encoder based on either the Viterbi algorithm or a tailbiting MAP technique. The performances of these simple schemes often exceed those of all previous methods in the literature with similar complexity.

For $R = 2$ bits per source sample we propose two trellis source coding schemes. The first method consists of one trellis encoder with 4 branches stemming from each state. All 4 exiting branches enter different states. In the second method we describe a system having two concatenated $R = 1$ encoders. The difference between the original sequence and the quantized output of the first encoder serves as input to the second, a method well-known in residual quantization.

Two trellis based methods to perform quantization at $R = 1/2$ are also presented. Both constructions utilize a vector-valued reproducer alphabet. The first method finds a codebook by optimizing the reconstruction values of two scalar quantizers. We compare the performance to a second method where an initial codebook consisting of samples from a training set is used instead. Both methods utilize the LBG algorithm to find optimized codebooks. The vectors from the codebook are then associated with the trellis branches to complete the code trellis.

The methods are easily adapted to various bit rates, but here we present results only for $R = 2$ and $R = 1/2$ bits per source sample. Results, demonstrated for the memoryless Gaussian source, show similar or better performances than previous methods with similar coding complexity. The complexity is comparable to that of TCQ [2]. We have also compared the Viterbi algorithm to the tailbiting MAP algorithm for short sequences using the same reproducer alphabet. Simulations show a superior performance of the tailbiting MAP algorithm.

- [1] T. Eriksson, M. Novak, and J. B. Anderson, "MAP Criterion Trellis Source Coding for Short Sequences," in *Proc. DCC'03*, Snowbird, Utah, Mar. 2003, pp. 43–52.
- [2] M. W. Marcellin and T. R. Fischer, "Trellis Coded Quantization of Memoryless and Gauss–Markov Sources," *IEEE Trans. on Communications*, vol. COM-38, no. 1, pp. 82–93, Jan. 1990.

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