On the Block Size of Trellis Quantizers

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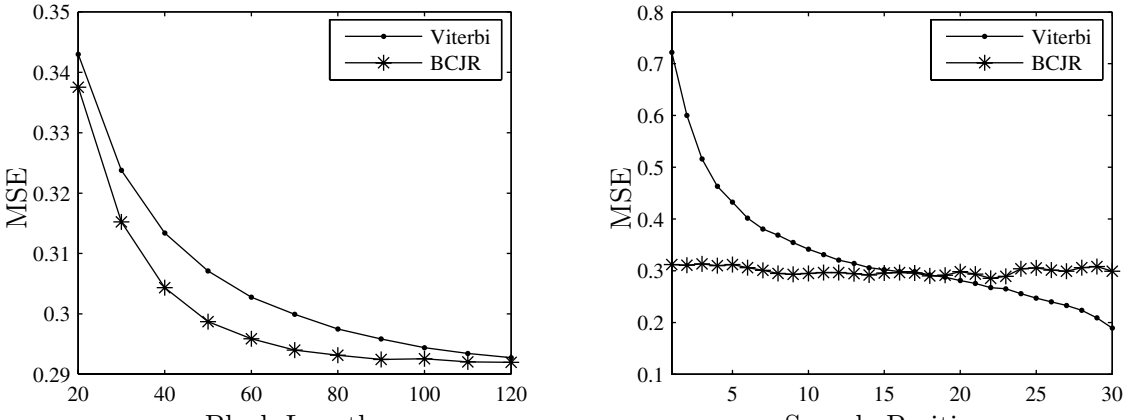
Summary—We examine the effect of block size on the performance of trellis based quantization. In particular, the Viterbi and tailbiting BCJR algorithms are compared. It is shown that for short blocks of data, the T–BCJR algorithm [1] achieves a superior performance over the Viterbi algorithm (VA).

Various publications have reported trellis based quantization schemes with results close to the theoretical limit for certain source distributions and large block sizes. But in practical systems the block size should be kept short to prevent delay in e.g., real-time transmission of speech or video. These schemes employ the Viterbi algorithm to find the minimum distortion trellis path; a major drawback is the trellis start-up effect. An alternative approach is to use the maximum a posteriori probability (MAP) heuristic [2] and the T-BCJR algorithm. If the MAP-encoder does not produce a tailbiting state sequence, the path is modified for a number of stages at the beginning and end of the block such that it tailbites.

The figure shows MSE as a function of block size and sample position, respectively, for a rate $R = 1$ bit per sample, 32-state trellis quantizer and an IID Gaussian source. The effects of start-up are clearly visible. For the T–BCJR algorithm the distortion is evenly distributed across the whole block. The performance decrease for short blocks stems from the increase in the number of tailbiting violations for short blocks and the suboptimal modification to ensure tailbiting. The results presented here hold for a large class of trellis constructions, such as TCQ.



[1] J. B. Anderson and S. M. Hladik, "Tailbiting MAP Decoders," *IEEE Journ. Sel. Areas Comm.*, vol. 16, pp. 297–302, Feb. 1998.

[2] T. Eriksson, M. Novak, and J. B. Anderson, "MAP Criterion Trellis Source Coding for Short Sequences," in *Proc. DCC'03*, Snowbird, Utah, pp. 43–52, Mar. 2003.

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