Image Coding with the MAP Criterion

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Abstract—BCJR based source coding of image residuals is investigated. From a trellis representation of the residual, a joint source–channel coding system is formed. Then the BCJR algorithm is applied to find the MAP encoding. MAP and minimized squared error encoding are compared.

We explore the use of the maximum a posteriori probability (MAP) criterion in the context of image coding. The proposed method consists of splitting the image into two components, a model and a residual image [1], and coding them separately with different methods. A set of polynomial basis images is used to represent the model. Some redundancy can be found in the residual signal. Thus a decorrelation procedure, accomplished by a modified KL-transformation, is applied prior to the residual encoding.

In the encoding of the noise-like residual source we use a trellis structure and the MAP as distortion measure. We show how the MAP path in the trellis, the one corresponding to the highest probability conditioned on the observed information, can be used to represent the observed signal. This directly leads to the BCJR [2] algorithm and the path in the trellis is determined as the transitions between the states with highest probability at each time instant. This path is the representation of the sequence. An advantage of the MAP metric in image coding is that MAP allows single outliers. Minimum squared error (MSE) does not allow this, and instead tries to find a compromise resulting in the smallest average distortion.

A joint source–channel (JSC) encoding system is then formed. It is natural to let the design be of that founded on the same trellis structure. When used as a JSC encoder, the trellis branch symbols produced by a convolutional encoder are sent over the transmission channel. Convolutional codes naturally incorporate the property of distributing the codewords in a pseudo-random manner. No separate channel encoder is required since the output sequence can be found directly in the trellis structure used by the BCJR algorithm.

The novelty of this work is the use of the BCJR algorithm and the MAP criterion in the source coding procedure. The source encoding system described preserves other features than an MSE based encoder. Also, blocking artifacts are reduced. For a comparison see the full paper version [3].

References

[1] M. Novak, "Transmission error robust fractal coding using a model-residual approach," in Proc. *Data Compression Conference,* pp. 149–158, Snowbird, Utah, March 1998.

[2] L.R. Bahl *et al.*, "Optimal Decoding of Linear Codes for Minimizing Symbol Error Rate," *IEEE Trans. Information Theory,* vol. IT-20, pp. 284–287, March 1974.

[3] `http://www.it.lth.se/tomas/eriksson_novak_anderson_dcc02.ps`, November 2001.