Low Complexity Finite-State Scalar Quantization of Image Subbands

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Subband image coding is one of the most efficient image compression techniques known to date. Its advantages over standard techniques based on transform coding are particularly important at very low bit rates. The ability offered by a multiresolution decomposition approach to separately quantize the information contained in different frequency bands of an image, according to a criterion that accounts for the different sensitivity of the human visual system to each band, is crucial to the success of the technique. At low bit rates, the bands with lower energy content (usually the higher frequency bands) are very coarsely quantized, which accounts for most of the coding gain. Image quality is preserved by finely quantizing the higher energy content bands, commonly associated with the low frequency areas of the spectrum. In this paper we propose a fast and efficient method of achieving this goal. Our method is based on the combination of entropy coding with three types of scalar quantization: (i) scalar quantization, (ii) finite-state scalar quantization (FSSQ) and (iii) predictive FSSQ (PFSSQ). Scalar quantization is applied to bands with very low inter-pixel correlation, whereas FSSQ is used for bands with medium to high inter-pixel correlation. The common case that the lowest frequency band of an image exhibits linear inter-pixel correlation is exploited through PFSSQ, which uses a contextual model of the quantized prediction error to more accurately encode it. Furthermore, it is known that when entropy coding is employed, optimum scalar quantizers are nearly uniform. Therefore, uniform quantizers have been used throughout, which eliminates the need of training for quantizer design. The results of our experiments show that this system is specially well suited to very low bit rate image coding. An example of these results is given in Figures 1 and 2.