Improved multiple description wavelet based image coding using subband uniform quantization

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1. Introduction and problem description

Multiple description coding (MDC) is a joint source-channel coding whose objective is to encode a source into several descriptions in such a way the quality of the recovered signal increases with the number of received descriptions. To accomplish this goal, each description alone must carry a sufficient amount of information about the original source. This necessarily means that there is a certain amount of common information and, hence, correlation between the descriptions.

Many approaches have been proposed to realise MDC. The first MD coder was designed by Vaishampayan [1] in which multiple description scalar quantizers were used in an extension of the old JPEG coder. Other methods for the design of MDC coders use correlation inducing transforms (multiple description transform coding: MDTC) [2–5]. Pereira et al. [6] and Sumohana et al. [7] have studied MDC techniques based on wavelet transform, but not considering correlating transforms in wavelet domain. A wavelet transform based MDTC coder for coding still images has been addressed by Khelil et al. [8].

The scheme proposed in [8], which constituted an improvement of the MDTC coder proposed by Goyal et al. [4,5], considers the transmission of images using MDTC based on wavelet transform for the case of four descriptions. The four generated descriptions (representing the four subbands obtained after applying a first level wavelet transform) are uniformly quantized with a constant quantization step. Unfortunately, we noticed that uniform quantization is performed within each subband with the same quantization step even though the four subbands do not have the same energy and they are not equally important.

In this paper, we propose to improve the technique described in [8] by using subband uniform quantization. The proposed approach employs four levels of quantization estimated according to the relative energy within each subband and are optimized heuristically with a genetic algorithm (GA) [9]. Simulation results show an improvement in the objective measure of peak signal to noise ratio (PSNR) and in the subjective perceptual quality of the reconstructed images.

The rest of this paper is organized as follows. In Section 2, we give a brief description of the multiple description transform coding. Section 3 presents our proposed wavelet transform based MDC coder. The optimization method using genetic algorithm is described in Section 4. The simulation results are presented in Section 5. Finally, some concluding remarks are given in Section 6.

2. Multiple description transform coding (MDTC)

Contrary to conventional transform coding (such as the DCT), where the transform is used to decorrelate the input image, the MDCT coding system uses a transform that introduce controlled amount of correlation among the transformed coefficients, based on linear transforms, mapping N input variables to N coefficients. The transform coefficients are partitioned into packets such that in case of packet loss, the lost coefficients can be estimated from the...
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