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CODING TECHNIQUES OF MULTICOMPONENT IMAGES

Thesis Highlights

Two methods for multicomponent image coding were investigated and compared:

- **the multicomponent zigzag DCT encoder**
- **the multicomponent hybrid encoder with "P-th" law quantization.**

For the multicomponent zigzag DCT encoder (Fig. 1), bit-rates as low as 0.83 [bpp] (0.1 [bppc] the per channel bit-rate) and average PSNR of 31 [dB] for a block size of $16\times16\times8$ have been achieved (Fig. 2). These results show that the multicomponent zigzag DCT encoder significantly outperforms the conventional array of two-dimensional image transform encoders where the equivalent channel bit-rate is approximately 0.2 [bppc] for the same value of PSNR (Fig. 3). It has been shown also that at larger sizes of blocks in the transform encoder one can further decrease the bit-rate and obtain similar reconstruction qualities due to lower blocking effect for larger blocks.

A multicomponent hybrid encoder (Fig. 4) was also developed and experimented with. The encoder utilizes two-dimensional DCT in the spatial domain followed a one-dimensional DPCM across spectral components. The multicomponent hybrid encoder produces fairly good results when compared with an array of two-dimensional DCT component wise encoders. A bit-rate of 1.6 [bpp] (0.2 [bppc]) at PSNR value of 32 [dB] is required to represent an eight-component image with the hybrid encoder (Fig. 5) while an array of 8 two-dimensional encoders would have required 2.5 [bpp] (0.315 [bppc]) to obtain a similar quality of reconstruction. However, the multicomponent hybrid encoder does not perform as well as the multicomponent zigzag DCT encoder for high bit-rates when large sizes of transform blocks are used in the coding scheme. For small spatial sizes of transform blocks (i.e. 4×4 and 8×8), the multicomponent hybrid coder performs better than the multicomponent zigzag DCT encoder for low bit-rates (Fig. 6).

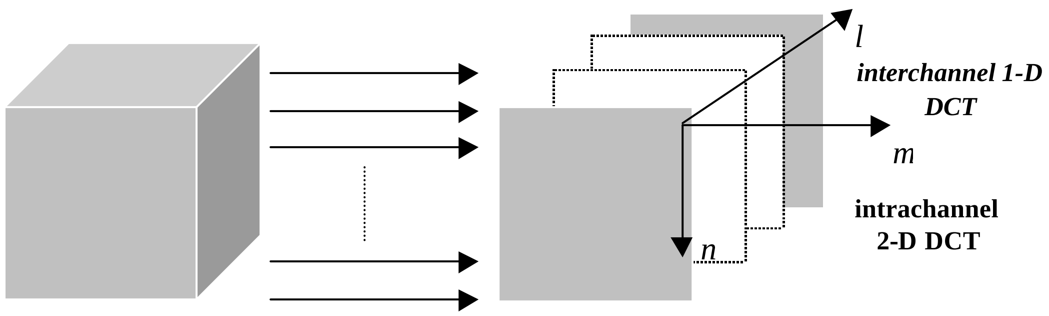

Figure 1: Illustration of three-dimensional DCT on a multicomponent image

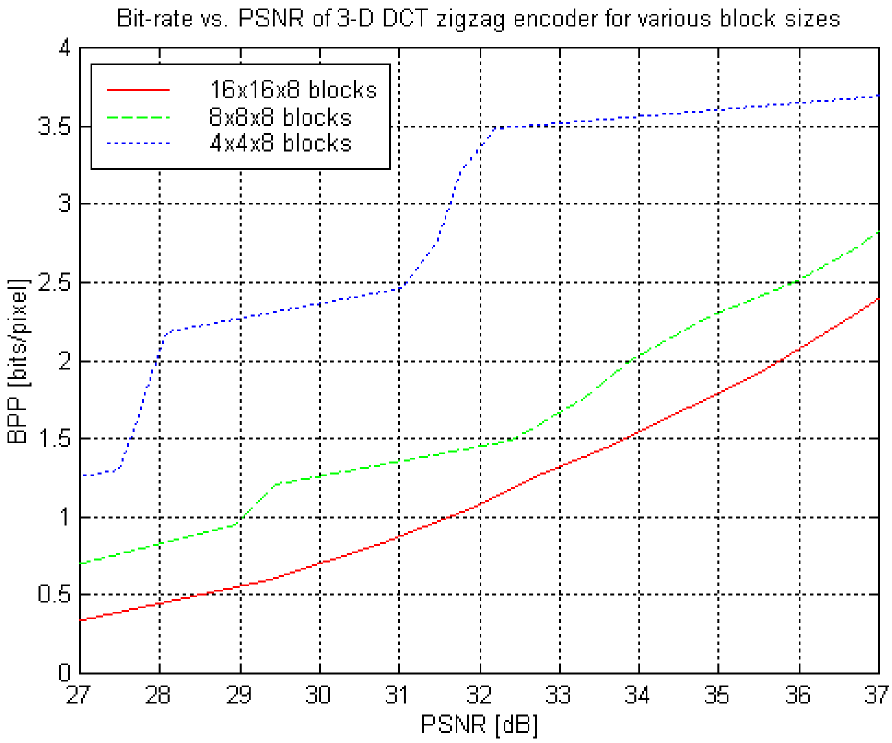

Figure 2: Comparison of the performances of the different multicomponent zigzag DCT encoders, varying in the size of block. Block sizes used are $16\times16\times8$**,** $8\times8\times8$ **and** $4\times4\times8$.`

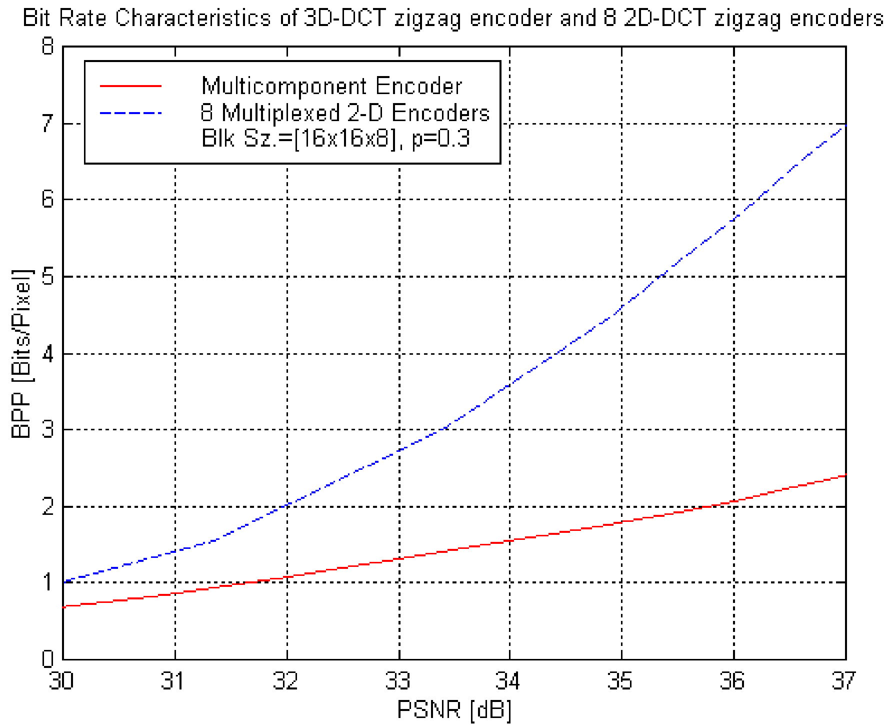

Figure 3. Comparison of the performance of the 8-channel multicomponent-zigzag-encoder and the performance of 8 ***multiplexed*** **two-dimensional zigzag image encoders. Block sizes are** $16\times16\times8$ **and** 16×16 **respectively. It is obvious that the multicomponent encoder outperforms the multiplexed two-dimensional encoder.**

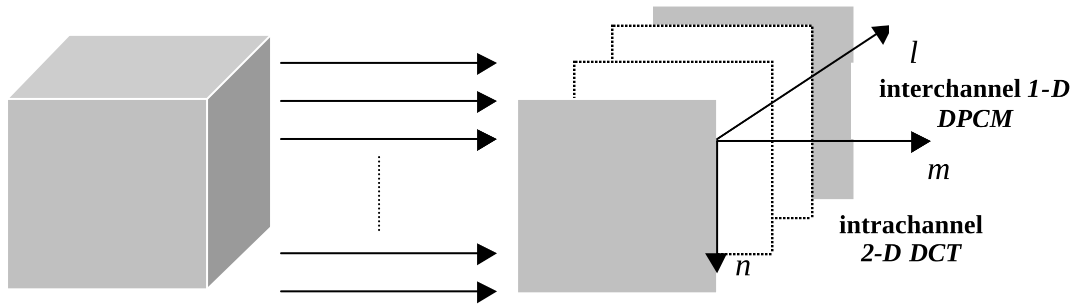

Figure 4: Hybrid coding of a multicomponent image (2D-DCT/1D-DPCM).

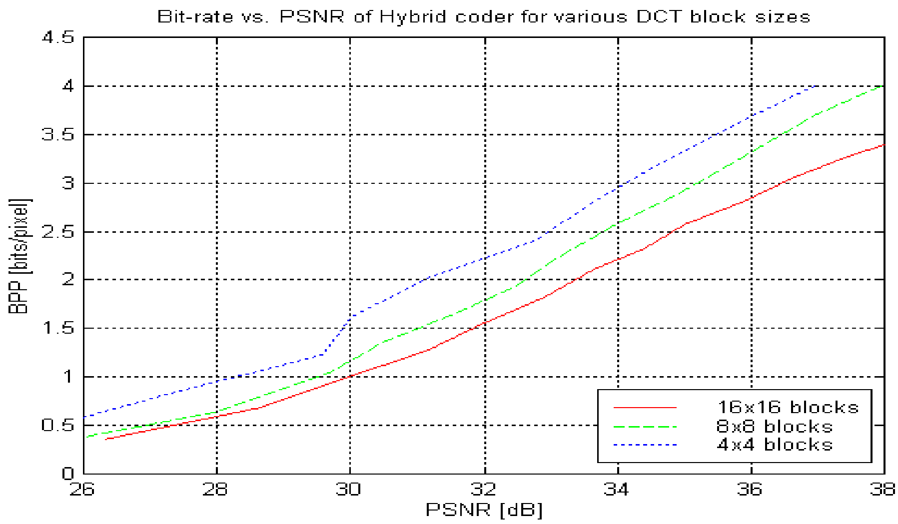

Figure 5. Comparison of the performance of the different multicomponent hybrid encoders (2D-DCT/1D-DPCM), varying in the size of block which was used for the 2D-DCT. Block sizes used are 16×16, 8×8 and 4×4.

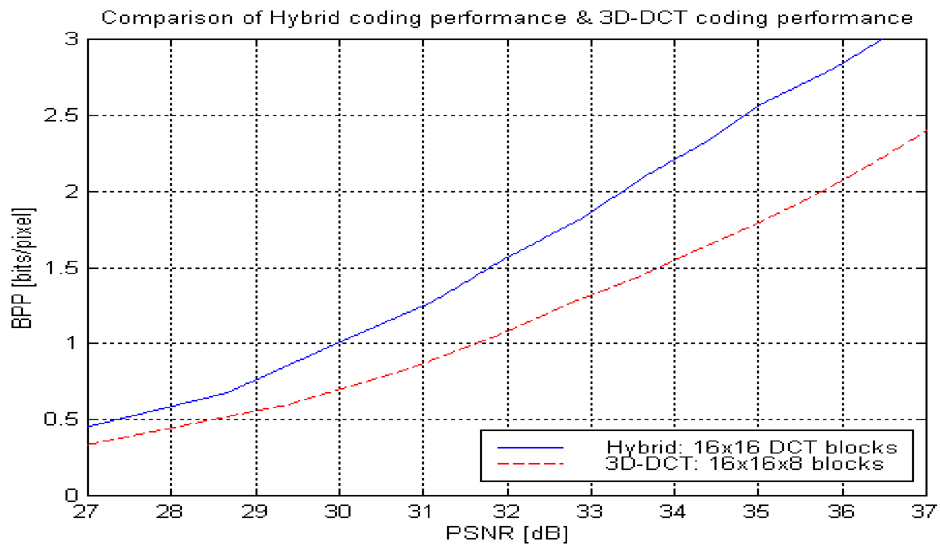

Figure 6. Comparison of the performance of the hybrid (2D-DCT/1D-DPCM) encoder and the multicomponent-DCT-zigzag-encoder. Block sizes are $16\times16\times8$ and 16×16 respectively. The multicomponent encoder performs better than the hybrid encoder.