Non-causal Temporal Prior for Video Deblocking

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Section 1 describes the video formats and the players to view them under different operating systems. Section 2 explains the field DCT coding mode by the MPEG2 codec that introduces vertical high frequency components to the coded sequence(mentioned in lines $286 - 288$ in the paper).

1 Video Description

This package includes results of six video sequences, "calendar", "city", "foreman", "gym", "pairs", and "yuna", as described in the main paper. We provide both the original size video and the cropped details for better comparison.

Our method has the best improvement on "foreman" and "yuna", where the motion is piecewise continuous. Our method does not completely remove the coding artifacts on "gym", especially in the fast-moving arms and legs. However, compared with the coded sequence and the output by VBM3D, our method still reduces the blocking artifacts and recovers the details better.

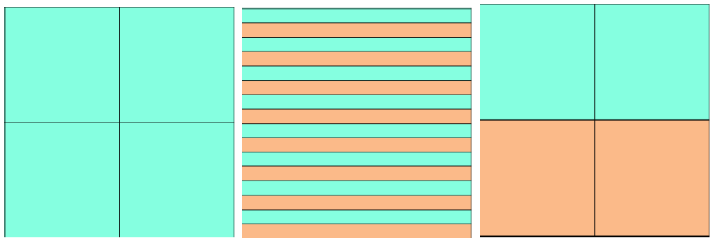
To reduce the file size, we convert the original AVI files into wmv format. The conversion introduces slight compression artifacts, though these artifacts influence little the overall visual quality. We include one uncompressed avi file "detail_foreman_mouth" for comparison.

The videos are in wmv (Windows Media Video) format. They can be directly played using Windows Media Player in Windows (tested in Windows 7), or using Quicktime with Flip4Mac plugin in Mac (tested in Mac OS X 10.6.5), or using Kaffeine/Xine in Linux. The Flip4Mac plugin can be downloaded at http://windows.microsoft.com/en-US/windows/products/windows-media-player/wmcomponents. Other cross-platform players such as VLC and RealPlayer can also be used to view these videos.

We compared our method to the state-of-the-art video denoising algorithm, VBM3D [2]. We used the code from the authors' website and adjusted the noise level parameter to achieve the best PSNR performance.

2 Field DCT Coding by the MPEG2 codec

The MPEG2 codec [1] divides each image into 16×16 macroblocks. Each macroblock has several coding modes and the rate-distortion optimization part selects the mode that uses the fewest bits. For example, the frame DCT mode divides the 16×16 macroblock into four 8×8 blocks, transforms each 8×8 into the DCT domain, and codes the DCT coefficients accordingly, as shown in Fig. 1(a). The field DCT mode will first



(a) frame (b) field, before (c) field, after

Fig. 1. The different modes for coding a 16×16 macroblock: (a) the frame DCT mode divides a macroblock into four 8×8 blocks, (b) and (c) the field DCT mode first reconfigures the macroblock into top (odd rows) and bottom (bottom rows) fields, and codes the reconfigured 8×8 blocks accordingly.

reconfigure the macroblock into two 8×16 blocks by taking only the top field (odd rows) and the bottom field (even rows), as shown in Fig. 1. Each 8×16 block is further divided into two 8×8 blocks, which are coded independently. Although the top/bottom field blocks may not have high vertical frequency components within each 8×8 block, the even and odd lines of the coded images may have mismatch between them and the reconstructed macroblock may have the vertical high frequency components magnified.

In addition, the MPEG2 codec performs parity check of the DCT coefficients before dequantization. If the sum of all the DCT coefficients is odd, the lowest bit of the quantized coefficient $C_q(8,8)$ is flipped. Because $C_q(8,8)$ is 0 for most blocks, the step tends to magnify the highest frequency coefficient $C(8,8)$.

References

1. `http://www.mpeg.org/MPEG/video`.
2. K. Dabov, A. Foi, and K. Egiazarian. Video denoising by sparse 3d transform-domain collaborative filtering. In *EUSIPCO*, 2007.