THE INTERFRAME IMAGE PROCESSING IN A VIDEO CODEC BASED ON THE WAVELET TRANSFORMATION

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Abstract

There is an interframe video data compression based on the motion compensation of block image structure in the article. It is a version of the imaging of compensated frame for increasing wavelet codecs' efficiency that do not use the block division of image.

Keywords: *wavelet video codec, method of motion compensation, the interframe processing, JPEG, MJPEG, MPEG.*

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1. INTRODUCTION

To improve the efficiency of inter frame video stream processing they use special motion compensation methods, in which individual pieces of the key frame are moved so as to ensure maximum compatibility with the same fragments in the next frames. Thus, if such a match is found, then the fragments are not transmitted, because they are already in the memory buffer of the decoder by transmission of the key frame. Only values of new coordinates of a frame (displacement vectors) are transmitted. If the match of the fragments isn't found, they are transmitted in full. Thus, the video frame using in motion compensation consists of two parts:

1. Numerical information about the displacement vector of image fragments, which called meta information.
2. The video part with non-compensated fragments of images.

2. VIDEO PROCESSING OF TV IMAGES

Currently, there are various methods of motion compensation [1]: pixel, block, parametric models, object-oriented ones, with have advantages and disadvantages. They are different in a positioning accuracy, a metainformation amount, a speed, and a complexity of implementation. However, the block methods are more widely used. Here the image is divided into square blocks, usually 16x16, 8x8 or 4x4 pixels, as shown in Figure 1.

Fig-1: Partitioning the image into blocks in the motion compensation

The motion is often found by the parallel shifts with limited maximum displacement, although it can be extended by rotation and scaling operations. To estimate the accuracy of blocks positioning they:

commonly use measures the Sum of Absolute Differences (SAD) [1-2]:

$$SAD = \sum_{peObj} \left| F_{Orig}(p) - F_{Comp}(p) \right| \qquad (1)$$

or the Sum of Squared Differences (SSD):

$$SSD = \sum_{peObj} \left[F_{Orig}(p) - F_{Comp}(p) \right]^2 \qquad (2)$$

where the summation is over all points of the compensate object (for example, a rectangular block), F_{Orig} and F_{Comp} are luminance of the original and compensated frames, respectively, at the point p = (x, y).

The positioning of the corresponding blocks is estimated by the minimum value of the above metrics. However, not only the accuracy of the block positioning affects to the efficiency of image compression with motion compensation, but also the searching time of their coordinates and the size of the met information do. Moreover, the larger the block size, the smaller the size of the met information, because the number of using blocks are reduced as also the accuracy of motion compensation, since the movement of square blocks poorly approximated with fragments of arbitrary shape. In addition, the higher the accuracy of the blocks' positioning, the more time is spent on sorting of various states of comparable blocks.

Motion compensation based on block matching is in good agreement with the block structure of signal matrices of discrete cosine transform (DCT), which forms the basis of the image compression standards, JPEG, MJPEG, MPEG, and it increases a compression efficiency by 4-8. However, the main disadvantage of usage DCT in JPEG and MPEG

standards is a broken smooth of pixels brightness change on the block boundaries at high compression ratios, which leads to a distortion in the block artifacts. They reduce intelligibility and quality of the reconstructed image, as shown in Figure 2.

Fig -2: Manifestation of block artifacts with compression for 80 times

Currently alternative methods of image compression based on wavelet transforms (WT) are quick developing. There is the image doesn't divide into blocks and processes as a whole in them. This eliminates the distortion in the block artifacts, so images with high compression ratios don't split into blocks, and just lose detail due to blurring of the boundaries, but, generally, the quality is considerably higher than in JPEG. It increases the compression ratio by 1.5-2 without significant deterioration in image quality (Figure 3). However, today "non-block" image processing in wavelet codecs doesn't allow them to apply the motion compensation methods, as it is done for MPEG standards, that's why such codecs typically operate in MJPEG-2000 standard, where each frame of the video stream is processed and compressed separately, and the output video stream consists of a sets of static images (key frames), in which only intraframe redundancy is removed [3-4]. This, on the one hand, WT with the same quality of image allows frame compression for 1.5-2 times higher than single (key) frames in MPEG, on the other hand, applied to the video stream, the wavelet codecs are inferior to them in total compression ratio due to the absence of motion compensation, which provides the main compression in the MPEG codecs.

Fig -3: Comparative quality of source and decoded images after WT with compression for 80

Therefore, to increase the efficiency of the wavelet codecs we propose a method of motion compensation based on imagining of compensated image by the frame difference. In this method the compensated frame consists of frame difference data of transformed blocks of current and previous frames, which are in frame buffer 1 and 2, respectively, and metadata, in which blocks' motion vectors are stored.

3. CONCLUSION

The main feature of the wavelet transformations codecs is that they process an image as a whole without block divisions, as it is done in the MPEG codecs. Thus, the block artifacts are eliminated and the quality of the reconstructed images is improved, but we can't apply motion compensation methods of image blocks that provide main compression of MPEG format's images. So, to increase the efficiency of the wavelet video codec we proposed motion compensation method based on the formation of compensated frame difference which is processed by wavelet codec as a normal image. This approach will increase the compression efficiency of the video stream for 1.5-2.

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