VIDEO COMPRESSION: A NEW ACCORDION BASED APPROACH

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Abstract: **In this paper, we propose a new strategy to for the improvisation in the performance of ACC-JPEG. ACC-JPEG is the approach based on the accordion transform that tends to exploit the both intra and inter frame correlation. The ACC-JPEG technique compresses the video by reducing the spatial, spectral and temporal redundancies of the input video. The temporal redundancy is mainly depending on the co-relation between successive video frames. The accordion function converts the temporal redundancy into the spatial redundancy, which was removed using Discrete Cosine Transform (DCT). The accordion based ACC-JPEG technique is modified by changing the extracted block size used for the accordion manufacturing.**

I. INTRODUCTION

Among all multimedia applications, transmission of video frames requires large bandwidth and more bytes for storage. To reduce transmission bandwidth and storage memory, video compression is necessary.

The main intention of video coding in most video applications is to reduce the amount of video signal for storing and/or transmission purposes without affecting its visual quality. On root of quality, disks capacity and bandwidth the desired video performance can be achieve. For portable digital video applications, highly-integrated real-time video compression and decompression solutions are required. [1,2].

The major difference lies in the interframe correlation exploitation that exists between successive frames in video sequences. There are many different approaches which aim to explore these interframe correlations.

A. Predictive methods

Most conventional video coding standard lies on the motion estimation process in order to estimate the motion that occurred between some reference frame and the current frame. The most commonly used ME method is the block-matching motion estimation (BMME) algorithm. In this algorithm, the current frame is first divided into blocks. The motion of each block is then estimated by searching for the best-match block in the reference frame according to some distortion measure. However, it introduces a high complexity processing which in some cases make it difficult to meet existing technologies [3,4].

B. 3D methods

It consists generally in utilizing 3D transforms that consists in extending intra frame image coding methods to inter frame video coding. A 3-D coding method has the advantage that it does not require the computationally intensive process of motion estimation [5].

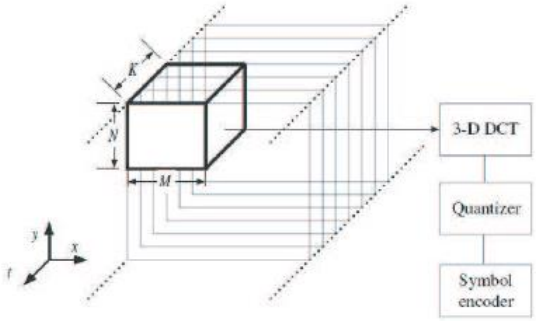


Fig. 1. 3D DCT Video Compression

Despite their advantages, these methods are not efficient overall and still suffer from several weaknesses. In fact, limiting the transformation to small cubes (8x8x8 blocks) also limits the potential for compression since all missed correlations between pixels and frames could be found beyond the 8-pixel surroundings. Therefore, the exploitation of both spatial and temporal redundancy is limited by the number of frames in the GOF and it depends on both available memory resources and the application maximum allowable delay.

Moreover, 3D transform consist on one extension of the 2D transform with the temporal axis being the third dimension. It consists on applying the waveform transform on the

spatial and the temporal direction. Thus most 3D transform based video compression methods process temporal and spatial redundancies in the 3D video signal in the same way. This can reduce the efficiency of these methods as pixel's values variation in spatial or temporal dimensions is not uniform and so, temporal and spatial redundancies have not the same pertinence [6-12].

C. 3D to 2D transform

It consists in 3D to 2D transformation of the video frames; it will then investigate the video temporal redundancy using 2D-transforms and avoids the computationally demanding motion-compensation step. Above all, the used method projects temporal redundancy of each pictures group and combines it with spatial redundancy into one 2D representation with high spatial correlation. Then, the new representation - called Accordion representation - will be compressed by 2D transform based encoder [13-14]. When this accordion is compressed using the DCT based JPEG it is known as ACC-JPEG.

In this paper we have proposed a modification in the ACC-JPEG by varying the block size of the extracted block used for the accordion construction. The small block size corresponds to the less temporal redundancy. Thus we may have some improvement in the compression performance.

II. CLASSICAL ACCORDION APPROACH

The Accordion transformation allows representing video data with high correlated form. It consists in projecting temporal redundancy of each group of pictures into spatial domain to be combined with spatial redundancy in one representation with a high spatial correlation in order to exploit the 2D transforms characteristics (DCT, DWT…) in temporal domain.

A. Accordion representation

The input of our encoder is the so called video cube which is made up of a group of frames (GOF). This cube will be decomposed into temporal frames which will be gathered into one 2D representation. Temporal frames are formed by gathering the video cube pixels which have the same column index (c.f. figure 2).

To exploit this succeeding assumption, we start by carrying out a temporal decomposition of the 3D video signal, the figure 2 shows temporal and spatial decomposition of one 8X8X8 video cube:

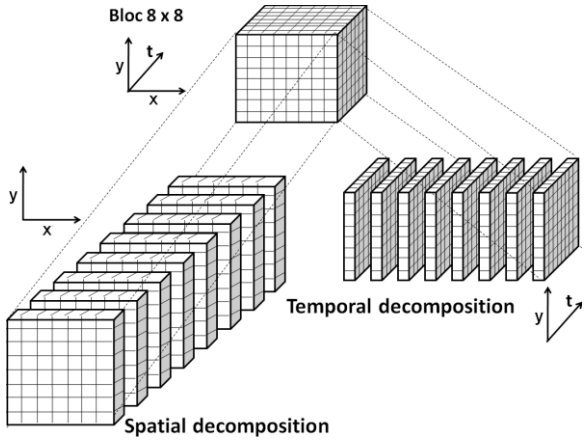


Fig. 2. Temporal and spatial decomposition

"Frames" obtained from the temporal decomposition is called temporal frames. These latter are formed by gathering the video cube pixels which have the same column rank. According to the mentioned assumption, these frames have a stronger correlation compared to spatial frames. In turn to increase correlation in Accordion Representation we reverse the direction of even frames.

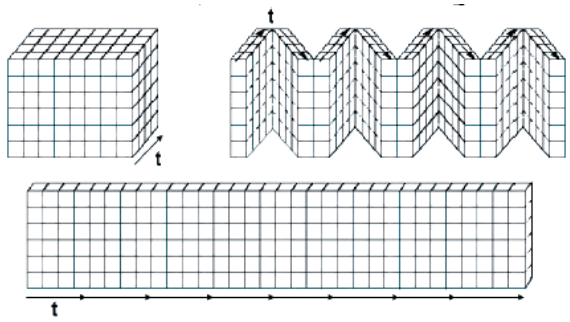
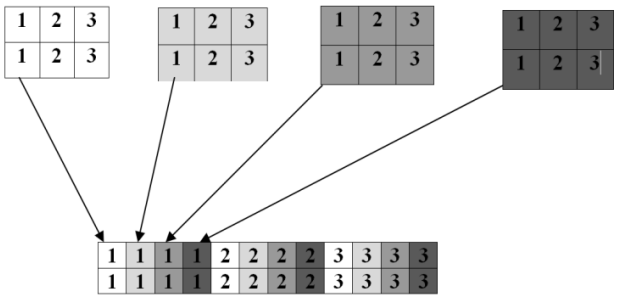


Fig. 3. ACCORDION Representation

Fig. 3 illustrates the principle of this representation. Thus, the "Accordion representation" is obtained as follows: first, we start by carrying out a temporal decomposition of the video 3D. Then, the even temporal frames will be turned over horizontally (Mirror effect). The last step consists of frames successively projecting on a 2D plan further called "IACC" (Inverse Accordion) frame.



(a)

(b)

Fig 4 (a) Accordion representation example (b) "Miss America" accordion representation

B. ACC – JPEG Coding

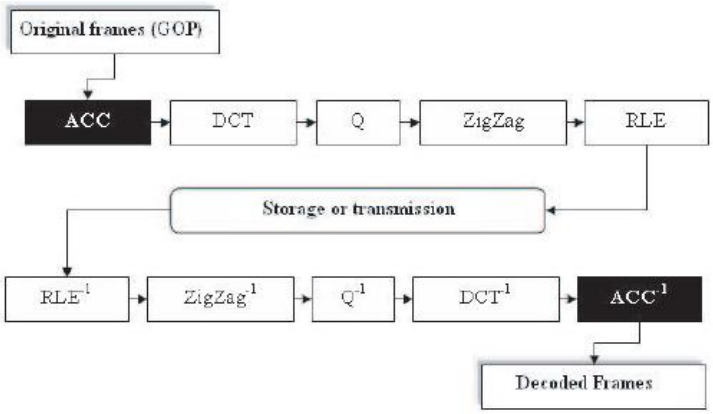


Fig 5 . ACC - JPEG diagram coding

ACC - JPEG Coding, as depicted in Fig. 5, was preceded as follows:

1) Decomposition of the video in groups of frames (GOP).

2) "Accordion Representation" of the GOP.

3) Decomposition of the resulting "IACC" frame into 8x8 blocks.

4) For each 8x8 block:

- Discrete Cosine Transformation (DCT).
- Quantification of the obtained coefficients.
- Course in Zigzag of the quantized coefficients.
- Entropic Coding of the coefficients (RLE, Huffman)

III. PROPOSED STRATAGY

The ACC-JPEG technique is a good technique it can convert the temporal redundancy in the spatial redundancy. Then the 2 D transformation can provides the better compression. The standard frames taken for the accordion construction is the NR=8. For a normal motion video, if the NR is greater than 8, the temporal redundancy becomes high and for the value smaller than 8 the temporal redundancy is low so we get no benefit in the compression but quality becomes better. But if the motion is higher in the video then we may get less PSNR with the NR=8 so we need to reduce the NR value. On the other hand if the motion in the video is less then we can increase the value of NR.

Similarly the extracted 3D block size also affects the PSNR performance, In the ACC- JPEG the 8x8x8 3D block is used to create the accordion. In the JPEG image compression the 8X8 block is used for the transformation and encoding. In the JPEG, when the block size is to be taken small the compression PSNR performance increases. This thought motivated us to reduce the block size to 4x4x8, 2x2x8 and 1x1x8. This small block size will have less spatial redundancy so PSNR obtained is higher.

IV. EXPERIMENTAL RESULTS

Here the results are shown for the different block size 3D block size and different bit rate.

Table 1: Results of ACC- JPEG compression for different 3D block size

Block size	PSNR value of video		Bit rate (Mbps)
	Rhinos	Traffic	
16x16x8	38.0901	38.6709	0. 147456
8x8x8	41.6353	40.4882	
4x4x8	45.3206	46.6865	
2x2x8	50.3450	49.7119	
16x16x8	35.8547	37.9357	0. 589824
8x8x8	39.7920	38.7869	
4x4x8	44.6959	44.4568	
2x2x8	49.9934	48.4822	
16x16x8	34.0703	36.5689	1.327104
8x8x8	38.4990	37.5432	
4x4x8	44.3014	43.9567	

2x2x8	49.7465	47.9685	
16x16x8	32.5610	35.8794	2.359296
8x8x8	38.0988	36.8795	
4x4x8	44.0230	43.2659	
2x2x8	48.4761	47.1364	
16x16x8	31.9726	34.5616	3.686400
8x8x8	37.9197	35.6422	
4x4x8	43.9242	42.1986	
2x2x8	48.4315	46.3568	

From the above result we have seen that with reduction in the value of x and y dimension of the block the PSNR is increasing significantly, whereas with the change in the bit rate there is very little change in the PSNR value. ACC-JPEG is a good technique which uses the 2D DCT transform

V. CONCLUSION

In this Paper, we have seen the significance and importance of the video compression. We have seen the different methods and strategies used for the video compression. We have also seen the predictive method, 3D transform based method, and 3D to 2D transformation based methods. Further we have seen the Classical accordion based approach and ACC-JPEG technique of the compression. ACC-JPEG technique is based on the accordion construction. That why the temporal redundancy is converted into the spatial redundancy, also because it uses the 2D DCT so the it is fast as compare to the normal #D transform based MPEG techniques. Then we have seen the performance enhancement of the ACC JPEG by choosing the small block size extracted for the ACC manufacturing. The PSNR gradually increases with the reduction in the block size gradually i.e. 16x16x8, 8x8x8, 4x4x8, and 2x2x8. Thus in the extraction we can say that , to increase the PSNR of the ACC-JPEG it is much better to use the smaller block size. In the Future we may try to find some new method to get the better compression performance of the ACC-JPEG technique.

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