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A ROBUST VIDEO COMPRESSION USING WAVELET BASED DISCRETE COSINE TRANSFORM

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ABSTRACT: Optimization of encoding process in video compression is an important research problem, especially in the case of modern, sophisticated compression technologies .In this paper, we consider HEVC, for which a novel method for selection of the encoding modes is proposed. By the encoding modes we mean e.g. coding block structure, prediction types and motion vectors. The proposed selection is done basing on noise-reduced version of the input sequence, while the information about the video itself, e.g. transform coefficients, is coded basing on the unaltered input. The proposed method involves encoding of two versions of the input sequence. Further, we show realization proving that the complexity is only negligibly higher than complexity of a single encoding. The proposal has been implemented in HEVC reference software from MPE Grand tested experimentally. The results show that the proposal provides up to 1.5% bit rate reduction while preserving the same quality of a decoded video.

1. INTRODUCTION

The objective of video coding in most video applications is to reduce the amount of video data for storing or transmission purposes without affecting the visual quality. The desired video performances depend on applications requirements, in terms of quality, disks capacity and bandwidth. For portable digital video applications, highly-integrated real-time video compression and decompression solutions are more and more required. Actually, motion estimation based encoders are the most widely used in video compression. Such encoders exploits inter frame correlation to provide more efficient compression. However, Motion estimation process is computationally intensive; its real time implementation is difficult and costly. This is why motion-based video coding standard MPEG was primarily developed for stored video applications, where the encoding process is typically carried out off-line on powerful computers. So it is less appropriate to be implemented as a real-time compression process for a portable recording or communication device (video surveillance camera and fully digital video cameras). In these applications, efficient low cost/complexity implementation is the most critical issue.

Thus, researches turned towards the design of new coders more adapted to new video applications requirements. This led some researchers to look for the exploitation of 3D transforms in order to exploit temporal redundancy. Coder based on 3D transform produces video compression ratio which is close to the motion estimation based coding

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one with less complex processing. The 3d transform based video compression methods treat the redundancies in the 3D video signal in the same way, which can reduce the efficiency of these methods as pixel's values variation in spatial or temporal dimensions is not uniform and so, redundancy has not the same pertinence. Often the temporal redundancies are more relevant than spatial one. It is possible to achieve more efficient compression by exploiting more and more the redundancies in the temporal domain; this is the basic purpose of the proposed method. The proposed method consists on projecting temporal redundancy of each group of pictures into spatial domain to be combined with spatial redundancy in one representation with high spatial correlation. The obtained representation will be compressed as still image with JPEG coder.

2. LITURE SURVEY:

The first recorded uses of steganography can be traced back to 440 BC when Herodotus mentions two examples of steganography in The Histories of Herodotus. Demaratus sent a warning about a forthcoming attack to Greece by writing it directly on the wooden backing of a wax tablet before applying its beeswax surface. Wax tablets were in common use then as reusable writing surfaces, sometimes used for shorthand. Another ancient example is that of Histiaeus, who shaved the head of his most trusted slave and tattooed a message on it. After his hair had grown the message was hidden. The purpose was to instigate a revolt against the Persians

3. EXISTING SYSTEM

Image Compression

Image compression addresses the problem of reducing the amount of data required to represent a digital image .The underlying basis of the reduction process is the removal of redundant data. From a mathematical viewpoint, this amount to transforming a 2-D pixel array into a statistically uncorrelated data set .The transformation is applied prior to storage or transmission of the image. At some later time, the compressed image is decompressed to reconstruct the original image or approximation of it.

Image Compression and Reconstruction:

Three basic data redundancies can be categorized in the image compression standard.

1. Spatial redundancy due to the correlation between neighboring pixels.
2. Spectral redundancy due to correlation between the color components.
3. Psycho-visual redundancy due to properties of the human visual system.

The spatial and spectral redundancies are present because certain spatial and spectral patterns between the pixels and the color components are common to each other, whereas the psycho-visual redundancy originates from the fact that the human eye is insensitive to certain spatial frequencies. The principle of image compression algorithms are (i) reducing the redundancy in the image data and (or) (ii) producing a reconstructed image from the original image with the introduction of error that is insignificant to the intended applications. The aim here is to obtain an

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acceptable representation of digital image while preserving the essential information contained in that particular data set.

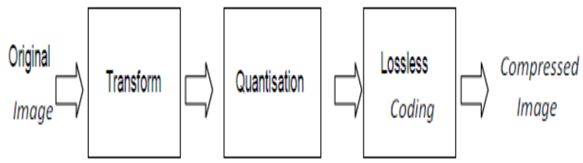

Fig 1 Compression Process

The problem faced by image compression is very easy to define, as demonstrated in figure shown above. First the original digital image is usually transformed into another domain, where it is highly de-correlated by using some transform. This decorrelation concentrates the important image information into a more compact form.

The compressor then removes the redundancy in the transformed image and stores it into a compressed file or data stream. In the second stage, the quantization block reduces the accuracy of the transformed output in accordance with some pre-established fidelity criterion. Also this stage reduces the psycho-visual redundancy of the input image. Quantization operation is a reversible process and thus may be omitted when there is a need of error free or lossless compression. In the final stage of the data compression model the symbol coder creates a fixed or variable-length code to represent the quantize output and maps the output in accordance with the code.

Generally a variable-length code is used to represent the mapped and quantized data set. It assigns the shortest code words to the most frequently occurring output values and thus reduces coding redundancy. The operation in fact is a reversible one.

The decompression reverses the compression process to produce the recovered image as shown in below figure. The recovered image may have lost some information due to the compression, and may have an error or distortion compared to the original image.

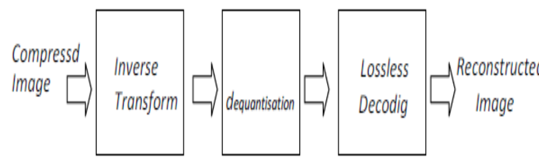

Fig 2 Decompression Process

The transform coding developed more than two decades ago, has proven to be a very effective video coding method, especially in spatial domain. Today, it forms the basis of almost all video coding standards.

4. PROPOSED SYSTEM:

The main idea of the paper focuses on a method for video encoding, basing on two versions of the encoded sequence: the original one, and the noise-reduced one. The noise-reduced version of a sequence (denoised) is used for selecting the encoding modes. The original, unaffected version of a sequence (containing noise) is used for calculating the encoded content, e.g. quantized transform coefficients, and thus for production of the output bit stream. Implementation of the method (Fig) uses two modified encoders, each working on different version of a sequence being

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encoded, the original input one, and the denoised one.

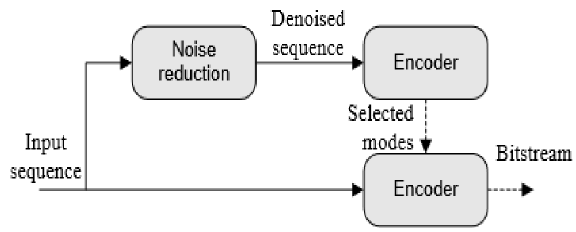

Fig 3: The general scheme of the proposed method of coding modes selection in the encoder.

The most common transform based intra frame video coders use the DCT which is very close to JPEG. The video version is called M-JPEG, wherein the .M. can be thought of as standing for .motion.. The input frame is first segmented into N N blocks. A unitary space-frequency transform is applied to each block to produce an N X N block of transform (spectral) coefficients that are then suitably quantized and coded. The main goal of the transform is to decorrelate the pixels of the input block. This is achieved by redistributing the energy of the pixels and concentrating most of it in a small set of transform coefficients. This is known as Energy compaction. Compression comes about from two main mechanisms. First, low-energy coefficients can be discarded with minimum impact on the reconstruction quality. Second, the HVS 1 has differing sensitivity to different frequencies.

Thus, the retained coefficients can be quantized according to their visual importance. Actually, the DCT, witch will be used in our video compression approach, is widely used in most modern image/video compression algorithms in the spatial domain (MJPEG, MPEG). Although its efficiency, it produces some undesirable effects; in fact, when compression factors are pushed to the limit, three types of artifacts start to occur: .graininess. due to coarse quantization of some coefficients, .blurring. due to the truncation of high-frequency coefficients, and .blocking artifacts,. which refer to artificial discontinuities appearing at the borders of neighboring blocks due to independent processing of each block.[7] Moreover, the DCT can be also used in the temporal domain: In fact, the simplest way to extend intraframe image coding methods to interframe video coding is to consider 3- D waveform coding. The 2D-DCT has the potential of easy extension into the third dimension, i.e. 3D-DCT. It includes the time as third dimension into the transformation and energy compaction process [3][4][5][6]. In 3-D transform coding based on the DCT, the video is first divided into blocks of M N K pixels (M; N; K denote the horizontal, vertical, and temporal dimensions, respectively). A 3-D DCT is then applied to each block, followed by quantization and symbol encoding, as illustrated in Figure 1.

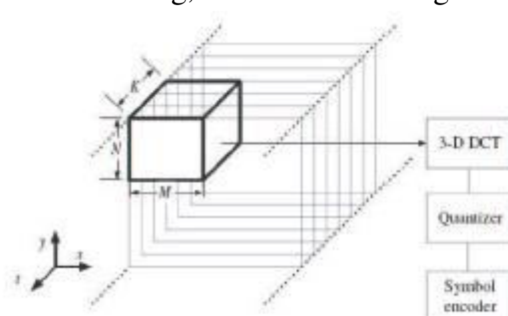

Fig 4 3 D DCT

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A 3-D coding method has the advantage that it does not require the computationally intensive process of motion estimation. However, it presents some disadvantages; it requires K frame memories both at the encoder and decoder to buffer the frames. In addition to this storage requirement, the buffering process limits the use of this method in real-time applications because encoding=decoding cannot begin until all of the next K frames are available. Moreover, the 3D DCT based video compression method produce some side effects in low bit rates, for example the effect of transparency produced by the DCT 3D [8]. This artifact is illustrated by figure 2. The technics of transformed 3Ds was revealed since the 90s, but the research in video compression was oriented towards the coding based on motion estimation. The design tendency of new coding diagrams led some researchers restarting the exploitation of transformed 3Ds in video compression. The coders based on this type of transformation produce high compression ratio with lower complexity compared to motion compensated coding. 3D DCT based video Compression methods treat video as a succession of 3D blocks or video cubes, in order to exploit the DCT properties in both spatial and temporal dimensions. The proposed coding method will be based on the same vision. The main difference is how to exploit temporal and spatial redundancies. Indeed, the proposed method puts in priority the exploitation of temporal redundancy, which is more important than the spatial one. The latter assumption will be exploited to make a new representation of original video samples with very high correlation. The new representation should be more appropriate for compression.

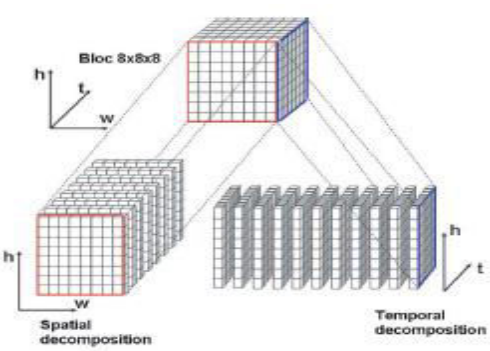

Fig5: Temporal and spatial decomposition of one 8X8X8 video cube:

5. RESULT

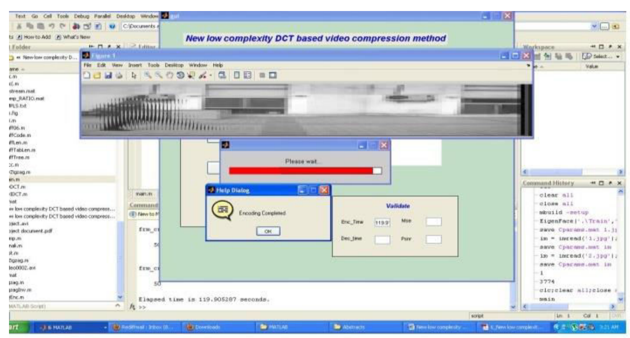

Fig 6: encoding process

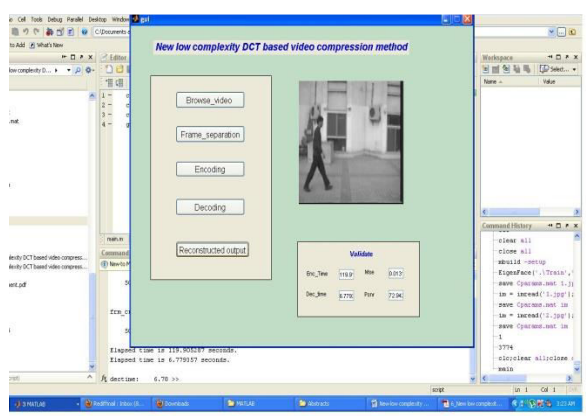

Fig 7: decoding process

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6. CONCLUSION:

The paper presents a method for encoding modes selection, on the example of HEVC coding technology. In the presented method, two encoders are used. The first encoder works with noise-reduced version of the input sequence and generates encoding modes which are then used in the second encoder. Although the second encoder worked with the original, unaltered version of the input sequence (with noise), the selected encoding modes are optimized for the content without the influence of the noise. The proposal was implemented with the use of HM (version 13.0) software, which is a HEVC model software created by JCT-VC group. As an addition to our previous paper in the subject [24], we have presented extended results which confirm already attained conclusions. The results show that the proposed method enables up to 1.5% reduction in the bit stream. This indicates that the encoding modes selected based on the noise-reduced version of the sequences are closer to the optimal choice, but still does not allow for bit rate reduction comparable to the case in which the noise is totally omitted. Here, we additionally tested a variant in which motion vectors are recalculated in the second encoder and it turned out that also such a modification does not bring significant gain. This means that the gain coming from directly compressing the noise-reduced version of the sequences, without the noise, comes mainly from omitting transform coefficients related with noise components in the encoded signal and to a lesser extent, with a better choice of encoding modes.

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