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High Efficiency Video Coding based Compression Scheme using Suitable Algorithm for Efficient Denoising

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***Abstract*:** *Data compression is very much useful in the process of image and video transmission in a network as it reduces the size of the data and thereby saves the storage space required. Video compression technique is having many applications and they include digital TV, DVD, Blu-Ray disk etc. High Efficiency Video Coding is an advanced compression scheme which is a block based compression method in which the compression is applied to the images by considering the block of images. The data during acquisition and transmission are having noise contamination and this noise degrades the quality of the data so this noise should be efficiently removed and retain the quality of the data. SURE-LET algorithm is used to reduce the noise added to the video. This algorithmic rule is based on an image domain minimization of an estimate of mean square error(Stein's Unbiased Risk Estimate) and therefore the denoising method will be expressed as a linear combination of elementary denoising processes. The resulting data will be noise free and will be of improved quality.*
Keywords*:Blu-Raydisk,Compression,HighEfficiencyVideoCoding,meansquareerror,SURE-LET.*

I. Introduction

Considering various networks, many efficient methods should be established for the storage and transmission of the data through the network. Reducing the size of the data while preserving the quality of the data is a major consideration. The quality of the data such as audio, image, video etc are affected by the addition of noise while transmission. There are many sources that add noise to the data. This noise should be removed so that the data could be retrieved without damaging the content and quality.

The previous compression method H.264/AVC [1] is a block oriented motion compensation based video compression standard and it is a compression method that is used for various activities like recording, compression, and distribution of video content. H.264 is a lossy compression method, however it has the potential to make lossless encoding additionally. H.264 provides bit rate savings of 50% or additional. The multiview extension of H.264/AVC referred to as MVC was chiefly developed for efficient compression of scenes shot from completely different viewpoints. For a multiview compression theme it doesn't matter if video streams originate from a free viewpoint setup round the scene of interest or from a 3D production camera. The essence is that neighboring views from a similar scene contain plenty of correlation. Multiview compression makes use of this aspect by taking in to consideration neighboring views throughout the compression process of a view. The way MVC uses inter-view correlation is analogous to how single view compression takes advantage of temporal correlation between successive frames. In a single-view block based codec like H.264/AVC, this correlation is reduced with a motion compensation method.The method of prediction between completely different views is termed inter-view prediction. The information compression ratio of H.264 and MVC [2] are less and also the compression efficiency obtained by these methods are less. The implementation of these method are costly.

For these reasons, High Efficiency video coding utilizing SURE-LET algorithm is used to efficiently compress the video information by maintaining the quality with improved coding efficiency and less complexity and cost and also by logically reducing the noise contained in the video.

The rest of the paper is organized as section II . video compression, section III deals with the gaussian noise, section IV deals with the proposed scheme. Conclusion and reference in rest of the sections.

II. Video Compression

Video compression reduces redundancy in video data using modern coding techniques. Most of the video compression algorithms and codecs mix temporal motion compensation and spatial image compression. In scientific theory, video compression may be a sensible implementation of source coding. Most of the video codecs conjointly uses audio compression techniques in parallel so as to compress the separate, combined data streams in concert package. The majority of video compression algorithms use the lossy compression methodology. Video that's not compressed needs a awfully high data rate. In lossy compression methodology, there's a trade-off between video quality, system requirements and cost of processing the compression and decompression. Some video compression schemes usually operates on macroblocks that are square-shaped groups of neighboring pixels. These blocks of pixels are compared from one frame to succeeding, and only the variations among those blocks are send by the video compression codec. In areas of video having additional motion, to stay up with the larger number of pixels that are changing, the compression should encode additional data.

Video compression reduces and removes the redundant video data in order that the digital video file are often effectively sent over a network and stored on computer disks. Significant reduction in file size are often achieved with very little or no adverse result on the visual quality with efficient compression techniques. If the file size is further lowered by raising the compression level for a given compression technique then the video quality are often affected. Different compression technologies are available. Most of the network video vendors these days use standard compression methods. Standards are necessary to confirm interoperability and compatibility. They are significantly relevant to video compression because the video is used for various purposes and in some video surveillance applications it is required to be viewed many years from the recording date. Video information will be represented as a series of still image frames. The sequence of frames contains spatial and temporal redundancy. These redundancies are eliminated or coded in a smaller size by the video compression algorithms. By storing only the variations between frames or by exploitating sensory activity options of human vision, the similarities will be encoded. Almost like JPEG compression, the compression algorithms will average a color across these similar areas to reduce space. Some of these ways are inherently lossy and therefore the others could preserve all relevant data from the original video that's uncompressed.

Inter frame compression is one amongst the foremost powerful techniques for compressing video. In order to compress the current frame, inter frame compression uses one or additional earlier or later frames in a sequence whereas in intra frame compression only the current frame is employed, effectively being image compression. The most powerful used technique works by comparing each frame in the video with the previous frame. If the frame contains areas where nothing has moved or modified then the system merely issues a brief command that copies that part of the previous frame in to the next one. If the sections of the frame are moving in a simple manner, the compressor avoids a command that tells the decompressor to rotate, shift, lighten, or darken the copy. This longer command still remains much shorter compared to intra frame compression. For programs which will merely be played back by the viewer, interframe compression works well however it will cause issues if the video sequence has to be edited. Interframe compression copies information from one frame to a different. If the original frame is only cut out then the subsequent frames can't be reconstructed properly. Compression involves processes that apply an algorithm to the source video to make a compressed file that is prepared for storage or transmission. To play the compressed file, an inverse algorithm is applied to produce a video that shows nearly a similar content as the original source video. Latency is the time taken to compress, send, decompress and show a file. The latency is higher if the compression algorithm is advanced. Video codec (encoder/decoder) is a pair of algorithm that works together. Video content that is compressed using one standard can't be decompressed using completely different standard. Video codecs of various standards are ordinarily not compatible with one another. This is because one algorithm cannot properly decode the output from another algorithm. It is possible to implement many various algorithms within the same software package or hardware, that would enable multiple formats to coexist. Different compression standards uses completely different ways to reduce data, and thus ends up in completely different bit rate, quality and latency. Compression algorithms are of two varieties specifically image compression and video compression. Image compression uses intra frame coding method. Data is reduced in an image frame just by removing spare data that will not be noticeable to the human eye. Example for such a compression standard is Motion JPEG. Images in a Motion JPEG sequence is compressed as individual JPEG images.

Fig 1. Motion JPEG format,the three images in the above sequence are coded and sent as separate unique images (I-frames) with no dependencies on each other.

To reduce video data between a series of frames, video compression algorithm uses inter frame prediction. This involves techniques like difference coding in which one frame is compared with a reference frame and only pixels that have changed with relevance to the reference frames are coded. The number of pixel values that's coded and sent is reduced in this way. The images appear as in the original video sequence when such an encoded sequence is displayed. In order to further reduce the information alternative techniques like block-based motion compensation are often applied. In block-based motion compensation it takes into consideration much of what makes up a new frame in a video sequence that may be found in an earlier frame, however in a very completely different location. Block based motion compensation divides a frame into a series of macroblocks. A new frame are often composed or predicted by looking for an identical block in a reference frame(block by block). If a match is found then the encoder codes the position wherever the matching block is to be found within the reference frame.

In inter frame prediction, each frame in a sequence of images is classified as a certain type of frame, such as an I-frame, P-frame or B-frame. Intra frame or I-frame is a self-contained frame that may be independently decoded without any reference to other images. I-frame is the first image in a video sequence. I-frames are required as beginning points if the transmitted bit stream is damaged. An encoder can automatically insert I-frames at regular intervals or on demand if new clients are expected to join in viewing a stream. The I-frames consume way more bits however they do not generate several artifacts that are caused by missing information. A predictive inter frame or P-frame, makes references to elements of earlier I and/or P frame(s) to code the frame. Compared to the I-frames, P-frames sometimes need fewer bits, but a disadvantage is that they're terribly sensitive to transmission errors because of the complex dependency on earlier P and/or I frames. A bi-predictive inter frame or B-frame, may be a frame that produces references to both an earlier reference frame and a future frame. Latency is increased using B-frames.

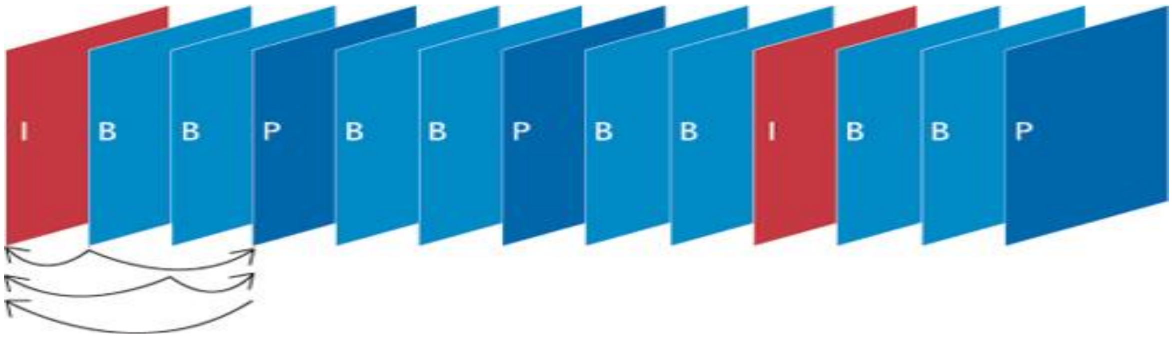

Fig 2. A typical sequence with I,Band P-frames are shown.

Decoding should always begin with an I-frame when a video decoder restores a video by decoding the bit stream frame by frame. If used, P-frames and B-frames should be decoded together with the reference frame(s).

III. Gaussian Noise

Gaussian noise is statistical noise having a probability density function (PDF) equal to that of the normal distribution, which is also known as the Gaussian distribution. In other words, the values that the noise can take on are Gaussian-distributed. A special case is white Gaussian noise, in which the values at any pair of times are identically distributed and statistically independent. In communication channel testing and modeling, Gaussian noise is used as additive white noise to generate additive white Gaussian noise.

In telecommunications and computer networking, communication channels can be affected by wideband Gaussian noise coming from many natural sources, such as the thermal vibrations of atoms in conductors, shot noise, black body radiation from the earth and other warm objects, and from celestial sources such as the Sun Principal sources of Gaussian noise in digital images arise during acquisition e.g. sensor noise caused by poor illumination and/or high temperature, and/or transmission e.g. electronic circuit noise. In digital image processing Gaussian noise can be reduced using a spatial filter, though when smoothing an image, an undesirable outcome may result in the blurring of fine-scaled image edges and details because they also correspond to blocked high frequencies. Conventional spatial filtering techniques for noise removal include mean (convolution) filtering, median filtering and Gaussian smoothing. The Gaussian smoothing operator is a 2-D convolution operator. It is used to blur images and remove detail and noise. It is similar to the mean filter in this sense but it uses a different kernel that represents the shape of a Gaussian hump. The impact of Gaussian smoothing is to blur an image in a very similar fashion to the mean filter. The standard deviation of the Gaussian determines the degree of smoothing. The Gaussian outputs a weighted average of each pixel's neighborhood with the average weighted more towards the value of the central pixels. This can be in contrast to the mean filter's uniformly weighted average. Gaussian provides gentler smoothing and preserves edges better than a equally sized mean filter due to this. One of the principle justifications for using the Gaussian as a smoothing filter is because of its frequency response. Most convolution-based smoothing filters act as low pass frequency filters, that is their impact is to get rid of high spatial frequency components from an image. By taking the Fourier transform of the filter, the frequency response of a convolution filter, i.e. its impact on different spatial frequencies, may be seen.

IV. Proposed Scheme

HEVC [3][4] with an acceptable denoising algorithm like SURE-LET algorithm is employed. An image-domain minimization of an estimate of the mean square error called Stein's unbiased risk estimate (SURE) has been used as a replacement approach to image denoising. Compared to the present denoising algorithms, SURE(Stein's unbiased risk estimate) makes it unneeded to theorize an applied math model for the noiseless image. Although the process is performed in a transform domain we have a tendency to conjointly use non orthonormal transforms and this minimization is performed within the image domain. The denoising method may be expressed as a linear combination of elementary denoising processes- linear expansion of thresholds (LET). A denoising algorithmic program just amounts to resolve a linear system of equations that is clearly quick and economical. The SURE-LET principle encompasses a vast potential.

During acquisition and transmission, images are usually added with additive noise. Reducing the noise level whereas conserving the image feature is the main aim of an image denoising algorithmic program. Transform domain image denoising, processes images with noise. They initial apply some linear, usually multiscale transformation, then performs a typically nonlinear and typically multivariate operation on the transformed coefficients, and so finally applies an inverse transformation and reverts to the image domain.

The SURE-LET [5] denoising approach is formed doable by the existence of a superb unbiased estimate of the mean square error (MSE) between the noiseless image and its denoised version(Stein's unbiased risk estimate). MSE is exactly the amount that we would like to reduce if we have a tendency to judge denoising performances by comparing PSNRs. The SURE takes the form of a quadratic expression in terms of the denoised image. This approach so consists minimization of the SURE within the image domain. The method is totally characterized by a group of parameters. To require full advantage of the quadratic nature of the SURE, think about the denoising processes that can be expressed as a linear combination of elementary denoising processes that's the linear expansion of thresholds (LET). This SURE-LET strategy is computationally economical because it offers rise to a mere linear system of equations by minimizing the SURE for the unknown weights, and take into account processes described by quite few parameters. There is a trade-off between the sharpness of the outline of the method that will increase with the amount of parameters, and also the predictability of the MSE estimate, that is reciprocally associated with the amount of parameters. This approach has already applied within a non redundant, orthonormal wavelet framework, and showed that a simple thresholding function that takes inter scale dependences into consideration is incredibly economical, each in terms of computation time and image denoising quality. Despite its easy MSE justification, the SURE doesn't belong to the tool box of the quality signal process practician though it's in fact far better established among statisticians. The best known use of the SURE in image denoising is Donoho's Sure Shrink algorithm in which a soft-threshold is applied to the orthonormal wavelet coefficients, and where the threshold parameter is optimized on an individual basis in every sub band through the minimization of the SURE. Otherwise, the approach is most closely associated with SURE-LET. Yet, the specificity of SURE-LET for redundant or non orthonormal transforms lies within the indisputable fact that this minimization is performed within the image domain whereas it's true that due to some Parseval like MSE conservation, image domain MSE/SURE minimization is equivalent to separate in-band MSE/SURE minimization whenever the analysis transformation is nonredundant orthonormal, this is often grossly wrong as soon as the transformation is either redundant or nonorthonormal. This is often really the observation created by those that apply soft-thresholding to an undecimated wavelet transform. The Sure Shrink threshold determination yields considerably worse results than an empirical alternative.

The uncompressed video data are huge so in order to make the data small in size without affecting the quality much, the video data must be compressed and thereby saving the bandwidth and space required for storage. Here the YUV video data that has been read is converted in to a number of frames and operations are done on the individual frames to compress the data efficiently. The frame is subjected to undergo filtering which enhances the images for either human consumption or for any other further operations. Perhaps we need to reduce noise in the image or certain image details need to be emphasized or suppressed. Signal processing consist of taking an input image and create another image as output. Other appropriate terms often used are filtering, enhancement, or conditioning. The major notion is that the image contains some signal or structure, which we want to extract, along with uninteresting or unwanted variation, which we want to suppress.

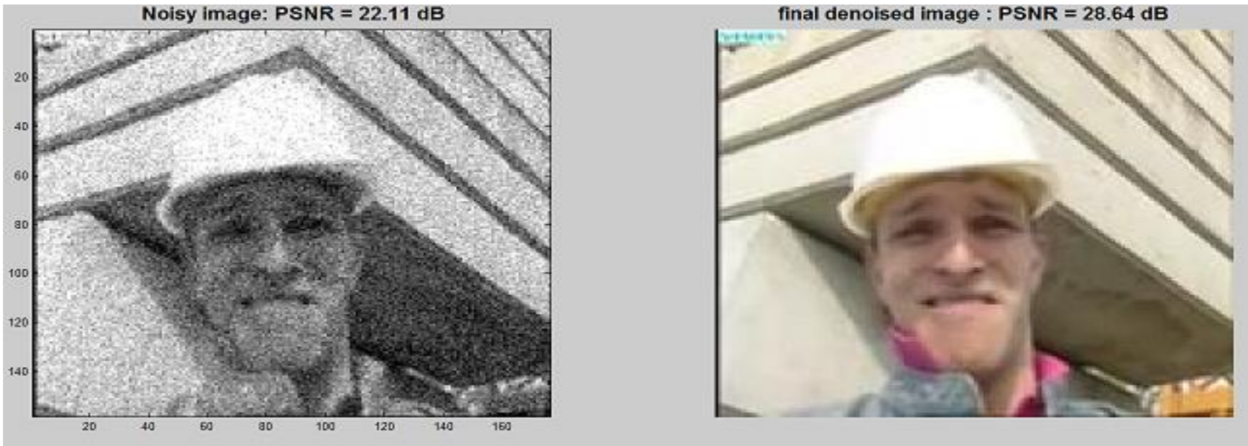

Fig 3. Noisy video frame in comparison with compressed denoised frame

The Gaussian function has important applications in many areas of mathematics, including image filtering makes it useful for smoothing images. A Gaussian filter is a filter whose impulse response is a Gaussian function and it has the minimum possible group delay. Gaussian filter is considered as the ideal time domain filter. These properties are important in areas such as oscilloscopes and digital telecommunication systems. Mathematically, a Gaussian filter modifies the input signal by convolution with a Gaussian function; this transformation is also known as the Weierstrass transform

Image compression are of two types and they are lossy or lossless. Lossless compression method is preferred for medical imaging, clip art, technical drawings etc. Lossy compression methods introduces compression artifacts especially when used at low bit rates. Lossy methods are especially suitable for natural images like photographs in applications where minor loss of fidelity is acceptable to achieve a substantial reduction in bit rate.

Compressing an image is significantly different from that of compressing the raw binary data. Compression of images can be done by general purpose compression programs, but less than optimal result is obtained. This is because images have certain statistical properties which can be exploited by encoders that are specially designed for them. Some of the finer details in the image can be avoided for saving the storage space or a little more bandwidth. This also means that lossy compression method can be used .

Lossless compression involves compressing the data which when undergo decompression will be an exact replica of the original data. This is the case when binary data are compressed. When decompression takes place they need to be exactly reproduced. On the other hand, images need no to be reproduced exactly. As long as the error between the compressed image and the original image is tolerable, an approximation of the original image is enough for most purposes .

The data is considered to have noise incorporated with it. This noise must be removed, for this we are using a denoising algorithm known as SURE-LET algorithm that efficiently reduces the noise and would give a noise free output

V. Conclusion

An efficient compression algorithm that is entirely based on HEVC and a solution which is forward compatible with H.264/AVC and stereo MVC is proposed. Significant gain can be obtained by using this method. The noise incorporated along the video information during the transmission of the data could be efficiently be removed by using the SURE-LET algorithm and therefore a noise free video data could be obtained with high efficiency. The PSNR value of the compressed denoised video in comparison with the noisy video shows that the signal strength of the final denoised video is very high, that is the quality of the denoised video is high.

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