AN APPLICATION OF DENOISING METHODS FOR VIDEO COMMUNICATION

Dnyaneshwar V. Somwanshi[1], Dr. Sonal K. Jagtap[2]
[1] PG Student ,[2]Asso. Prof.
Dept. of Electronics and Telecommunication Engg
SKNCOE, Savitribai Phule University of Pune, Pune, India
Email: [1]dvsomwanshi@gmail.com, [2]skjagtap.skncoe@sinhgad.edu

Abstract—High Efficiency Video Coding (HEVC) which is a new video standard is decided freshly. HEVC increases the video coding rate performance, but the difficulty in coding also increases in association with the old standards. In very professional applications of video domain compression perfor-mance is controlled by noise. So it is essential to analyze the denoising performance in high efficiency video. The performance of quantization parameters from low to medium is present and noise due to source is present in the reconstructed frames. This is unambiguous in-loop frame denoising filter for this range. The noise which was badly influences the prediction can be modeled and estimated by using methods discussed in the paper. The denoising filter which exploits the HEVC core transform is discussed. A coding mode adaptive arrangement for motion compensation with noise filtered reference frame is discussed and described. The compression will indicate that especially for low to medium quantization parameters, settings for lossless compression noticeably bit-rate savings and it can be manipulated.

Index Terms—Video enhancement; Noise reduction techniques in Video; Video denoising; Video compression; Video communi-cation

I. INTRODUCTION

Input video sequences of a video encoder can be desta-bilized due to different noise sources. One of key sources of impurity for video sequences is the additive noise intro-duced by the video camera or similar device. Analog video signals are frequently degraded due to channel noise in the conventional analog transmission systems. These are essential to be sometimes digitally converted in the receiver side. Many analog video applications such as DVD recorder can encode analog video signals, e.g., NTSC/PAL. Though, noisy analog video signals are not only visually irritating, but they are also tough to be encoded competently owing to uncorrelated nature of noise. There are many noise reduction techniques for video sequences is available. A spatial-domain adaptive filtering system and a motion-compensated spatio-temporal filtering system have decent de-noising performance. The conventional denoising schemes have been devised in the light of noise reduction itself rather than optimal combination of filtering with a video encoder. The noise reduction operation is independent of video encoding. Transform-domain Wiener filtering achieves fast denoising because all the processing is worked in the DCT domain simply by mounting the DCT coefficients.

II. VIDEO DENOISING METHODS

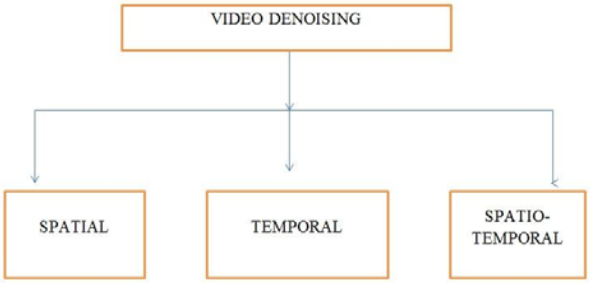

Fig. 1. Video denoising methods.

Video is made up of temporal combination if many images spacing at little time distance. so when the video is comprising of noisy content it should be processed. Video enhancement and noise reduction has been one of the popular research area.the main objective of video denoising algorithms is that removal of the noisy content without altering the original video. When including the denoising difficulty from image information to video information, temporal correlation of noisy content is considered as first priority. [1] suggested a method of temporal filtering to noise suppression with preserving image edges at the same time. These temporal filtering methods were based on block motion estimation. In [2] applied the KarhunenLoeve (KL) transform alongwith the temporal direction to decorrelate dependency amongst successive frames and then used adaptive Wiener filtering to flat frames. Maximum methods using temporal filtering work sound for still or slow-motion video subsequently temporal filtering can be done attractively with exact motion evidences. Huge motion estimation incorrectness occurring in fast motion video has a tendency to result in inaccurate noise estimation, as it demands for a vast memory buffer to apply temporal filtering.

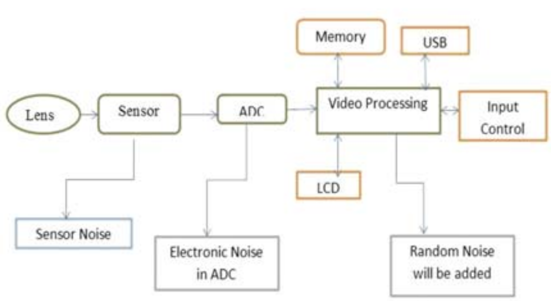

Fig. 2. Sources of noise in video.

III. RELATED WORK

In [3] discussed a technique for film grain noise extraction, modeling and synthesis is calculated and applied to high-definition video coding. Film grain noise improves the natural appearance of pictures in high-definition video and should be conserved in coded video. The coding of video information with film grain noise is costly. It was proposed to enhance the coding performance by removing film grain noise from the input video at the encoder before the main processing step, and again combining it back to the decoded video at the decoder processing step. Implementing this method, with removing film grain noise from image or video with a varying denoising method without changing its original information is important. Execution of a parameter based prototype to generate film grain noise that is close to the real one is essential. This can be done with observed characteristics i.e. power spectral density and the cross channel spectral correlation. Using this framework, the coding gain of denoised video is higher although the visual quality of the concluding reconstructed video is well conserved.

The total variation minimization method is used for noise reduction purpose, to conquer film grain noise. Denoising tech-nique influence distortion zones which have sharp conversion between neighboring pixels, it is very much significant to recognize areas of image edges before applying the denoising process. In smooth areas performance of denoising will be selectively only. The denoising method based on the total variation minimization standard can be of more comprehensive with some prior data of noise. The preprocessing task at the encoder can be divided into three steps

1)Temporal information is used to extract noise character-istics

2)Identify smooth regions of the image

3)Prior noise information is used to denoise each image.

In [4] proposed a technique of film grain noise which is inherent in analog film stock and is generated in the process of exposing and developing silver-halide crystals. Film grain noise can be modeled as a zero-mean Gaussian noise and the noise variance varies with the intensity of noise-free signal. Film grain noise is temporally independent. Film grain noise is spatially correlated. The higher the image resolution is, the more likely that the viewer will perceive the film grain noise. For high-definition videos, the film grain noise is significantly noticeable, which is the essential part of the original of the video, thus, it is desired to maintain in the encoded video. However, the encoding of film grain noise pays a lot because of its random characteristics. Since the film grain noise is temporally independent, it can not be predicted by motion compensation. As a consequence, most of the film grain noise remains in the prediction residue, and it costs many bits to encode in the DCT domain because the film grain noise contains a lot of high-frequency components.

In addition, the existence of film grain noise has an adverse influence on the accuracy of motion estimation, which further reduces the coding efficiency. To overcome those problems mentioned above, first propose the film grain noise encoding structure described in [5], in which film grain noise is detached from the original video sequence as the pre-processing step and encoded as a parameterized example. and then the decoder simulates the film grain noise based on the transmitted model parameters. Old method not provide any specific method to estimate the noise parameters or any method to remove the film grain noise, and these methods will be explored in our work. [6] propose that the H.264/MPEG-4 AVC encoder itself is used as the film grain elimination filter and the film grain noise is evaluated by subtracting the encoded picture from the original picture; then, only one representative macroblock of film grain is encoded and transmitted, and the film grain noise for the whole frame is obtained by mirroring, rotation and scaling the encoded macroblock of film grain. The appearances of film grain noise for different macroblocks can differ a lot, thus it is hard and unreasonable to find a demonstrative macroblock of film grain. The film grain noise found also consists of coding artifacts, which are spatially variant. In image edges are first checked and a 2D spatial filtering operation is applied to remove film grain noise in non-edge areas while edge regions are kept as original.

The coding efficiency is considerably amplified because the noise is partially removed. There is still chance for improvement. Since spatial filtering is used for denoising, to avoid distortion and blur, only the noise in non-edge regions is filtered. So for video containing full of edges, the increase of coding efficiency will be restricted. The spatial filtering does not reflect the signal dependent characteristics of the variance of film grain noise. First, based on the features of film grain noise, the spatial correlation of noise and the relationship between noise variance and signal intensity are estimated. Then, to avoid the blurring problem and to fully utilize the temporal correlation of video sequence, a temporal filter based on multi assumption motion compensation is used for extracting the film grain noise. Finally, the film grain noise is modeled and synthesized by an AR model.

IV. UNDERSTANDING FROM EXISTING METHODS

The main disadvantages of video denoising algorithms are as follows

TABLE I
COMPARISON OF ALGORITHMS

Algorithm	Method	Step	Type of filter
Film grain noise extraction	Pre-processing Step	Smooth Region Detection and Denoising	Nonlinear Filtering Approach
Film grain noise removal	Pre-processing step		Multi-Hypothesis Motion Compensated Filter
In-Loop Denoising For Lossless Coding	In Loop	Denoising of reference frame	Adaptive Wiener Filter
Non-Local In-Loop Denoising	In Loop	Denoising of reference frame	low complexity adaptive Wiener filter,and the BM3D algorithm
In The Loop Denoising Filter For Impulse Noise Reduction	In Loop	Impulse Noise Reduction	Adaptive Median Filter
HEVC Deblocking Filter	In Loop	Reduce visible artifacts at block boundaries	deblocking filter
Loop filter for Motion Compensated Frame	loop filter	Motion compensated frame	Adaptive Loop filter and adaptive interpolation filter

1) The number of skipped blocks increases with increasing QP, the complexity of framework becomes relatively high with increasing QPs compared with the unmodified HEVC.

2) Increasing the sliding step size also reduces the effi-ciency of the FDF-based algorithms.

3) For example, using a sliding step size of two reduces the complexity by a factor of four and at the same time also the average bitrate savings are reduced by approximately 2%.

4) Together with the noise estimation process, the complex-ity of the whole in-loop denoising framework is approx-imately twice the complexity of the interpolation filter, which is especially visible for high QPs in which the motion compensation process dominates the decoding complexity.

5) The introduced reference frame denoising scheme is not very efficient for high QPs and could therefore be switched off.

6) For low QPs, where the introduced framework is effi-cient the additional complexity in the decoder is rela-tively small. The reason for this behavior is that more processing in the decoder is required using low QPs because less SKIP modes are used

V. COMPARISON OF ALGORITHMS

Most methods using temporal filtering work well for still or slow-motion video since temporal filtering can be done nicely with accurate motion information. However, large motion estimation errors occurring in fast motion video tend to result in erroneous noise estimation. Furthermore, it demands a large memory buffer to implement temporal filtering.

1) Spatial video denoising method where image noise re-duction is applied to each frame individually

2) Temporal video denoising methods ,where noise be-tween frames is reduced. Motion compensation may be used to avoid ghosting artifacts when blending together pixel from several frames.

3) Spatial-Temporal video denoising methods use a com-bination of spatial and temporal denoising this is often referred to as 3D denoising

VI. CONCLUSIONS

As in different applications preprocessing cannot be applied. Other possibilities for coding of noisy video content have to be considered. Therefore, the inter-frame prediction within a video codec is analyzed by In-Loop Filtering algorithm. It has been motivated that an in-loop denoising framework can be established for efficient coding of noisy video content. It has been shown that noise is still present for a wide range of QPs. Different denoising techniques are studied in this work, which is applied for improving of noisy video content.

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