Adaptive Filtering and Video Compression using Neural Networks

Kalyan Chatterjee, Nilotpal Mrinal, Mandavi, Prasannjit, Amit Sur

Abstract- Video Compression is concerned with reducing the amount of data required to reproduce a video. Adaptive Filtering and Video compression is necessary because video is often disturbed by useless noise at the time of compression and video requires more space to store. In this paper, we present an Adaptive Filtering technique for the removal of useless noise from video. After cancelling the unwanted noise, we get a filtered video. After that we take the filtered video as input to the neural network. Finally, we have used back propagation algorithm to compress the video.

Keywords- Adaptive Filtering, MPEG standards, Neural Network, Singularity maps.

I. INTRODUCTION

Compression of video data aims at minimizing the number of bits required to represent each frame image in a video stream. Video compression has a huge number of applications in several fields, from telecommunications, to remote sensing,

To medicine. Depending on the application, some distortion can be accepted in exchange for a higher compression ratio. This is the case of lossy compression schemes. In other cases

Distortion of video is not allowed. Video compression techniques have been classified into four main classes:

Waveform, object-based, model-based and fractal coding techniques. Waveform compression use time as a third dimension. Object based technique consider video sequencing as a collection of different objects. Compression of image and video data has been the object of intensive research in the last twenty years. The first studies of the Moving Picture Expert Group (MPEG) started in 1988.

They aim at developing new standards for Audio-Video Coding. The main difference with respect to the other standards is that MPEGs are "open standards". MPEG standards aim at processing multimedia contents in a physical and in a semantic context, but they do not address other issues like multimedia consumption, diffusion, copyright, access or management rights. MPEG-21 was

Introduced with the explicit goal of overcoming this limitation, by providing new solutions to access, consumption, delivery, management and protection processes

Of different types of contents. MPEG-21 is essentially based on two concepts:

Digital Item and Users. The Digital Item (DI) represents the fundamental unit of distribution and transaction (e.g. video collections, music albums); it is modelled by Digital Item Declaration (DID), which is a set of abstract terms and concepts. A User is every entity interacting with the MPEG-21 environment or making use of Digital Items. Management of Digital Items is permitted only to a restricted set of Users.

II. ADAPTIVE FILTERING

Due to continuous changing of noise over a time period and overlapping of frequencies of noise and signal adaptive filtering is going to become necessity. They are proving to be a powerful resource for real time application when there is no time for statistical estimation. The ability of adaptive filters to operate satisfactorily in unknown and possibly time-varying environments without user intervention and improve their performance during operation by learning statistical characteristics from current signal observations has made them a more efficient.

III. ADAPTIVE NOISE CANCELLATION

The input x (n), a noise source N_1 (n), is compared with a desired signal d (n), which consists of a signal s(n) corrupted by another noise N_0 (n). The adaptive filter coefficients adapt to cause the error signal to be a noiseless version of the signal s (n). Both of the noise signals for this configuration need to be uncorrelated to the signal s(n). In addition, the noise sources must be correlated to each other in some way, preferably equal, to get the best results.

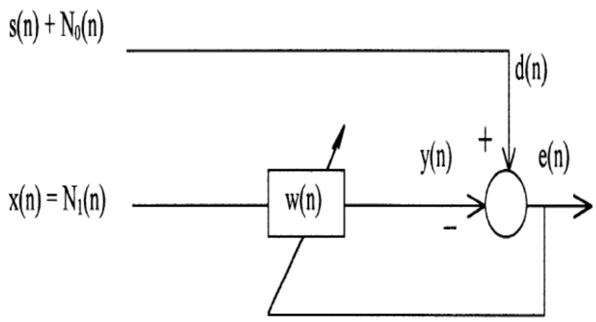

Figure 1: Block Diagram of Adaptive Noise

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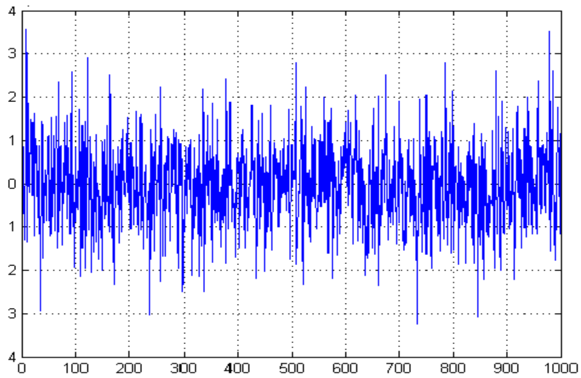


Figure 2: Signal mixed with noise

IV. VIDEO COMPRESSION

Neural Networks have been successfully applied to video compression, for example in intra-frame coding schemes, Object clustering, motion estimation and object segmentation. The power of Neural Networks as learning systems was also exploited to remove artifacts and in post processing. An important issue in video compression is computational complexity, since more complex algorithms usually require more expensive hardware implementations. As a matter of fact, the parallel architecture of NNs allows to considerably Reduce the computational cost with respect to more conventional approaches. Singularity Maps and Human Vision is a very efficient way of video compression.

A. Singularity Maps and Human vision

Emulation of the human vision system inspired several solutions to video compression, yielding low compression ratios. A Singularity Map is obtained by labelling, with topological index and grey scale correspondence, the singular point of the border of the frame image.

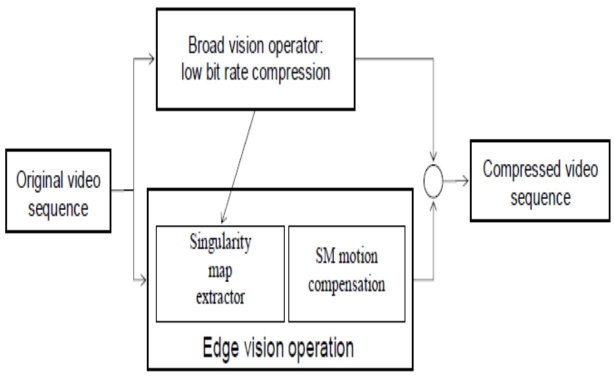


Figure 3: Block Diagram of Human Vision System.

B. Motion Compensation

Motion compensation (MC) is one of the most powerful techniques that can be used to reduce temporal correlation between adjacent frames. It is based on the assumption Those in a large number of applications adjacent frames are usually highly correlated. Temporal correlation can be reduced by coding a block in a frame as a translated version of a block in a preceding frame. Of course the motion vector has To be transmitted. Frames are typically segmented in macro blocks of 16x16 pixels, made of 4 blocks of 8x8 pixels.

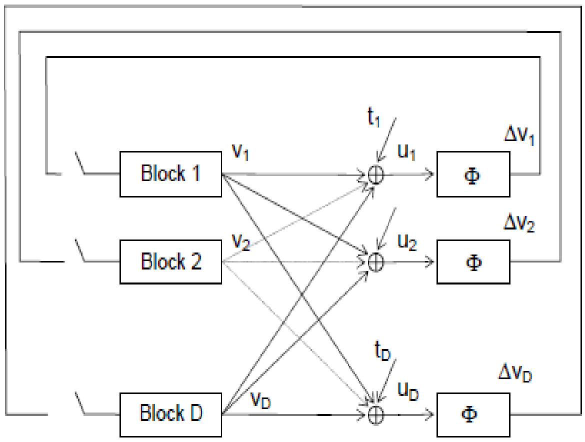


Figure 4: Block Diagram of neural network for Motion Compensation.

C. Group of Frame Generation using one Video

The GOF generation algorithm consists of the following steps:

1. the first frame is selected as a reference image of the *i*-th GOF;
2. A subsequent frame *n* belongs to the *i*-th GOF if the variance of the image difference between frame *n* and the key frame is below. The number of frames For which this condition is verified gives the *DA*.
3. The final extracted sub-sequence consists of the key frame *I* and the frames obtained by subtracting each subsequent frame to the key frame.

Images contained in every GOF are coded by a set of properly trained neural networks. The key frame *I* and the last frame of the GOF *D1* will be coded with a fitted *quad-tree* structure, as shown in figure 5. For each sub-block of the key frame *I* and of the frame *D1* in addition to the compressed data it is Necessary to code also the quad tree segmentation.

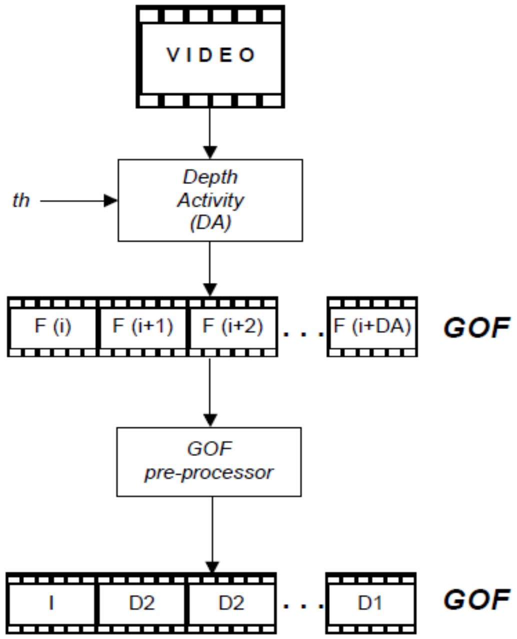


Figure 5: Block Diagram of Frame generation using one video

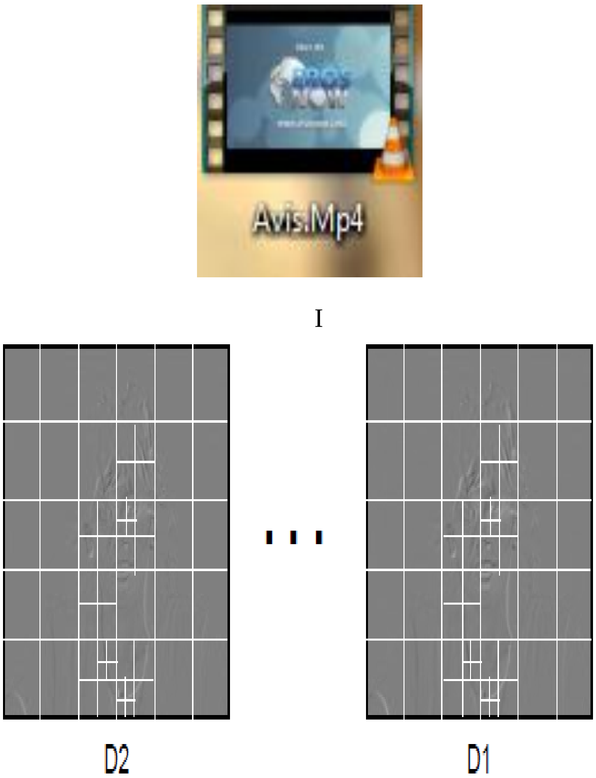
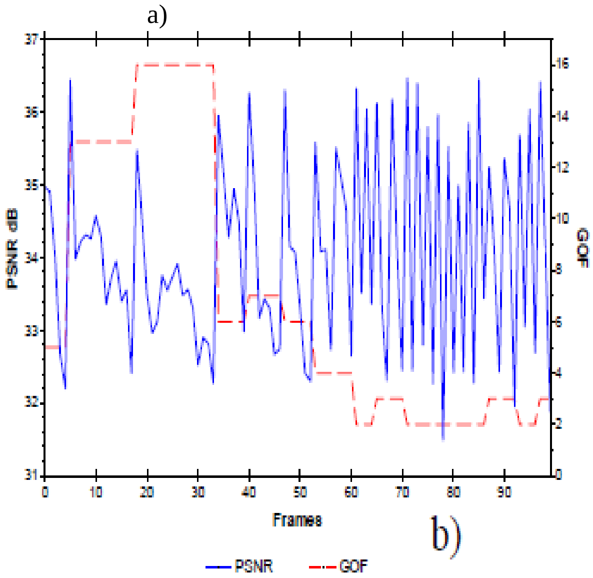


Figure 6: Quad Tree Scheme Applied within GOF.

V. Results

A. Filtered Signal

a)



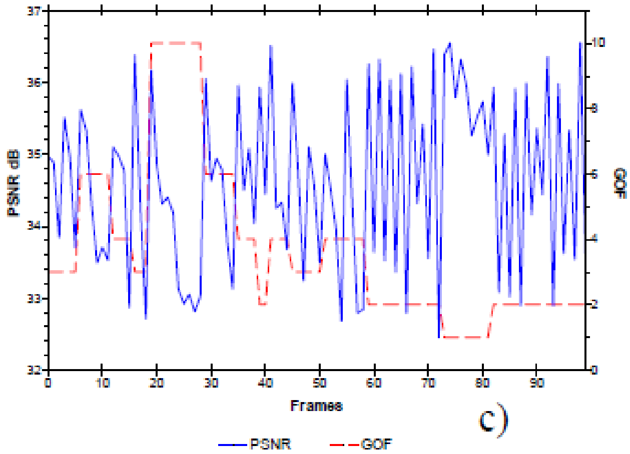


Figure 7: a) avis.Mp4 Compressed. (b),(c) GOF and PSNR evolution using two different threshold.

B. PSNR and bit rate for different threshold in avis videos

	Th=8	Th=15	Th=30
	Psnr br (dB) (kbps)	Psnr br (dB) (kbps)	Psnr br (dB) (kbps)
avis	3462 20563	3402 16678	3312 14655

C. PSNR and Bit rate obtained with three different neural architecture

Reconstructed video	avis	avis	avis
No. of Hidden neurons	6	5	4
PSNR(dB)	2892	2822	2802
Br(kbs)	43332	38923	32888

VI. CONCLUSION

In this paper, we have presented a new compression technique for video compression. A new noise filtering technique has also been developed.

We have used singularity maps and human vision for getting compression ratio near about 1000:1. The performance comparison with respect to the search range in temporal prediction are also described. Using the new backward-adaptive temporal prediction and the adaptive selection method between spatial and temporal prediction the new scheme presented is found to be better than the state-of-the-art lossless compression algorithms. Adaptive noise cancellation is used for filtering. Hence, we can conclude that singularity maps and human vision is the best method for video compression.

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