PSNR denoising performance of E-RF3D with DST and DCT

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ABSTRACT

In the digital video processing reduction of noises is very essential because noise corrupts the quality of videos and image. Many research are made for the removal of noises. The criteria of noise removal problem depends on the noise type. Videos are degraded by different type of noises. We study a framework for the denoising of video which is jointly corrupted by fixed pattern noise (FPN) and random noise (RN). This approach is based on motion compensated 3D spatiotemporal volume and spatiotemporal filtering. Simulation result is obtained by using Modified RF3D filter with DST and DCT transform. Result is analyse in terms of PSNR having different values of FPN and RN and it is found that DCT gives better result.

Keywords: Video denoising, Fixed pattern noise, PSNR, Random noise, DST, DCT.

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INTRODUCTION:

A major method of communication in the modern age is the visual information transmission in the form of digital images. Videos are the sequence of images. Different types of noises are responsible for the degradation of videos. Degradation comes from blurring as well as noise due to electronic and photometric sources. Noise is present in an image either in an additive or multiplicative form. Different noise models including additive and multiplicative types are used. They include Gaussian noise, salt and pepper noise, speckle noise, Uniform noise, impulsive noise and Brownian noise.[1]. Selection of the denoising algorithm is application dependent. Hence, it is necessary to have knowledge about the noise present in the image and its models to select the appropriate denoising algorithm. . A 2-dimensional digital image can be represented as a 2-dimensional array of data s(x, y), where (x, y) represent the pixel location and a video refers to a 3D moving visual information. Colour images are considered as three band monochrome images, where each band is of a different colour. Typical colour images are red, green and blue

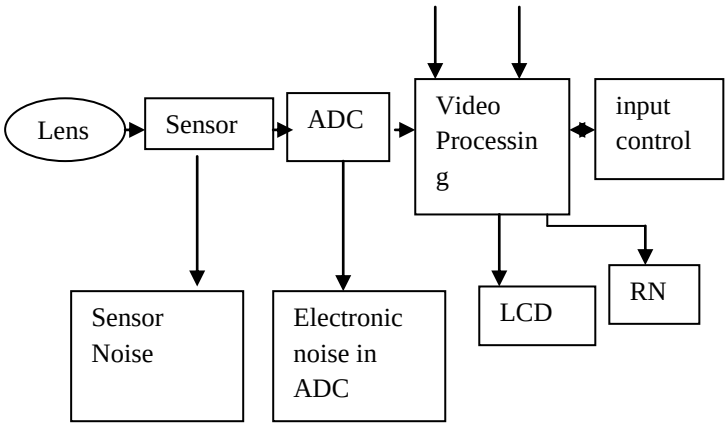
images and are also referred to as RGB images. This is a 24 bits/pixel image. Generally, the de-noising methods are based on image to image prediction, motion compensation and estimation. Some other methods are also used which are VBM3D [2] in VBM3D, group of 3D arrays are used. This 3D arrays are extracted from the set of consecutive frames. and In VBM4D [3] spatiotemporal volumes are used. These methods uses sparsifying transforms such as the DCT wavelet as part of their framework and it gives better noise attenuation. In this work we study the framework which is based on RF3D [4]. This method is used for the de-noising of video which is jointly corrupted by random (RN) and fixed pattern Noise (FPN). Random noise is difficult to remove but Fixed pattern noise is easier to remove since it is repeatable [5]. There are many noise reduction techniques for video sequences is available. A spatial-domain adaptive filtering system and a motion-compensated spatiotemporal filtering system have decent de-noising performance. RF3D framework is based on motion-compensated 3-D spatiotemporal volumes characterized by local spatial and temporal correlation, and on a filter designed to sparsify such volumes in 3-D spatiotemporal transform domain leveraging the redundancy of the data. [4] By using this RF3D framework we developed a modified RF3D using different transform.

VARIOUS SOURCES OF NOISE IN VIDEOS

At the time of image acquisition or transmission noise is introduced in the image. Different factors may be responsible for introduction of noise in the image and videos which are as follows-

1. Sensor noise which is generated by imaging sensor during the image acquisition.
2. Insufficient Light levels and sensor temperature may introduce the noise in the image.
3. Interference in the transmission channel may also corrupt the image.
4. If dust particles are present on the scanner screen, they can also introduce noise in the image.
5. storage media, Lens

Figure 1: Sources of noise in video. [6]



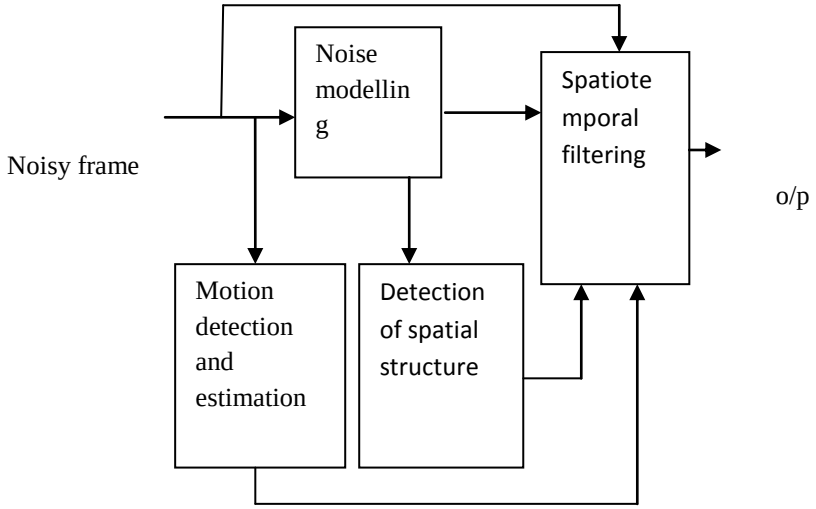
VIDEO DE-NOISING AND ITS METHODS

The process of removal of noise from video is called Video denoising. Video signals are often corrupted by additive noise or motion blur. Video signals are considered as a sequence of two dimensional images. Video de-noising is done by the set of some linear and non linear operations on a set of neighbouring pixels. Depending on various signal processing problem various algorithm is proposed mainly for image denoising [7]. The best video denoising can be achieved by exploiting information from both future and past frames. Several types of algorithm and linear and non linear filters are used for the denoising purpose.

Video denoising method is classified in three types- spatial, temporal and spatiotemporal. Most methods using temporal filtering work well for still or slow-motion video. However, large motion estimation errors occurring in fast motion video tend to result in erroneous noise estimation.

1) Spatial video denoising method- It uses only spatial filter for noise removal. Spatial filter takes only spatial information and it causes spatial blurring at high noise level [8]. In this method noise reduction is applied to each frame individually.
2) Temporal video denoising- In this method, where noise between frames is reduced. Motion compensation may be used to avoid ghosting artefacts when blending together pixel from several frames.A large memory buffer to implement temporal filtering.
3) SpatialTemporal video denoising- This methods is called 3D denoising method and it is the combination of spatial and temporal denoising.

Figure 2: Video De-noising Concept



PARAMETER AND TRANSFORM USED

In this paper result is obtained in terms of PSNR and DST and DCT transform is used.

- PSNR is the ratio between maximum possible power of a signal and the power of distorting noise which affects the quality of its representation [10]. It is defined by.

$$PSNR = 20log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right)$$

MSE= Mean square error and MAX_f is the maximum signal value.

- DCT- DCT transform have strong energy compaction property. The discrete cosine transform (DCT) is a technique for converting a signal into elementary frequency components.

- DST- The Discrete Sine Transform (DST) is used to represent signal in terms of a sum of sinusoids with its different frequencies and amplitudes..To obtain DST of a digital signal, elements of the signal are reconfigured as an odd (anti-symmetric) extension of the input. [11]

SIMULATION RESULT

We obtained the result by using proposed modified RF3D filter with Discrete cosine transform (DCT) and discrete sine transform (DST). Result is obtained in terms of PSNR having different

combinations of ς_{FPN} and ς_{RN}. The filter tool is obtain from the [9]. In this work two videos Miss America and Foreman is used. Method is applied to the data corrupted by Gaussian noise.

Table- 1(a)

Video Frame		Miss America 150			
Filter	ς_{FPN}	ς_{RN}			
		5	10	15	20
Modified RF3D with DST	5	39.17	38.17	37.24	36.22
	10	34.83	34.51	34.02	33.48
	15	31.63	31.48	31.3	30.97
	20	29.34	29.28	29.17	29

Table-1(b)

Video Frame		Miss America 150			
Filter	ς_{FPN}	ς_{RN}			
		5	10	15	20
Modified RF3D with DCT	5	39.27	38.48	37.72	36.82
	10	34.87	34.66	34.23	33.73
	15	31.67	31.53	31.4	31.08
	20	29.39	29.3	29.21	28.95

Table- 1(a) and 1(b) PSNR denoising performance of Modified RF3D using DST and DCT transform on Miss America video.

Table- 2(a)

Video Frame		Foreman 300			
Filter	ς_{FPN}	ς_{RN}			
		5	10	15	20
Modified RF3D with DST	5	37.26	35.21	33.55	32.23
	10	34.19	33.07	32.05	31.16
	15	31.52	30.90	30.27	29.75
	20	29.52	29.16	28.75	28.36

Table- 2(b)

Video Frame		Foreman 300			
Filter	ς_{FPN}	ς_{RN}			
		5	10	15	20
Modified RF3D with DCT	5	37.39	35.49	33.95	32.70
	10	34.25	33.23	32.30	31.49
	15	31.55	30.98	30.40	29.94
	20	29.54	29.20	28.83	28.46

Table- 2(a) and 2(b) PSNR denoisng performance of Modified RF3D using DST and DCT transform On Foreman video.

CONCLUSION

Video de-noising is the process of removing different type of noise from video. Enhancement of noisy video is a necessary task in video processing. The corrupting noise might result in the degradation of visual quality of the images in the sequence and also affects the efficiency of video. So the reduction of noise is very essential. Different types of filters like VBM3D, BM4D, WR, RF3D are used for the denoising purpose. This are based on Spatial, temporal or spatiotemporal filtering.

The performance of the method is evaluated by comparing the values of PSNR obtained by DST DCT transforms and modified RF3D on the different values of Random and Fixed pattern noise. Experimental result show that DCT transform gives the better result than DST transform.

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