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CLASSIFICATION OF NOISE IN VIDEO - A REVIEW

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Abstract

Video quality is degraded by noise in various video processing stages which includes acquisition, encoding, decoding, transmission and others. Noise has to be reduced for video quality enhancements. This paper reviews on various video noise classification techniques.

Based on the noise classification techniques examined, noise in video can be classified and removed with appropriate filters and hence video quality is improved.

Keywords: Noise classification Techniques, Noise Filters, Noise Removal, Statistical Feature, Transmission, Video quality.

1. Introduction

Noise in video affects the perceived quality in various applications such as video conferencing, pattern recognition, image processing and others. In all the cases, there is a need for noise removal. To perform the above said step, noise types are to be identified and appropriate filters has to be applied on these noise.

1.1 Noise Types

Noise in general can be classified

1. Salt and pepper noise
2. Gaussian white noise
3. Non Gaussian white noise
4. Speckle noise
5. Quantization noise
6. Shot noise

Noise has the following properties such as correlation, randomness and additive. There are appropriate filters designed in the literature for removing such noises.

Reduction in noise enhances the quality of video.

2. General Steps for Noise Classification

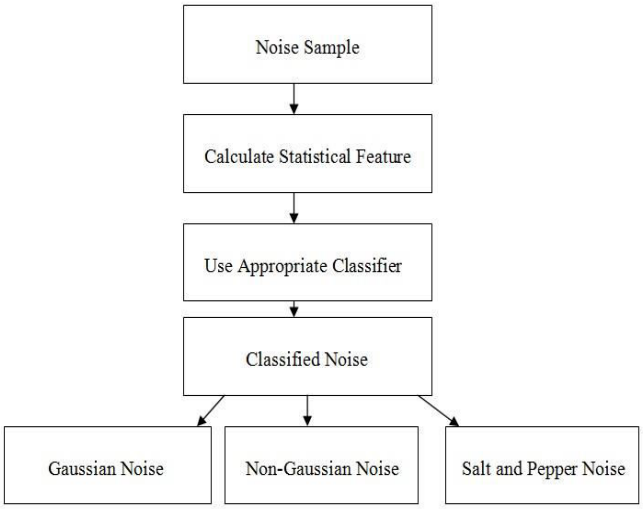

Figure 1: General video noise classification architecture.

The general video noise classification architecture is depicted in Figure1. The classification steps are given as follows

1. Take the input video noise samples

2. Measure statistical features such as kurtosis, skew, mean, variance as per the requirement

3. Use appropriate classifier to classify the noise samples

4. The final output is the classified noise such as Gaussian, Non-Gaussian and salt and pepper noise.

3. Noise classification Techniques

This section discuss on the various noise classification algorithms proposed in the literature. Yixin Chen and Manohar Das [1] has investigated an automatic technique for identification of noise in images. Statistical features such as kurtosis and skew ness are extracted and pattern classifiers are used to identify noise.

The observed image is modelled for additive and multiplicative noise and it is given in equation 1 and equation 2.

$$K(i,j) = V(i,j) + B(i,j), \quad (1)$$

$1 \le i \le R, 1 \le j \le S$

$$K(i,j) = V(i,j)B(i,j), \quad (2)$$

$1 \le i \le R, 1 \le j \le S$

$V(i,j)$ is the Original image of RxS

$B(i,j)$ is the additive/multiplicative noise added to the original image

Kurtosis is a measure relative to normal distribution which is given in equation 3

Kurtosis= $E(x-\mu)^4 / \sigma^4$ (3)

Skew ness is a measure of asymmetry and it is given in equation 4

Skewness= $E(x-\mu)^3 / \sigma^3$ (4)

Kurtosis and skewness are the fourth and third order moments respectively.

Table-1: Statistical parameters.

Noise Type	PDF	Mean	Variance	Skew	Kurtosis	Filters selected
Salt and pepper	P_a for y=a P_b for y=b 0 otherwise	a P_a +b P_b	$(a-\mu)^2 P_a + (b-\mu)^2 P_b$	0	Depends on density of noise	Median
Gaussian	$\frac{1}{\sqrt{2\pi b}} e^{-\left(y-a^2/2b^2\right)}$	A	b^2	0	3	Weiner
Non Gaussian/Uniform	$\frac{1}{b-a}$ if a≤y≤b 0 otherwise	1/2 $(a+b)$	$\frac{(b-a)^2}{12}$	0	1.8	Weiner
Speckle	$P_y = ae^{-ay}$ for y≥0 0 for y<0	$1/a$	$1/a^2$	2	9	Homo-morphic

The measure of skewness, kurtosis, PDF, mean, variance and filters selected for Gaussian, non - Gaussian, speckle and impulse noise from [9] and [10] are given in Table 1.

Lionel Beaurepaire et.al[2] has proposed similar approach for identification of noise based on standard deviation measure and histograms. Three classes of noise image which is degraded by additive, multiplicative and impulse noises are given as input. The nature of noises are identified based on histograms. The statistical measure used in this approach is the standard deviation. The estimation of standard deviation depends on the histograms.

Vozel et.al[3] has discussed on Unsupervised learning approach and a multi threshold method is followed to classify additive, multiplicative and impulse noises. The nature of noises are identified by the statistical parameter measurements. The parameters used for estimation are the mean and variance .The quality of homogenous regions are calculated by the total uniformity .

Santhanam and Radhika[4] has investigated on noise classification algorithms based on probabilistic neural network and artificial neural network[5]. As a first step, noises are introduced in the samples. Kurtosis and skewness measures are estimated and based on probabilistic neural network approach noises are classified. Shamik tiwari et.al[6] and

Raina et.al[7] has made similar kind of experimentation for classifying noises with feed forward back propagation network and minimum distance classifier . Tsong-Yi Chen et.al[8] has investigated on noise classification based on spatial relation. Standard deviation is calculated as a measure.The pixels are compared with the neighbouring pixels with certain threshold to find out the noise.

The summarization of the video classification methods are given in Table 2

Table-2: Summarization of classification techniques.

Paper	**Classification technique**	**Statistical Measure**
Yixin Chen and Manohar Das[1]	Pattern classifier	Kurtosis and Skewness
Lionel[2]	Based on histograms	Standard deviation
Vozel et.al[3]	Unsupervised learning	Multi Threshold
Santhanam and Radhika[4] and [5]	Probabilistic neural network and artificial neural network	Kurtosis and Skewness
Shamik tiwari et.al[6]	Feed forward propagation network	Mean and Variance
Raina et.al[7]	Minimum distance classifier	Kurtosis and Skewness
Tsong-Yi Chen et.al[8]	Based on Spatial relation	Standard deviation

4. Conclusion

The paper has examined various noise classification techniques and statistical measures used for identifying type of noises. The identified noise types has to be removed with necessary filters for the improvement of quality in video.

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