CLASSIFICATION OF NOISE IN VIDEO - A REVIEW

U.Rahamathunnisa*, R.Saravanan
School of Information Technology, VIT University, Vellore – 632014, India.
Email: rahamathu.u@vit.ac.in
Received on 12-05-2016, Accepted on 02-06-2016

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

The general video noise classification architecture is depicted in Figure 1. 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 discusses the various noise classification algorithms proposed in the literature. Yixin Chen and Manohar Das [1] have investigated an automatic technique for identification of noise in images. Statistical features such as kurtosis and skewness 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.

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

\[ 1 \leq i \leq R, 1 \leq j \leq S \]

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

\[ 1 \leq i \leq R, 1 \leq j \leq S \]

\( V(i, j) \) 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 = $E(x - \mu)^4 / \sigma^4$  \hspace{1cm} (3)

Skewness is a measure of asymmetry and it is given in equation 4

$$\text{Skewness} = E(x - \mu)^3 / \sigma^3$$  \hspace{1cm} (4)

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

**Table-1: Statistical parameters.**

<table>
<thead>
<tr>
<th>Noise Type</th>
<th>PDF</th>
<th>Mean</th>
<th>Variance</th>
<th>Skew</th>
<th>Kurtosis</th>
<th>Filters selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt and pepper</td>
<td>$P_a$ for $y=a$ $P_b$ for $y=b$ 0 otherwise</td>
<td>$aP_a + bP_b$</td>
<td>$(a-\mu)^2 P_a + (b-\mu)^2 P_b$</td>
<td>0</td>
<td>Depends on density of noise</td>
<td>Median</td>
</tr>
<tr>
<td>Gaussian</td>
<td>$\frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{(y-\mu)^2}{2\sigma^2}}$</td>
<td>$A$</td>
<td>$b^2$</td>
<td>0</td>
<td>3</td>
<td>Weiner</td>
</tr>
<tr>
<td>Non Gaussian/Uniform</td>
<td>$\frac{1}{b-a}$ if $a \leq y \leq b$ 0 otherwise</td>
<td>$1/2 (a+b)$</td>
<td>$\frac{1}{12} (b-a)^2$</td>
<td>0</td>
<td>1.8</td>
<td>Weiner</td>
</tr>
<tr>
<td>Speckle</td>
<td>$P_y = ae^{-ay}$ for $y \geq 0$ 0 for $y &lt; 0$</td>
<td>$1/a$</td>
<td>$1/a^2$</td>
<td>2</td>
<td>9</td>
<td>Homomorphic</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Classification technique</th>
<th>Statistical Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yixin Chen and Manohar Das[1]</td>
<td>Pattern classifier</td>
<td>Kurtosis and Skewness</td>
</tr>
<tr>
<td>Lionel[2]</td>
<td>Based on histograms</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>Vozel et.al[3]</td>
<td>Unsupervised learning</td>
<td>Multi Threshold</td>
</tr>
<tr>
<td>Shamik tiwari et.al[6]</td>
<td>Feed forward propagation network</td>
<td>Mean and Variance</td>
</tr>
<tr>
<td>Tsong-Yi Chen et.al[8]</td>
<td>Based on Spatial relation</td>
<td>Standard deviation</td>
</tr>
</tbody>
</table>

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.

References


**Corresponding Author:**

U. Rahamathunnisa*,

Email: rahamathu.u@vit.ac.in