Noise Estimation and Reduction to Improve Image Quality in Singly Image - Survey Paper

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Abstract - Noise is major issue observed during the image processing in image processing applications. These noise levels have to be predicted and after estimation get it reduced to certain maximum declined level. We can't be completely structure noise free image but we can improve the quality of image by estimating those noise. The proposed approach is an innovative way to estimate and remove the noise which found through observation during the processing of image. Principal component analysis (PCA) approach is followed to remove the noise by estimating it, this can be done by following one of the statistical technique which is frequently used in signal processing for data dimension reduction or for the data correlation. In principal component analysis image blocks were rearranged into vector and compute the covariance matrix of this vector. Then by selecting the covariance matrix eigen values which corresponds only to noise. With the help the average of the eigen values we can be able to estimate the noise present in the image , for estimation of noise in image we just take a partial region of the image so that it will be convenient for us to reduce it by using the denoise function.

Keywords: Image Processing, Noise Estimation, Noise Removal, Principal Component Analysis.

1. Introduction:

As noise in images during image processing deprecates its quality, to improve and to avoid it, many algorithms were suggested and proposed which made a positive impact and performed an optimal functioning.

The basic idea behind this dissertation is that in previous research work is mainly focused on either denoising or reducing of noise but not both simultaneously. But in this work, estimation of noise and its removal is main motive. Thus the estimation of noise and its removal will be done with the help of Principal component Analysis (PCA). In this survey paper, some of the previous research work by the scholar with their conclusion has been summarized. This helped to understand the previous work and motivated to continue it.

2. Literature Review:

2.1 Review on Noise estimation methods

By referring different paper which published by different scholars were reviewed and concluded here some of the traditional approaches for the estimation of level of noise were categorized into three main classes [1]: Block based, Filter based and Adaptive based. Before 1990, filter based methods were ordinarily in use. Those methods perform a pre filtering operation in which noisy image turned to blurred and suppress the image structure. By subtracting the filtered image from the original one a difference image will be computed and the level of noise is estimated using that difference image, which is considered to be containing only the noise signal. Some noise estimation methods were discussed which were previously proposed during research. The traditional method for estimating the noise standard deviation is based on the following general ideas [2]:

- Locate homogenous areas in the image (because in flat areas pixel fluctuation are supposed to be due to exclusively to random noise).
- Compute the local variance in the detected flat areas.
- Repeat steps 1 and 2 until the whole image has been processed.
- Finally estimate the mean variance (or standard deviation) by averaging the computed local estimations.

The major drawback in this method is that it requires huge number of computation. This increases time complexities.

2.1.1 Texture based noise estimation

Xinho lui [3] on his paper presented weak texture patch based noise estimation through principal component analysis. He proposed an algorithm to select weak textured patches from a single noisy image based on the gradients of the patches with their statistics.

2.1.2 Block Based noise estimation

Pyatykh [4] on his paper proposed better method for the estimation of the level of noise. His method is based on the principal component analysis of image blocks. The main advantage of the PCA method is that:

1. It is comparably highly efficient.

2. For the estimation of noise or blur his proposed method is useful, and that to be in the state of homogenous also.

3. Overall his algorithm is better and result oriented then other.

The result or output shows only stochastic texture, whose correlation with the properties are very nearby to those of whit noise which cannot be successfully processed.

2.2 NOISE REMOVAL THROUGH PCA

So far large numbers of different noise reduction methods were proposed. Conventional denoising methods can be generalized into two main groups:

1. Spatial domain filtering

2. Transform domain filtering.

Spatial domain filtering methods play an important role if there is any signal denoising and then manipulate that noisy signal in direct fashion. Conventional linear spatial filter smoothing the signal by suppressing the noise with the filter like Gaussian filter. These algorithms performs well in the situation where signal variation is comparatively low, such spatial filters result in undesirable noise of signal in situation where variation is high.

2.2.1 Patch Based PCA for image denoising

Deledalle and salmon [5] have introduced three tiers denoising algorithm which performed hard thresholding on the coefficient of the patches in image specific orthogonal dictionaries. This algorithm considers three methods such s Local PCA, Hierarchical PCA and Global PCA which consist of the following two steps:

1. An orthogonal basis from the noisy image by performing a principal component analysis.

2. By obtaining the denoised patch through nullifying all the small coefficient during the representation of the noisy patch.

2.2.2 Two Stage Image Denoising by Principal Component Analysis Zhang [6] represented an efficient image denoising approach by using principal component analysis (PCA) with local

Pixel grouping (LPG).

The suggested algorithms were classified into two stages. In first stage an initial estimation of the image is done by removing the noise from the image and in the second it will further refine the output of the output from the initial stage. Both the two stages have same procedure except with their parameter of noise level.Number of principal components may be equal to or less than the original values. Then passed to inverse PCA transform and denoised output is taken as the result.

3. Problem Statement:

The proposed methods in prior research, it is found that their algorithm function on the basis of either by comparing the two image for the estimation of pixel density or to depict the noise or capable of either performing only estimation of noise or its removal. In those algorithm both estimation and reduction of noise is not performed simultaneously in single image.

4. Future Use:

In this research paper, a brief about previous work regarding the image processing is concluded with respect to noise present in image and its removal and along with that it is targeted that how an Image will become noise free in reduced time manner by both estimation and removal. So that in future if image will be present noises or blur free than it will be easy and convenient to pass string of images as password for security point of view and many other authentications.

References:

[1] S. I. Olsen, “Estimation of Noise in Images: An Evaluation,” Graphical Models and Image Process. vol. 55, pp. 319-323, July 1993.

[2] S. Battiato, A.Bosco, M. Mancuso, G. Spampinato, “Adaptive Temporal Filtering for CFA Video Sequences”, In Proceedings of IEEE ACIVS’02 Advanced Concepts for Intelligent Vision Systems 2002, pp. 19-24, Ghent University, Belgium, September 2002

[3] Xinhao Liu, Masayuki Tanaka and Masatoshi Okutomi," Noise Level Estimation Using Weak Textured Patches of a Single Noisy Image", Proceedings of IEEE International Conference on Image Processing (ICIP2012), September, 2012.

[4] Pyatykh, Stanislav, Zheng, Lei and Hesser, Jürgen, "Fast noise variance estimation by principal component analysis", Proc. SPIE8655, Image Processing: Algorithms and Systems XI, vol. 8655, February 19, 2013; doi:10.1117/12.2000276.

[5] A. Deledalle, J. Salmon, A. S. Dalalyan, "Image denoising with patch based PCA: local versus global"British Machine Vision Conference (BMVC), 2011 .

[6] Lei Zhang , Weisheng Dong, David Zhang, Guangming Shib, “Twostage image denoising by principal component analysis with local pixel grouping”, Science Direct, Pattern Recognition , Vol. 43 , 1531 –1549, 2010