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PCA Based Noise Level Estimation for Texture Images

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ABSTRACT: Principal component analysis (PCA) is a new method used to estimate the noise level in image blocks. PCA can be used to reduce the complexity and noise level in the image which contains the texture image. The noise variance can be calculated as the smallest Eigen value of the image block. Eigen value is the set of scalar associated with linear system of equation (matrix). The proposed system is compared with the existing method which shows a good compromise between speed and accuracy. This technique does not use homogenous areas of images. Hence it can be processed with images which contain textures only.

KEYWORDS – Principal component analysis, Noise Estimation, Eigen value.

I. INTRODUCTION

A TEXTURE IMAGE

It is a set of metrics calculated in image processing designed to quantify the perceived texture. Texture image gives us information about the spatial arrangement of color or intensities in an image or selected region of an image. Texture images can be artificially created or found in natural scenes captured in an image. Texture Images are one way that can be used to help in Segmentation (image processing) or classification of images. Textures might be divided into two categories namely, tactile and visual textures.

In that Tactile textures refer to the immediate tangible feel of the surface.Visual textures represents to the visual impression that textures produce to human observer, which related to local spatial variations of intensity in an image. The natural texture often display different properties, such as regularity versus randomness ,uniformity versus distortion ,which can be hardly be described in a unified manner. **Image noise** is random variation of brightness or color information in images. Image noise is an undesirable by-product of image capture that adds spurious and extraneous information. A noise level or standard deviation of the Gaussian noise is necessary for many image, image processing algorithm and applications.

The performance depends on the accuracy of the noise level estimate. Noise variance estimation algorithm were being developed over last two decades most of them include one or several common steps such as Separation of signal from the noise which include Preclassification of homogenous area, image filtering and wavelet transform which then analysis the local variance.

Principal component analysis (PCA) is one of the statistical techniques frequently used in signal processing to the data dimension reduction or to the data decorrelation. Principal component analysis (Karhunen-Loeve or Hotelling transform) - PCA belongs to linear transforms based on the statistical techniques.

II. RELATED WORKS

A.IMAGE INFORMATIVE MAPS FOR ESTIMATING NOISE STANDARD DEVIATION AND TEXTURE PARAMETERS *[2]***],**

It proposes the accurate estimation of either Texture Image or noise STD, distinguish two complementary informative maps: noise- (NI-) and texture-(TI-) informative ones. Fractional Brownian motion (fBm) model for

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Texture Image is used to obtain the required Fisher information. Utilizing NI map along with DCT-based noise STD estimator has established to be significantly more efficient. It is generally based on iterative separation of the processed image into two areas: noise-informative one that is able to present information on noise STD and texture informative area that allows estimating texture correlation structure or roughness. The 2D fBm model has been sed as the model for Texture Image.

B.ESTIMATION ALGORITHMS FOR ONBOARD IMAGE QUALITY ASSESSMENT [4],

It proposed that noise can be establish into remote sensing data by the sensor.. To decide on a suitable noise estimation algorithm, compared two existing algorithms capable of blind automaticestimation of Gaussian additive noise. One of the algorithms, based on image pyramids, was modified for the dense spatial detail of remote sensing images. The modified algorithm gave the best performance. The input image is separated into blocks and computes the block standard deviation. The drawback of this paper is that the image pyramid performs the worse than the unique image and it appears to have a smaller amount dense spatial structure.

C.SIGNAL–DEPENDENT NOISE CATEGORIZATION FOR MAMMOGRAPHIC IMAGES DE NOISING [6],

Proposes the noise description under the assumption of a heteroscedastic signal– dependent noise model in the context of medical imaging. In particular, in this kind of application, a complicated noise variance estimation algorithm is applied using robust estimators and nonlinear regressions. A direct relation between noise variance and pixel intensity values is obtained and used within a multiresolution denoising algorithm, performed by Wavelet Thresholding (WT). This process subtracts low frequency components detected by a Gaussian filter and edges detected by an edge detector from the input image. Since the process figures the noise variance as a function of the gray value, the estimates for all gray values have been averaged in order to calculate the final estimate.

D.AUTOMATIC NOISE ESTIMATION IN IMAGE USING LOCAL STATISTICS [7],

Proposes a easy and novel method in which the image has to work with a adequately great amount of low variability areas, the variance of noise (if additive) can be estimated as the mode of distribution of local variance in the image and the coefficient of variance of noise (if multiplicative) can be estimated as the mode of distribution of local estimates of coefficient of variation. Noise estimation is the task parameter in the image restoration method. These methods are usually based on a degradation model where the noise dependent parameter to be estimated and it controls the amount of filtering to be executed. Noise estimation techniques in the spatial domain have been classified based on blocks and filtering methods. The former deals the local standard deviation of the image, which is calculated by MXN blocks. In the later, the image filtered by low pass filter and the noise estimated using the standard deviation of the difference between the original and filtered image. In this process noise variance estimated as the mode of distribution of local variances.

III. SYSTEM ARCHITECTURE

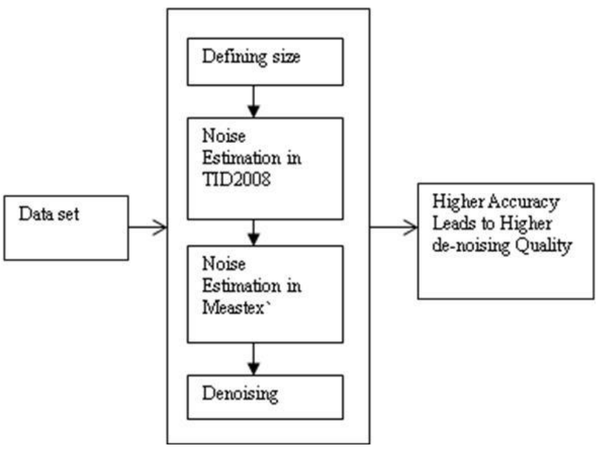

Fig 1 System Architecture 3.1 Define the size of the image

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This module is used to define the size of the image block. Correlation between pixels of the image texture has been calculated. Hence the block size should be larger enough and at least be comparable to the size of the texture pattern. On the other hand, the block size cannot be arbitrary large. In this process the block size is defined to be 5x5 blocks. Parameter C_0 and P_0 have been chosen so that σ^2_{ub} = C_0Q (P_0) is an upper bound of the true noise variance, i.e this value always overestimate the noise level. In 8-bit images with the gray value

range [0:255], the noise is usually clipped. In order to prevent the influence of clipping to the noise level estimation process, skip the blocks, in which more than 10% of pixels have the value 0 or 255.

A. NOISE ESTIMATION IN TID2008

The TID2008 database contains 25 RGB images. Each component has been processed independently, i.e. the results for each noise level have been obtained using 75 grayscale images. Though the reference images from TID2008 are considered as noise free images, they still contain a small level of noise. This level should be estimated in order to compare all methods fairly. This estimation can be done using the following semiautomatic procedure:

(i)Rectangular homogeneous area A has been selected manually in each reference image. This area contains almost no structure, i.e. it contains almost only noise with variance.

(ii)Uses a high –pass filter to remove possible image structures from A.

EstimateNoiseVariance algorithm which calls GetUpperBound and GetNextEstimate. GetUpperBound taken as the initial estimate and iteratively calls algorithm GetNextEstimate until convergence is reached. Algorithm GetUpperBound computes a noise variance upper bound. This algorithm is independent from image block PCA in order to increase the robustness of the whole procedure. The PCA is used to reduce the complexity and noise level.

Fig 2 Images from TID2008 Database 3.3 NOISE ESTIMATION IN MEASTEX

In the TID2008 database, images are of little or big homogenous areas. For this reason, this method is tested in images which contains texture image only. Meastex database, that contains 236 real textures stored as 512 x 512 grayscale. The accuracy of the proposed method is significantly better. The accuracy of the image is determined with the corrected estimates and standard deviation. Along with 236 images in the database, there are 4 images for which the error is larger. Which also obtains the autocorrelation value for these images.

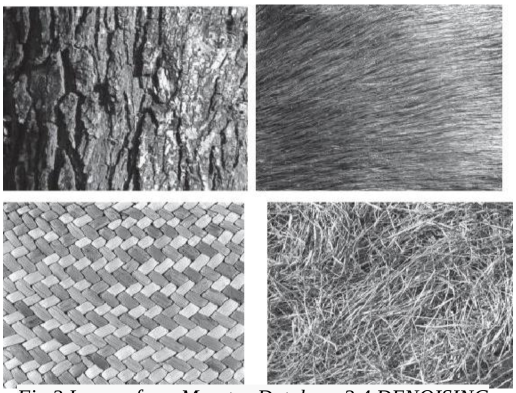

Fig 3 Images from Meastex Database 3.4 DENOISING

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Finally, the obtained noise level estimation algorithms are tested in denoising application. Performance of denoising algorithm is measured using quantitative performance measure such as peak signal to noise ratio, signal to noise ratio as well as interms of visual quality of the images. Where de noising algorithm uses the peak signal to noise ratio. The minimal value of the peak signal to noise ratio (PSNR) over each image database is obtained. But this value represents the behavior of a noise level. Thus, the denoising results show the higher noise level estimation accuracy to a higher denoising quality.

IV. CONCLUSION

In this work, it represents the new noise level estimation algorithm. The proposed method is compared with the existing method which provides the better accuracy for the image. The proposed method does not require the existence of homogenous areas in the input image; which can be applied to the texture also. By using the denoising method, the result shows the higher accuracy of noise estimation to higher quality image. In future, it can be used for image compression and segmentation applications.

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