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An Approach to Various Image Restoration Techniques

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Abstract – Image denoising is a method of improving the degraded quality of the image to review original information. High density saturated impulse noise is the highly degraded pixels present delve and deeper in the image which hide the original content of the image and make it noisy.

Index Terms – MSE (Mean Squared Error), PSNR (Peak Signal to Noise Ratio), Image Quality Index (IQI), Image Enhancement Factor (IEF) Impulse noise.

1. INTRODUCTION

An image is a two dimensional function f(x,y), where x and y are the spatial (plane) coordinates, and the amplitude off at any pair of coordinates (x,y) is called the intensity of the image at that level. If x,y and the amplitude values of f are finite and discrete quantities , we call the image a digital image . A digital image is composed of a finite number of elements called pixels, each of which has a particular location and value. Image Restoration is a field of Image Processing which deals with recovering an original and sharp image from a degraded image using a mathematical degradation and restoration model. Images are produced to record or display useful information. Due to imperfections in the imaging and capturing process, however, the recorded image invariably represents a degraded version of the original scene. The undoing of these imperfections is crucial to many of the subsequent image processing tasks. There exists a wide range of different degradations, which are to be taken into account, for instance noise, geometrical degradations (pincushion distortion), illumination and color imperfections (under / overexposure, saturation), and blur. Blurring is a form of bandwidth reduction of an ideal image owing to the imperfect image formation process. It can be caused by relative motion between the camera and the original scene, or by an optical system that is out of focus. When aerial photographs are produced for remote sensing purposes, blurs are introduced by atmospheric turbulence, aberrations in the optical system, and relative motion between the camera and the ground. Such blurring is not confined to optical images, for example electron micrographs are corrupted by spherical aberrations of the electron lenses, and CT scans suffer from X-ray scatter. In addition to these blurring effects, noise always corrupts any recorded image. Noise may be introduced by the medium through which the image is created (random absorption or scatter effects), by the recording medium (sensor noise), by measurement errors due to the limited accuracy of the recording system, and by quantization of the data for digital storage. The field of image restoration (sometimes referred to as image deblurring or image deconvolution) is concerned with the reconstruction or estimation of the uncorrupted image from a blurred and noisy one. Essentially, it tries to perform an operation on the image that is the inverse of the imperfections in the image formation system. In the use of image restoration methods, the characteristics of the degrading system and the noise are assumed to be known a priori. In practical situations, however one may not be able to obtain this information directly from the image formation process. The goal of blur identification is to estimate the attributes of the imperfect imaging system from the observed degraded image itself prior to the restoration process.

The restoration of image is shown in figure 1.below:

Original Image (a) Noisy Image (b) Denoised Image(c)

Figure 1 Restoration of Images

2. DIFFERENT TYPES OF DISTURBANCES

Gaussian-Noise: In this, the actual pixel of the image is misrepresented from original value by a miniature sum. Due to this, the image becomes faintly malleable and blurry.

Impulse-Noise: In this, the pixel value of image is not back off by a petite quantity but, in fact, it is introverted away by a new value. Impulse noise is basically introduced due to the bit error in transmission, faulty memory locations or timing errors in analog-to-digital conversion and also introduced during image acquisition stage.

Salt and Pepper Noise: In this type of noise there are intense values for the noisy pixel 0's and 255's. The pixel(p_i) is denoised pixel if $0< p_i <255$. In this the noisy pixel is found at value 0 and 255 only.

Poison Noise: This is a photon noise which is originated due to sensor motion because sensor is not sufficient to detect original information. So this kind of noise is developed when photons are corrupted and information is degraded.

Speckle Noise: This type of noise is produced by various values of pixels which get multiply and gives coherent processing of back scattered signals from multiple distributed points.

Mixed Noise and Other Types of Noise: When other than single style of noise is there, it is called mixed noise. Other types of noises are Rayleigh noise, Exponential noise, Uniform noise etc.

2.1. Blurring

Blur is unsharp image area caused by camera or subject movement, inaccurate focusing, or the use of an aperture that gives shallow depth of field. Blur effects are filters that make smooth transitions and decrease contrast by averaging the pixels next to hard edges of defined lines and areas where significant color transition are. There are following common types of blur effects in images:

Average Blur: This type of blurring can be distribution in horizontal and vertical direction and can be circular averaging by radius R which is evaluated by the formula: $R =\sqrt{g2 + f2}$ (1) Where: g is the horizontal size blurring direction and f is vertical blurring size direction and R is the radius size of the circular average blurring.

Gaussian Blur: The Gaussian Blur effect is a filter that blends a specific number of pixels incrementally, following a bell-shaped curve. Blurring is dense in the center and feathers at the edge.

Motion Blur: The Motion Blur effect is a filter that makes the image appear to be moving by adding blur in a specific direction. The motion can be controlled by angle or direction (0 to 360 degrees or –90 to +90) and/or by distance or intensity in pixels (0 to 999), based on the software used.

Out of Focus Blur: When a camera images a 3-D scene onto a 2-D imaging plane, some parts of the scene are in focus while other parts are not. If the aperture of the camera is circular, the image of any point source is a small disk, known as the circle of confusion (COC). The degree of defocus (diameter of the COC) depends on the focal length and the aperture number of the lens, and the distance between camera and object.

3. IMAGE RESTORATION TECHNIQUES

To restore the image and refining it from noisy pixels to denoised image there are many image denoising techniques. This section explains, following image restoration techniques:

- Averaging Filter
- Inverse Filter
- Weiner Filter
- Adaptive Filter
- MDBUTMF
- DBCWMF

Mean Filter: This filter is used as a basic restoration technique in which the mean of the processing area is replaced with the processing pixel that is corrupted.

Median Filter: Median filter is another algorithm to process the noisy pixel where the median of denoised pixel in the window is replaced with the median of the processing window. There are several median filters like SMF, AMF etc which have better results for processing of window.

Inverse Filter: This filter is beneficial for the corrupted image where the blur function is assumed to be known. This filter works well when noise is not present and does not perform well when noise is present in the image.

Weiner Filter: This filter provides optimal approach between image de-noising and inverse filtering and gives better result when used for image restoration than the straight inverse filter.

Adaptive Filter: This filter builds a new approach in the field of image de-noising. This filter works in two phases where in first phase the classification of noisy and noise free pixels is done and in second phase the edge filtering is done for the image but this filter was having many problems due to large processing size.

MDBUTMF: This Algorithm considers the fixed window of 3x3 and calculates the noisy and noise free pixels in the processing window and if the density of noise is high or more numbers of pixels in window are corrupted than it replaces the dark portion of image.

DBCWMF: This is new and advanced approach to image restoration. This algorithm works in two phases with a window size (2n+1) x (2n+1) where the intense values of 0's and 255's are calculated and observed if number of noisy pixels are more then it replaces the noisy pixels of processing window with the mean of the pixels however if dense and deeper noise is found then it is replaced by median of the window. Number of problems with other algorithms is overcome by this filter but its disadvantage is replacing the pixels by its mean in a fixed window size.

4. ATTRIBUTES OF IMAGE

To evaluate the quality of the image there are different parameters, commonly used are Peak Signal to Noise Ratio, Mean Squared Error, Image Quality Index and capacity. Different parameters are discussed below as follows

Mean Square Error.

MSE is used to weigh up the variation between original images with a restored image. If O is the original image of size $M \times N$ and D is the restructured image, then the MSE (Db) is defined as:

$$MSE(dB) = \frac{1}{M \times N} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} (O - \mathrm{D})^2 \quad …….. (1)$$

Peak Signal-to-Noise Ratio.

Peak Signal to Noise Ratio estimates the superiority of the recreated image in respect to the original image. Greater the PSNR better will be the reconstructed images. The PSNR (Db) is defined as:

$$PSNR(dB) = 10 log_{10} \left(\frac{255^2}{\frac{1}{M \times N} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} (O - \mathrm{D})^2} \right) …. (2)$$

Image Enhancement Factor.

Image Enhancement Factor is the most widely used quality metric. It indicates the performance of filter at different noise densities. Mathematically, it is given as:

$$IEF = \frac{\mathrm{E}[N(i,j) - O(i,j)]^2}{\mathrm{E}[D(i,j) - N(i,j)]^2} \quad ……………… (3)$$

5. CONCLUSION

In this paper different types of noises and blurs are studied and techniques for image restoration have been enlightened. The degraded image contains noisy pixels which need to be restored in order to get original, perfect and denoised image. The different filters have been reviewed which helps to restore the degraded image. Different algorithms implemented by staid researchers evaluated better results in denoising the images at high percentages however more research in this field can lead to good results at high level noise densities.

REFERENCES

[1] Mr. Rohit Verma.,Dr. Jahid Ali India. A Comparative Study of Various Types of Image Noise and Efficient Noise Removal Techniques 2013.

[2] Vivek Singh Bhadouria · Dibyendu Ghoshal · Abul Hasan Siddiqi. ,A new approach for high density saturated impulse noise removal using decision-based coupled window median filter 2013.

[3] Xiaorong Tan, Qian Zhang, Daifeng Zha,” A New Salt and Pepper Noise Removal Filtering Algorithm,” Conference on Dependable Computing (CDC’2010).

[4] Charu Khare, Kapil Kumar Nagwanshi,” Implementation and Analysis of Image Restoration Techniques”, International Journal of Computer Trends and Technology- May to June Issue 2011 ISSN:2231-2803.

[5] Fernandez-Redondo, M. and Hernandez-Espinosa, C, ”A comparison among weight initialization methods for multilayer feedforward networks”, Proceedings of the IEEE–INNS–ENNS International Joint Conference on Neural Networks, Vol. 4, Como, Italy, 2000, pp. 543–548.

[6] Montreal, Canada, “Pattern classification by Assembling small Neural networks” IEEE Proceedings of International Joint conference on Neural networks, july 31-August4,2005.

[7] Bar, L., Sochen, N., And Kiryati, N. 2006. Semi-Blind Image Restoration Via Mumford-Shah Regularization. Ieee Trans. On Image Processing. 15, 2, 483–493.

[8] Asmatullah,anwar.M.Mirza,and asifullah Khan,” Blind Image Restoration using Multilayer Back Propagation”, Proceedings of the International Multi topic(INMIC2003),IEEEConference,Islamabad,pp.55-58,December 2003.

[9] Wang Z,. Bovik A.C Sheikh H.R and Simoncelli E.P.,”Image Quality Assesment : from Error Visibility to Structural Similarity”, IEEE Trans.on Image Processing, 13(3),pp.1-14,MArcah 2000.

[10] S.Annadurai and R.Shanmugalakshmi ,“Fundamentals of digital Image Processing”, Pearson education,2009.

[11] H. C. Andrews and B. R. Hunt. Digital image restoration. Prentice-Hall, NJ, 1977.