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RESEARCH ARTICLE

State-of-Art: Various Noises and Filtering Techniques in Image Restoration

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Abstract

The problem, we are concerned with in this paper, is the quality of image. In the digital communication, the data is send in the digital form. It may be either in audio or video form. The applications of the digital communication can be seen in many fields. The most important and useful field is Image processing. Image processing is a very important subject and it is used in many areas such as photography, satellite imaging, medical imaging, remote sensing, image compression etc. Here, our main concern is the Image Processing and it's Restoration. This image processing is required because of noise addition in any image and this added noise is removed by various methods, out of which we will discuss filtering technique mainly.

INTRODUCTION

Basically an image is a visual representation of something. As per dictionary Image is a representation of the external form of people or thing in art. It is an artifact that Pictures/tapes visual sensing, e.g. a 2-dimensional picture that has a similar visual aspect to few subject – usually an object/person, thus providing a portrayal of it. Image is an array/matrix consisting of square pixels which r picture elements fixed up in rows along with columns.

The main challenges [1] in the field of image processing is image de-noising, where the chief aim is to approximate the original image by oppressing noise from a noise-involved version of the image. The term 'noisy image' describes the image degradation caused by noise disturbance. Image de-noising is nothing but the process of reducing or removing the effect of noise from the noisy image and reproducing, as same as possible, the original 'Neat' image by using various de-noising techniques like various filters.

Motivation

Digital communications is basically all about transmitting the info digitally. This information could be in the form of audio, video or image. Signal transmission, receiving, processing, restoration are important steps of digital communication. Our main concern here is image processing and denoising. The main challenges in the field of image processing is image denoising, where the chief aim is to approximate the original image by oppressing noise from a noise-involved version of the image.

This article is reviewed various methods and some previous work in this area.

I. DIGITAL IMAGES

An image is a visual representation of something. An image is a picture that can be stored in different locations i.e. jpeg, jpg, pdf file.

In digital image processing, an image is a 2-dimensional function $f(x, y)$, where x and y are the plane coordinates, and the amplitude of f at any pair of co-ordinates (x, y) is called the intensity of the image at that level. In mathematical form, an image is an array or a matrix of square pixels (picture elements) arranged in columns and rows [2].

Types of images:

1. Binary image: Binary image is the simplest type of the image. It takes only two values “black and white” or “0 and 1”. The pixels in the binary image can assume only two values “0 or 1”. The examples of the binary images are line drawings, printed text on a white page and so on. There are number of applications in the computer where binary image is used for object recognition, tracking and so on.

2. Grey scale image: Grey Scale images can be considered as a “Monochrome or One color image”. It may be quantized to a number of intensity levels i.e. it contains only brightness information, no color information. As the number of intensity level increases, the image can be represented better than the other image. A grey image can be converted into the binary image via a threshold value.

3. True color image: Color image may be quantized in three different color bands where each band of the data corresponds to a different color.

II. NOISES

Noise is introduced in the image either at the time of image generation (e.g. when we use camera to draw the image) or at the time of image transmission. Noise is any unwanted signal that effects the image [3]. It is a undesired information that distorted the image. Noise comes in any image from the variety of source. Image Processing is useful for Noise Reduction and edge enhancement. Noise is any image cause a serious errors. The unwanted noise information can be introduced by the many reasons such as camera movement, scene environment, relative motion between the camera and an object.

The source of noises in Digital Images [4]

- ✦ Digital images are prone to a form of noise. Noise is the result of errors or can say faults in the image acquirement or can say attainment process that result in pels or picture elements values that do not reflect or can say show the true or can say actual intensities of the literal scene. Noise is normally introduced during the time of image acquisition or transmission. Dissimilar components may be responsible for it. The number of pixels contaminated in the image will decide the quantification of this noise. There are many ways that noise can be enclosed in an image, based on how the image is shaped. For example:
 - ✦ If the image is scanned from a pic created on film, the film grain is a origin of noise. Noise can also be the outcome of damage to the film.
 - ✦ If the image is gained right away in a digital format, the mechanism for collecting the data (such as a CCD detector) can bring in noise.
 - ✦ The imaging sensor may be dissembled by environmental conditions during image attainment.
 - ✦ Insufficient Light levels and sensor temperature may insert the noise in the image.
 - ✦ Interference in the transmission channel may also defile the image.
 - ✦ If dust particles or can say molecules are present on the input device such as scanner screen, they can also introduce may causes of noise generation in the image.

There are various types of noise presented in the image:

- ✦ Gaussian Noise
- ✦ Salt and Pepper Noise
- ✦ Impulse Noise
- ✦ Shot noise (Poisson noise)
- ✦ Speckle noise
- ✦ Brownie noise

III. FILTERS

The elimination of noise is a main concern of the image processing, as it causes error in the image. The presence of noise disturbs all the information of the image. The unwanted noise can be removed by the using of the filters. Filter removes the unwanted information from any image. Thus, a digital filter is used to remove noise from the degraded image. It is an important subsystem of the signal processing. The image, which gets distorted from the noise can be filtered by using different filters. Filters are of different types i.e. Linear filters and Non linear filters. In the past, the analog filters were used. Gradually, digital filters took over the analog filters because of their flexibility, low cost, reliability and programmability [5].

There is various filters which are as follows:

1. Inverse filtering: This is the very easy method of the image restoration process. In this filtering, there is no noise function, only blur function occurs. We have to find out blurring function. If there is any noise, then blurring filter has zeros at some frequencies (since it is a low pass filter), those frequencies will be amplified in the noise.
2. Pseudo inverse filtering: It removes the problem at zero (or near zero), but still amplifies noise at other frequencies where the blurring filter response is not zero but small.
3. Weiner filtering: It is also referred to as minimum mean square error filtering. It is used for reconstructing the degraded image in the presence of known psf.
4. Lucy Richardson filtering: The Lucy Richardson Algorithm has become very popular in the field of astronomy and medical imaging. It was derived from Baye's theorem in early 1970 by Lucy and Richardson.

IV. LITERATURE REVIEW

This section talks about various works in the filed od Noise removal and Filtering methods:

In this paper [6], we present the approach to process the image using different filtering methods by image restoration. The aim is to enhance the digital image, reconstruct it into the original form from the noisy image. This paper is an overview of effective algorithms that can be used for image restoration. For which, techniques are used on the basis of non linear filters to restore the image. The performance of Histogram Adaptive Fuzzy (HAF) is carefully examined and compared with other filters like Weighted Fuzzy Mean (WFM) filter, Minimum-maximum detector based (MDB) filter, Adaptive Fuzzy Mean (AFMF) filter, Centre weighted mean (CWM) filter on the basis of peak signal to noise ratio (PSNR).

Paper [7] focuses on restoration of degraded images which have been blurred by known or unknown degradation function. On the basis of knowledge of degradation function, image restoration techniques are divided into two categories: blind and non blind techniques. There are various image restoration techniques like de-convolution using Lucy Richardson algorithm(DLR), De-convolution using Weiner filter (DWF), De-convolution using regularized filter (DRF) and de-convolution using blind image de-convolution algorithm (BID). The analysis is done on the basis of various performance metrics like PSNR (Peak signal to noise ratio), MSE (Mean square error), RMSE (Root mean square error).

In this paper [8], we have presented that how to introduce a high quality image that cannot be obtained by simply de-noising the noisy image or de-blurring the blurred image alone. To remove blur, we need to judge (i) how the image is blurred (ii) restore a natural looking image through De-convolution. Blur kernel estimation is challenging because the algorithm needs to distinguish the correct image pair to the incorrect blurred image. We introduce an algorithm that a blur kernel can be estimated by analyzing blurred edges. We can recover the blur kernel by using inverse Radon Transform. In this paper, we compare Restored Gaussian blurred images by using four types of techniques of de-blurring images such as Wiener Filter, Inverse Filter, Lucy Richardson de-convolution algorithm and our purposed algorithm on the basis of Well-known image quality parameters like mean squared error (MSE) and peak signal to noise ratio(PSNR).

This [9] paper explains how image restoration can be achieved Partial Differential Equation and conventional Filters such as Mean filter, Median filter, Adaptive filter and Weiner filter. In the conventional filters, the original

image is lost as it is not done under a mathematical framework which is reversible, whereas PDE based model uses a standard mathematical technique which is able to reverse the filtering process, provided some portion of original data is available. Based on the type of noise present in the image, the PDE gives better results. In this paper, image de-noising is applied to Digital images.

In this paper [10], a novel blind image de-convolution approach based on noise variance estimation and blur type reorganization is presented. This method first performs the noise variance estimation from the noisy blurred image. Restoring the observed image suffering from blur and noise simultaneously is a challenging problem. Then, using the property that the certain blur may lead to the specific frequency component distortion of the image Fourier spectrum, the blur type can be reorganized. After this, according to the reorganized blur type, the blur coefficients can be computed more efficiently by minimizing the objective function based on autoregressive moving average (ARMA) model, and the restored image can be obtained by least square filter.

This [11] paper describes the new total variation based de-noising technique. The Total Variation (TV) regularization is popular in image restoration and reconstruction due to its ability to preserve image edges. It finds the threshold level of the noisy image that minimizes the error between restored and the noisy image. The problem of the corrupted image is repaired by the blind de-convolution algorithm. The de-convolution method is modified by the effects of the first order as well as second order of the blurred images into the image update algorithm. The simulation results have shown better performance of the proposed method in both de-noising as well as de-blurring noisy image.

V. CONCLUSIONS

During image acquisition and transmission, noise is seen in images. This paper talks about Image processing, Noises, various de-noising methods along with various literature review work in this domain. Here, this paper tries to review and compare various available methods for de-noising noised-images. On the other hand, Image de-noising is necessary action in image processing operation.

Our proposed work will be in this area to de-noise the noised image by the means of one of many filtering methods.

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