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Blind Deconvolution Deblurring Technique In Image Processing

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Abstract: Image processing is an important component of modern technologies because human depends so much on the visual information than the creatures. The challenge to scientists, engineers and business people is to quickly extract the valuable information from the raw image data. This paper focused on image restoration which is sometimes referred to image deblurring or image Deconvolution. Image restoration is concerned with the reconstruction or estimation of blur parameters of the uncorrupted image from a blurred and noisy one. 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 (Kundur and Hatzinakos, 1996). Blind Deconvolution algorithm can be used effectively when no information about the blurring and noise is known. The algorithm restores the image and the point spread function (PSF). The aim of this paper to show the effective Blind Deconvolution algorithm for image restoration which is the recovery in the form of a sharp version of blurred image when the blur kernel is unknown.

Keywords: Blind Deconvolution, Image Recovery, PSF, MATLAB, Digital Image, Blurred Image, Blind, Deconvolution algorithm method, Wiener Filter deblurring method, Regularized Filter deblurring method, Lucy-Richardson algorithm method

I. INTRODUCTION

Image processing is an important component of modern technologies because human depends so much on the visual information than other creatures. Image is better than any other information form for us to perceive. Among our information about the world, 99% is perceived with our eyes (Russ, 1995). Image processing has traditionally been an area in the engineering community. In the past few decades several advanced mathematical approaches have been introduced into this field, namely, the avariational calculus, partial differential equations (PDE) and stochastic approaches (or statistical methods), and they have become important tools for theoretical image processing. Digital image processing is a subset of the electronic domain wherein the image is converted to an array of small integers, called *pixels*, representing a physical quantity such as scene radiance, stored in a digital memory, and processed by computer or other digital hardware. There are no clear-cut boundaries in the continuum from image processing at one end to computer vision at the other. However, one useful paradigm is to consider three types of computerized processes in this continuum: low-, mid-, and high-level processes. Low-level processes involve primitive operations such as image preprocessing to reduce noise, contrast enhancement, and image sharpening. A low-level process is characterized by the fact that both its inputs and outputs are images. Mid-level processes on images involve tasks such as segmentation (partitioning an image into regions or objects), description of those objects to

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reduce them to a form suitable for computer processing, and classification (recognition) of individual objects. A mid-level process is characterized by the fact that its inputs generally are images, but its outputs are attributes extracted from those images (e.g., edges, contours, and the identity of individual objects). Finally, higher-level processing involves making sense of an ensemble of recognized objects, as in image analysis, and, at the far end of the continuum, performing the cognitive functions normally associated with human vision (Gonzalez and Woods, 2009).

Image restoration is concerned with the reconstruction or estimation of blur parameters 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 process of image restoration, the characteristics of the degraded 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 (Kundur and Hatzinakos, 1996).

II. LITERATURE REVIEW

There exist number of no blind or classical image restoration techniques like Inverse Filtering, Wiener filter etc but it has some drawbacks. For that purpose in recent year's blind Deconvolution methods for restoring images has been developed.

Howard Kaufman and A. Murat Tikal have proposed Inverse filtering classical image restoration technique. It was developed by Nathan in 1966 to restore images. It is also known as Deconvolution. Inverse of PSF was used to recover image. Inverse filtering can be efficiently implemented in frequency domain using FFT but Deconvolution by direct inversion was ill - posed .The advantage of the inverse filter is that it requires only the blur PSF as a priori knowledge but drawback is noise amplification.

Deepa Kundar have proposed method for novel blind Deconvolution scheme for nonparametric finite support restoration. In this, blurred image is taken as input to FIR filter, output represents the estimate of true image. Figure. 2.1 shows the concept of NASRIF algorithm. Characteristic of this method is that Image is nonnegative with finite support. The difference between the projected image and true image j (x, y) is used as the error signal to update the coefficients of filter. This requires replacing the negative pixel values within the region of support with zero and pixel values outside the region of support with the background grey-level value LB.

Method of constraint is computationally inefficient for use with the conjugate gradient minimization routine. Thus, used a penalty method and add a third term to the cost function. The cost function consists of three components. The first component prevents the pixels of the intermediate restorations from becoming highly negative and can have the effect of increasing convergence of the NAS-RIF algorithm. It also has the effect of reducing noise amplification when additive noise is present in the degraded image. Third component issued to constrain the FIR filter coefficients away from the trivial all zero global minimum. The major advantage of the algorithm is that it entails the minimization of a convex cost function. Drawback of this algorithm is noise amplification at low SNRs. The convexity of the proposed cost function is established analytically.

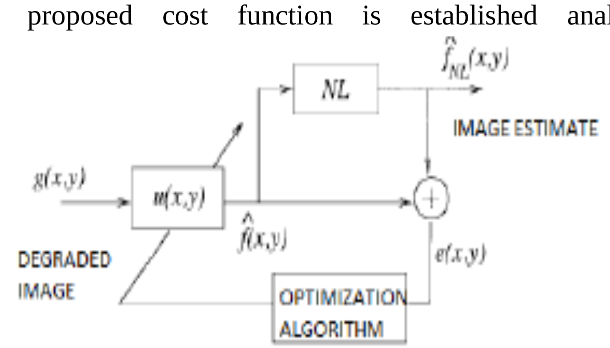

Fig 2.1 NAS-RIF algorithm

D. A. Fish, A. M. Brinicombe, and E. R. Pike have presented blind Deconvolution algorithm based on the Richardson–Lucy Deconvolution algorithm. It was developed from Bayer's

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INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE AND ENGINEERING TECHNOLOGY (IJRASET)

theorem. In this algorithm initial guess is required for the object to start algorithm. Then after that in subsequent iteration large deviation in the guess from true object are lost rapidly in initial iteration whereas detail is added more slowly in subsequent iteration. Two Lucky iteration are performed within one blind iteration, one for object evaluation anode for PSF evaluation. Advantages of this algorithm include nonnegative constraint if the initial guess f0(x) H0. Also energy is conserved as the iteration proceeds. Figure. 2.2 show the proposed Richardson Lucky algorithm.

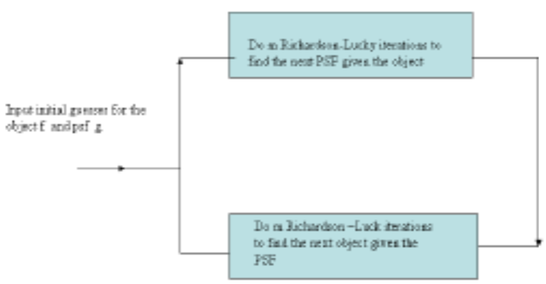

Fig 2.2 Blind Deconvolution based on the Richardson – Lucky algorithm

In Jae Myung have proposed maximum likelihood estimation approach, which is originally developed by R.A. Fisher in1920 state that desired probability distribution is the one that makes the observed data most likely. Estimation of parameter is made such that the probability or likelihood of receiving the observed image given the parameter set is maximized. Benefit of this approach is estimation of the true image is produced at every iteration so the algorithm is easily terminated when result is obtained.

M. Mattavelliet. all have presented Kaman filtering technique for image restoration where degraded image is divided into tuned channels which give set of sub images. Each of these perceptual component represent original image within band of frequency. It requires two models. Observation model which link original image tithe corrupted one and image model give relation between currently processed pixel and those already restored. Restoration is obtained by recombining all restoration components. Advantage is avoid heavy computational load.

S. DerinBabacan have presented algorithm for total variation(TV) based blind Deconvolution and parameter estimation utilizing avariational framework. In this, blind Deconvolution method has been implemented where unknown image, blur, and Hyper parameters are estimated simultaneously.

Unknown parameters can be of Bayesian formulation can be calculated automatically using only observation or using also prior knowledge with different confidence values to improve performance of algorithm. It gives higher quality restoration in both synthetic and real image experiment.

Feng-qing Qin have proposed method of blind imagesuper-resolution reconstruction. The point spread function of the imaging system is estimated to approximate the low resolution imaging process much more accurately. Utilizing Wiener filtering image restoration algorithm, multiple error parameter curves are generated at different parameters. The super resolution reconstructed image has higher spatial resolution and better visual effect.

III. PROPOSED WORK

The proposed efforts have been utilized to develop a Blind Deconvolution Algorithm that produces useful results when processing degraded scenes. This technique will capitalize on the statistics of the blurry image and the refined image estimate, in an iterative approach to converge on the correct seeing parameter. Image restoration methods can be considered as direct techniques when their results are produced in a simple one step fashion. Equivalently, indirect techniques can be considered as those in which restoration results are obtained after a number of iterations. Known restoration techniques such as inverse filtering and Wiener Filtering can be considered as simple direct restoration techniques. The problem with such methods is that they require knowledge of the blur function that is point-spread function (PSF), which is, unfortunately, usually not available when dealing with image blurring. The goal of this work is to

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develop a Blind Deconvolution algorithm for image restoration which is the recovery in the form of a sharp version of a blurred image when the blur kernel is unknown. The fundamental task of image deblurring is to de-convolute the blurred/degraded image with the PSF that exactly describes the distortion. Firstly, the original image is degraded using the Degradation Model. It can be done by Gaussian Filter which is low-pass filter used to blur in image. In the edges of degraded image, the ringing effect due to high frequency drop-off can be detected using Edge detection methods. This ringing effect should be removed before restoration using edge trapping. After removing the ringing effect, Blind Deconvolution algorithm is applied to the blurred images. It is possible to renovate the original image without having specific knowledge of degradation filter, additive noise and image spectral density.

Steps of Blind Deconvolution Algorithm

The proposed Blind Deconvolution algorithm consists of following steps:

Step 1: Read in Images: Images to be deplored are read into MATLAB environment.

Step 2: Simulate Blur: In this step a real life blur will be simulated using different types of filter.

Step 3: Restore the Blurred image using PSF of various sizes: This step involves the restoration of image using Blind Deconvolution Algorithm by trying PSFs of different sizes.

Step 4: Improving the Restoration: There some ringing in the image, restored in previous step. To avoid this we will exclude the pixels affected by the ringing.

Image deblurring or demising is a crucial part of restoring images that have been distorted by any movement (camera or object) during the capture process, by using out-of-focus optics, or by atmospheric turbulence etc. In order to make an estimate about the seeing parameter, which describes the effect of atmospheric turbulence, most of methods either use the short optical transfer function (OTF), which negates atmospheric tilt caused by phase delay, or rely on a posteriori data. Currently there are number of methods for image deblurring. Some of them are listed here:

1. Blind Deconvolution algorithm method
2. Wiener Filter deblurring method
3. Regularized Filter deblurring method
4. Lucy-Richardson algorithm method

In view of the above facts, the goal of the thesis “A MATLAB Approach To Image Processing Using Blind Deconvolution Deblurring Technique” were ascertained as:

1. To develop a Blind Deconvolution technique for the restoration of linearly degraded images. As explicit knowledge of either the original image or point spread function is not required.
2. To make a comparative study of the performance of the proposed technique using different blur kernels.

IV. CONCLUSION

Restoration technology of image is one of the important technical areas in image processing. In this work, the process of image restoration technique has been discussed. The process is based on Blind Deconvolution approach with partial information available about true image. Advantage of using Blind Deconvolution Algorithm is to dabbler the degraded image without prior knowledge of PSF and additive noise. The method differs from most of other existing methods by only imposing weak restrictions on the blurring filter, being able to recover images which have suffered a wide range of degradations. The advantage of the proposed Blind Deconvolution Algorithm is to dabbler the degraded image without prior knowledge of PSF and additive noise. But in other algorithms, to process the image the prior knowledge of blurring parameter is must.

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