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Novel Approach of Blurriness Reduction from Image by Particle Swarm Optimization

Sonia Rani[1], **Paru Raj**[2]
[1]M.Tech Student, [2]Asstt. Professor,
Department of Computer Science and Engineering, Prannath Parnami Institute of Management & Technology, Hisar, Haryana, India

ABSTRACT

Blurring of images can be caused by movement of object or camera while capturing the image. The DE blurring of Images is the reconstruction or restoration of the uncorrupted image from a distorted and noisy one. In this paper, an idea for two directional image deblurring algorithm is introduced which uses basic concepts of PDEs. Motion Blurring is introduced in two directions: horizontal and vertical. Then we proposed PDEs based model for image deblurring considering both the directions which is based on the mathematical model. A simple two dimensional algorithm has been introduced and implemented. The results show better quality of images by applying this algorithm. In this research various methods for noise reduction have been analyzed. In the analysis, various well-known measuring metrics have been used. The results show that by using the PDE technique noise reduction is much better compared to other methods. In addition, by using this method the quality of the image is better enhanced. Using PDE the unconstrained image problem can be easily done regularized. The median, mean and wiener filters have low PSNR values for Gaussian noise. Weiner filtering is the worst case for such noises. The PDE technique is much efficient than these for the motion blurring. The vertical deblurring shows the better results than horizontal and combined deblurring in PDE.

Keywords : PSNR, PDE, Deblurring Algorithm, DE Blurring, GPU, FFT

I. INTRODUCTION

Image restoration is an important part in the high level image processing. Image restoration approaches are used to obtain the original image from the degraded image or blur image. In the applications like remote sensing, microscopy, medical imaging, optics, photography, super-resolution applications, and motion tracking applications PSF is unknown or partially known among others. Blind image super resolution methods have also presented in this work which provides the effective image with higher spatial resolution. Image deblurring is an inverse approach which is used to recover the image which has suffered from the blurriness or linear degradation. There are two approaches for image deblurring that are non-blind and blind. In non-blind image deblurring, blurring operator is known and in blind deblurring method operator is unknown. Basically image deblurring process is to recover the original scene image from a degraded image using knowledge about its nature. In the non-blind image deblurring approach some noise is not removed and it does not gives effective results. Blurriness in image is appears when the relative motion is present between the camera and scene and it reduces the quality of the images. The recovering of original image from the blurred image is called as image restoration. Blind deconvolution approach gives better result as compared to bling restoration approach. Hence in recent years various blind

deconvolution techniques have been the degraded image. There are two methods of image deblurring

1. Blind deblurring
2.Non-Blind deblurring

A. FPA (Flower Pollination ALgorithm)

FPA is a global optimization algorithm which is used for the optimization of the solutions. Global pollination is considered under cross pollination and Biotic Pollination. In global pollination process pollen travel a long distance because insects can fly over long distance.

B. Weiner Filter

The method is founded on considering image and noise as random process and objective is to find an estimate of deblurred image of the uncorrupted image such that mean square error between them is minimized. The simplest approach is to restore the original image simple by dividing the transform of degraded image by degradation function.

$$F(u,v) = F(u,v) + N(u,v)/H(u,v) \qquad (4.1)$$

These are the frequency transform of deblurred image, original image, noise density and degraded function.

II. RELATED STUDY

Tofighi, et al. [1] proposed an approach of blind image deblurring using row-column sparse representation. A model is prepared for the outer product of kernel and image coefficient and ranks one matrix and solves the problem of rank minimization. In this work, two optimization problems are solved by row and column sparsity. Singular value decomposition is used to recover the image and kernel. The proposed BD-RCS achieves effective results and it estimates the blur kernel support and solves deblurred image problem. Cao, Shan, et al. [2] formulated the problem of blurred image by reducing the effect of ringing using Bayesian estimation. This method is used for image restoration and it uses Richardson Lucy algorithm to restore the image. This algorithm reduced the noise and ringing artifacts and also preserves the useful information. In this work, a prior probability model is built of the original image and then applies degradation function. Bayesian model is applied and then reduced the ringing in the image.

Mosleh et al. [3] proposed a simple and effective method of image deblurring by using Linear Approximation method which handles the saturation in deblurring method. This work is motivated from the measurable ringing artifacts through the multi-resolution pyramid. Quantification function is used to reduce the cost function and also reduce the ringing in deblurring process. For optimization Primal-dual algorithm is proposed to provide the effective biased patterns of the image. The results show the image quality is enhanced by the proposed method. Chandramouli et al. [4] presented a method of blurriness removal in the image captured by the plenoptic camera. Blind convolution method is used for identification of blur point and latent sharp image identification. In the absence of motion, the plenoptic camera images are affected by aliasing and defocus. The plenoptic cameras introduced the periodic patterns which are used to obtain numerical schemes to synthesize images. These methods are implemented on the effective GPU to enables the iterative models. The proposed method improves the image quality in non-uniform motion blur.

Qin, Zhengcai, et al. [5] worked on the text image deblurring by using Intensity Extermums Prior. This work is based on the white and black pixels of the blurred image are less in quantity as compared to the clear image. To prove this thing mathematically Intensity Extermums Prior method is used in this work. It is basically an optimization approach which utilizes the half quadratic splitting approach. The performance evaluation of the proposed approach is also done on the complex text image which contains cluttered background regions and it performs effectively on it. Pu, Haitao, et al. [6] explained an approach of double convolution neural network

which is used to solve the blurriness problem in the 2D blur image. Convolution neural network is used to deblur the barcode image. This technique is combined with deep learning to fill the gap between the traditional approaches. The proposed method achieves the effectiveness of the superior performance of the image.

Xu, Xiangyu, et al. [7] proposed Deep Convolution Neural network approach to extract the sharp edges from the blurred image. This work is done by the motivation of existing filtering methods that are used to deblurr the images. This model work on two approaches the first one is to remove the extra edges and enhance the sharp edges. In this work, no any deblurring algorithm is required to sharpen the edges and their selection. The result shows that it reduces the computation load and improves the image quality. Chang, et al. [8] formulated the problem of motion image blurring by using the hybrid approaches. In this work, Patch-based edge restoration and bilateral filtering method are used to deblur the motion image. In edge-based approach, edges are sharpened and the used for these edges to estimates the blur kernel. The present work is based on the deblurring algorithm which separates the blurred edges and smooth edges. The bilateral filtering method is used here to remove the narrow edges and the noise which generates the ringing effects. This approach provides the effective results in deblurring.

Tang, Yibin, et al. [9] proposed blind image deblurring method with sparse representation and external patch priors. In the existing methods internal prior is only considered in the deblurring process but in the proposed method external priors are used to reconstruct the latent image. In this work author proposed External patch Log Likelihood method with Gaussian mixture model which is used to describe the external patches. The proposed EPLL method is used with the existing sparse-based deblurring method where it designed each patch of the latent image very carefully. This iterative procedure effectively optimizes the latent image and blur kernel and provides effective deblurring result in the image. O'Connor, et al. [10] proposed convex optimization approach called as total variation deblurring which is mostly used for non-differentiable optimization. In this work, Fast Fourier Transformation method is used to solve the linear equations. In this approach, two models are used that are Space Varying operators and the Nagy-O'Leary model and efficient filter flow model. Douglas -Rachford algorithm is implemented with low complexity per iteration which is dominated by a small number of FFTs.

III. PROPOSED METHODOLOGY

FPA is a global optimization algorithm which is used for the optimization of the solutions. Global pollination is considered under cross pollination and Biotic Pollination. In global pollination process pollen travel a long distance because insects can fly over long distance. This algorithm works in the four steps that are following

1. Population Initialization
2. Exploration Process
3. Exploitation Process
4. Solutions Update

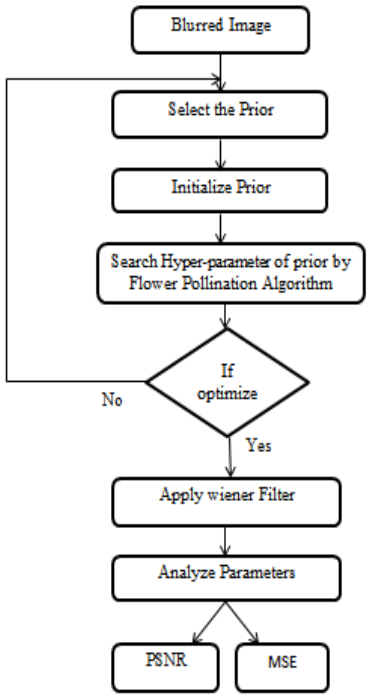

Figure 1 Flow Chart of Proposed Methodology

Search by Flower Pollination method.

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Step I: Min or max Objective F(u), where u=(u_1,u_2,……..u_d).

Step II: Initialize m pollen gametes or flower population having random solutions.

Step III: The best solution S_* is found in the initial population.

Step IV: A switch probability is defined as $p_S \in [0, 1]$.

Step V: In case T< MaxGen, for i=1:m

A step vector l (obeys Levy distribution) is drawn as $p_S > rand$, the global pollination

$$u_x^{1+1} = \gamma l(S_* - u_x^t) + u$$

Where,

γ is the scaling factor for step size control,

u_x^t is the solution vector at t iteration,

x, y **and** n are the pollens

B : Otherwise, drawing ϵ with uniform distribution [0,1]

So, local pollination $u_x^{1+t} = \epsilon(u_y^t - u_n^t)$

Step VI: New solution is evaluated as the solution obtained are better and updating the population.

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Step 6: If value is optimized then apply weirner Filter. Otherwise again initialize the value.

$$X(n) = d(n) + v(n)$$

Here d(n) and v(n) are stationary random process

X(n) mean square estimate of d(n) and v(n).

Weirner Filter: This filter is used to remove the blurriness from the image which occurred due to linear motion in image. It is basically used to reduce the noise in image. It reduces the mean square error as much as possible.

Step 7: Analyze the value of PSNR and MSE.

In this step peak signal to noise ratio (PSNR) and mean square error (MSE) is analyzed by comparing with existing methods.

IV. RESULTS AND DISCUSSION

The blurring of images can be caused by movement of object or camera while capturing the image. The deblurring of Images is the reconstruction or restoration. An idea for two directional image deblurring algorithm is introduced which uses basic concepts of PDEs. Motion Blurring is introduced in two directions: horizontal and vertical. A simple two dimensional algorithm has been introduced. The results show better quality of images by applying this algorithm. All the results are compared with the existing techniques and results are compared on the basis of the calculated PSNR and MSE values for the different techniques and for various noises. The PSNR and MSE value table is given in the results.

TABLE 1

PSNR CALCULATION FOR DIFFERENT TECHNIQUES

S.No	Type of Motion Blur	De-blurring Technique	PSNR Value
1	Horizontal	Wiener filter with PSO	45.23
2	Vertical	Wiener filter with	30.23

		PSO	
3	Horizontal	Wiener filter	16.3883
4	Vertical	Wiener filter	15.9225
5	Horizontal	PDE	27.434
6	Vertical	PDE	29.1383

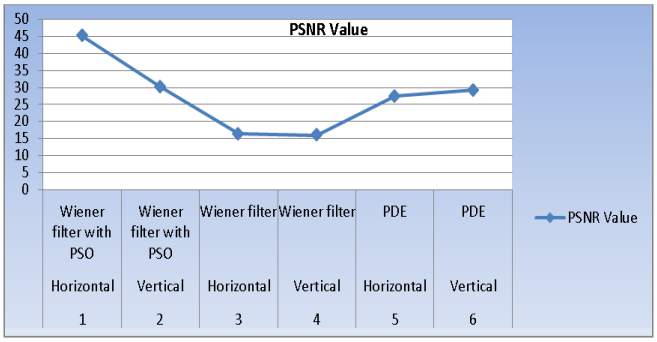

Figure 2 PSNR Calculations for Different Techniques

TABLE 2
MSE CALCULATIONS FOR DIFFERENT TECHNIQUES

S. No	Type of Motion Blur	DE blurring Technique	MSE
1	Horizontal	Wiener filter with PSO	25.23
2	Vertical	Wiener filter with PSO	24.23
3	Horizontal	Wiener filter	30.3883
4	Vertical	Wiener filter	31.9225
5	Horizontal	PDE	33.434
6	Vertical	PDE	40.1383

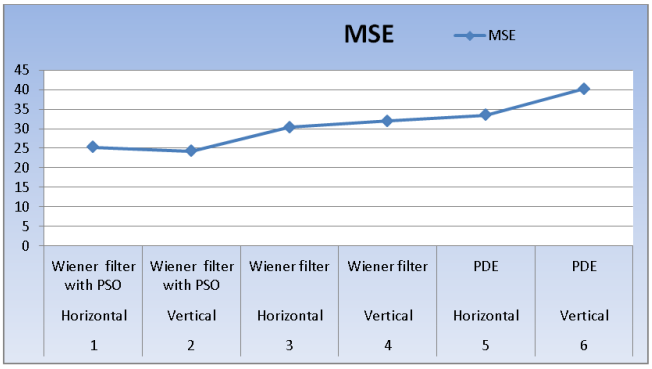

Figure 6.2 MSE Calculations for Different Techniques

V. CONCLUSION

An algorithm for solving the unconstrained optimization formulation of regularized image reconstruction. Experiments on a different set of the standard image recovery problems have shown that the proposed algorithm (Weirner with PSO) is much better than previous state-of-art methods. In this research various methods for noise reduction have been analyzed. In the analysis, various well-known measuring metrics have been used. The results show that by using the PDE technique noise reduction is much better compared to other methods. In addition, by using this method the quality of the image is better enhanced. Using PDE the unconstrained image problem can be easily done regularized. The median, mean and wiener filters have low PSNR values for Gaussian noise. Weiner filtering is the worst case for such noises. The PDE technique is much efficient than these for the motion blurring. The vertical deblurring shows the better results than horizontal and combined deblurring in PDE.

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