# Robust Technique for Extracting Deblur Image Using Fuzzy Logic Approach from Impulse Noise

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**Abstract**: *Image processing is very crucial in today world because various noises, attacks, and many more problem faced by an image from transmitter to receiver side. By applying various algorithms and filters we can remove such type of noises and attacks. Blur detection techniques are very helpful in real life application and are used in image segmentation, image restoration and image enhancement. Blur detection techniques are used to remove the blur from a blurred region of an image which is due to defocus of a camera or motion of an object. 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. Deblurring techniques are basically used to sharp an image using different methods & parameters so that we can abundant amount of knowledge. As we know there are various types of noises occurred in an image and to remove various techniques are used. Every technique is suitable for a particular noise and we cannot apply randomly to remove a particular noise. With advancement of time old technique are replaced by advanced method and today Fuzzy Logic is much more appreciated due to simple logic function and it is fourth generation technique*

*Keywords—Deblur, Digitized Image, Fuzzy Logic, Gaussian Noise, PSNR, Membership Function, MSE.*

## I. INTRODUCTION

A digital image is an array of real or complex numbers represented by a finite number of bits. An image given in the form of a transparency, slide, photograph, and chart is first digitized and stored as a matrix of binary digits in computer memory[1-2]. The digitized image can then be processed on a high resolution television monitor. For display, the image is stored in a rapid access buffer memory which refreshes the monitor at 30 frames per second to produce a visibly continuous display.
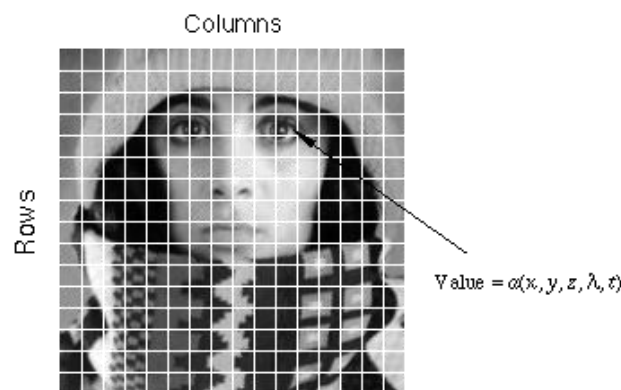


**Fig.1 Digitization of a continuous image**

From capturing to transmitting and finally in receiving various types of noises added with original image and due to it lots of important information can be corrupted which would be very useful. Therefore we have lot of challenging aspect

of these problem in which we have to design diggerent selectively filter to extract important information, such as blur image, without losing significant features or creating false ones [5]. Many nonlinear models have been proposed for this purpose, however, when an image consists of objects of non-uniform intensity or has been degraded by noise. Our goal is to study a new model for image restoration which not only removes noise and retains sharp edges, but also avoids stair casing in what should be smooth regions

The image degradation process can be modeled by the following equation:

$$\mathbf{g=H\cdot f+w}$$

Where, **H** represents a convolution matrix that models the blurring that many imaging systems introduce. For example, camera defocus, motion blur, imperfections of the lenses all can be modeled by **H.** The vectors **g**, **f**, and **w** represent the observed, the original and the noise images. More specifically, **w** is a random vector that models the random errors in the observed data [7]. These errors can be due to the electronics used (thermal and shot noise) the recording medium (film grain) or the imaging process (photon noise).



**Fig 2. Blur Image**



**Fig 3. Noisy Image**

There is a lot of difference between blur image and noisy image. Here we study to recover the blur image in fine quality. Image Restoration is the recovery of an original image x [m,n] from a given degraded image y[m,n] with a priori/posteriori knowledge of the degradation process. Image Restoration is not the same as Image Enhancement [10-13].

*Image Quality Measures:*

**A. Root Mean Squared Error (RMSE)**

Suppose that the original image u of size M X N has been denoised, using an image denoising scheme, and let u~ be the denoised estimate. The RMSE between the denoised image and the original image is given by

$$RMSE = \sqrt{\frac{\sum_{i=1}^{M}\sum_{j=1}^{N}(ui_j - u_{\sim ij})2}{MxN}}$$

**B. Peak Signal to Noise Ratio (PSNR)**

It is inversely proportional to the RMSE; its units are in decibels (dB) and are formally defined by

$$PSNR = 20 \log_{10}\left[\frac{255}{RMSE}\right](dB)$$

Where 255 is the maximum pixel value for an 8 bits/pixel gray-scale image

## II. LITERATURE SURVEY

With pace of time various techniques came into existent to remove various types of noises from the image using various techniques given by many researchers. Out of these some techniques are given below which are carried by different authors:

Chen; Jie Yang; Qiang Wu: This filter justifies its name by detecting noise to the perfection. Based on Progressive Switching Median Filter, it generates an edge flag image to classify the pixels of noisy image into ones in the flat regions and edge regions. The two types of pixels are processed by different noise detector. When noise is very high prevention of false-detection and non-detection becomes difficult. Therefore, iteration is dedicated for verification of the noise flag image. This scheme exhibits good performance on images not only with low noise density but also with high percentage

of corruption. But all these come at the cost of computational complexity which is very high and not at all suitable for real time applications [3].

W. Zhang and F. Bergholm: Proposed Progressive Switching Median filter: It is a median based filter, which works in two stages. In the first stage an impulse detection algorithm is used to generate a sequence of binary flag images. This binary flag image predicts the location of noise in the observed image. In the second stage noise filtering is applied progressively through several iterations. This filter is a very good filter for fixed valued impulsive noise but for random values the performance is abysmal [4].

Sunghyun Cho proposes a method for removing non-uniform motion blur from multiple blurry images. it restore images blurred by unknown, spatially varying motion blur kernels caused by different relative motions between the camera and the scene. This algorithm simultaneously estimates multiple motions, motion blur kernels, and the associated image segments Realworld experiments demonstrate the effectiveness of the proposed method [8].

Pei-Eng Ng and Kai-Kuang Ma proposed a technique to remove the edge error and restore the image; .Three different approaches seem to have been taken for reducing the restoration errors: (1) replacing the inverse filter with Wiener filters, (2) windowing the blurred image before restoration, and (3) working in the spatial domain rather than in the Fourier Large errors are often observed in inverse filter resto- transform domain.. The edge error can reduce by using Wiener filtering. The best restorations are obtained by subjecting the windowed-blurred image to a Wiener filter [14].

## III. METHODOLOGY

Fuzzy logic is also a structured, model-free estimator that approximates a function through linguistic input/output associations. Fuzzy logic is a powerful, yet straight forward; problem solving technique with wide spread applicability, especially in the areas of control and decision making [24]. Fuzzy Logic was first invented as a representation scheme and calculus for uncertain or vague notions. It allows more human-like interpretation and reasoning in machines by resolving intermediate categories between notations such as true/false, hot/cold etc used in Boolean logic In this context, Fuzzy Logic is a problem-solving control system methodology that lends itself to implementation in systems ranging from simple, small, embedded micro-controllers to large, networked, multi-channel PC or workstation-based data acquisition and control systems. It can be implemented in hardware, software, or a combination of both. FL provides a simple way to arrive at a definite conclusion based upon vague, ambiguous, imprecise, noisy, or missing input information. FL's approach to control problems mimics how a person would make decisions, only much faster

*Fuzzy Operation:* FL requires some numerical parameters in order to operate such as what is considered significant error and significant rate-of-change-of-error, but exact values of these numbers are usually not critical unless very responsive performance is required in which case empirical tuning would determine them.
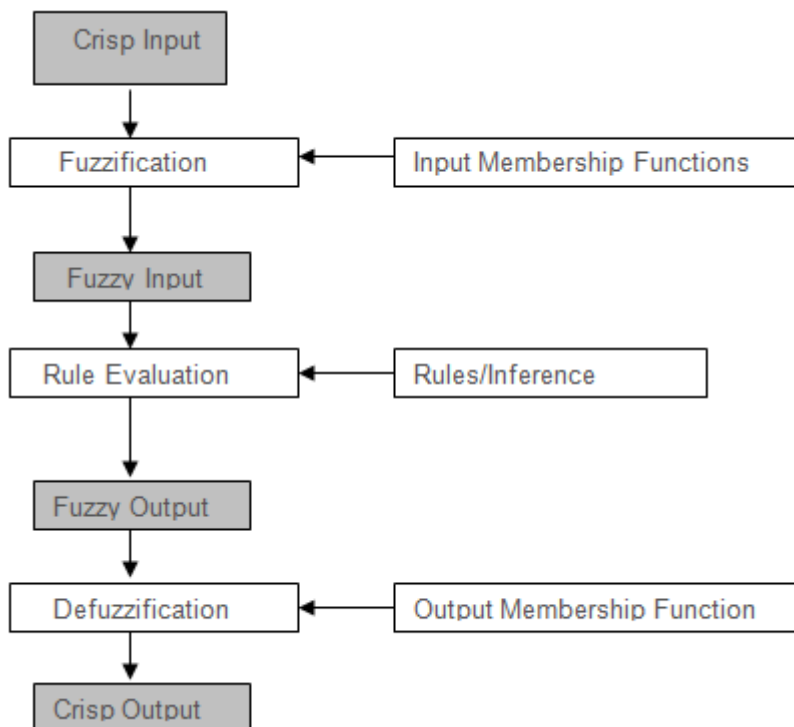


**Fig4. Fuzzy Logic Operation**

**Membership Functions:** The membership function is a graphical representation of the magnitude of participation of each input. It associates a weighting with each of the inputs that are processed, define functional overlap between inputs, and ultimately determines an output response. The rules use the input membership values as weighting factors to determine their influence on the fuzzy output sets of the final output conclusion. Once the functions are inferred, scaled, and combined, they are defuzzified into a crisp output which drives the system.
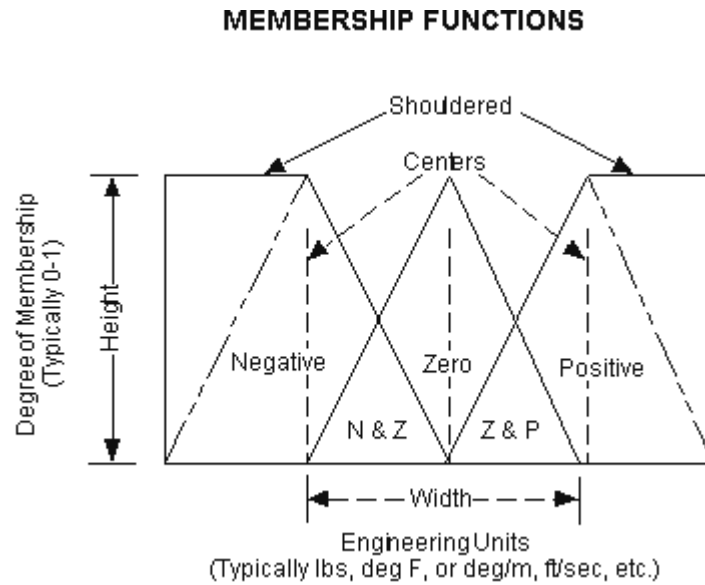
**MEMBERSHIP FUNCTIONS**



**Fig.5 Membership functions (UOD versus membership grade)**

**Algorithm for the first iteration**

INPUT: The noisy image with impulse noise.

$\mu(A(i, j))$: The membership degree for the fuzzy set more or less impulse noise.

F: the output image.

Steps:

(1)    FOR each border pixel $(i, j) \in A$

(2)    Perform comparison with neighbour pixel in window of 3x3

(3)    if the blur detected in image, perform the fuzzy filtration

(4)    Replace the pixel in window by the fuzzy derived pixels

(5)    If there is no blur detected by neighbour comparison

      i.   Perform the edge based comparison within window

      ii.  If it satisfy then perform fuzzy filtration

      iii. Replace the pixel by new fuzzy derived pixels

(6)    END FOR

**Algorithms for the next filtering iterations (m $\geq 2$ )**

INPUT: The output image of the previous iteration

Steps:

(1) FOR each border pixel $(i, j) \in A$

(2)    Perform comparison with neighbour pixel in window of 3x3

(3)    If the blur detected in image, perform the fuzzy filtration

(4)    Replace the pixel in window by the fuzzy derived pixels

(5)    If there is no blur detected by neighbour comparison

      i.   Perform the edge based comparison within window

      ii.  If it satisfy then perform fuzzy filtration

      iii. Replace the pixel by new fuzzy derived pixels

(6)  END FOR

## IV.  SOFTWARE USED AND SIMULATION RESULT

 **Software: MATLAB Version R2015a:** It is powerful software that provides an environment for numerical computation as well as graphical display of outputs. In Matlab the data input is in the ASCII format as well as binary format. It is high-performance language for technical computing integrates computation, visualization, and programming in a simple way where problems and solutions are expressed in familiar mathematical notation.

Using MATLAB, you can solve technical computing problems very easily and time saving as compared to traditional programming languages, such as C, C++, and FORTRAN. The name MATLAB stands for matrix laboratory.

In our research work simulation result are depicted below as:



**Fig.6 Original image**



**Fig.7 Blur image**



**Fig.8 Deblurring with undersized PSF**



**Fig.9 Deblurring with oversized PSF**



**Fig.10 Deblurring with INITPSF**

True PSF

Reconstructed Undersized PSF



Reconstructed Oversized PSF

Reconstructed true PSF



**Fig. 11**

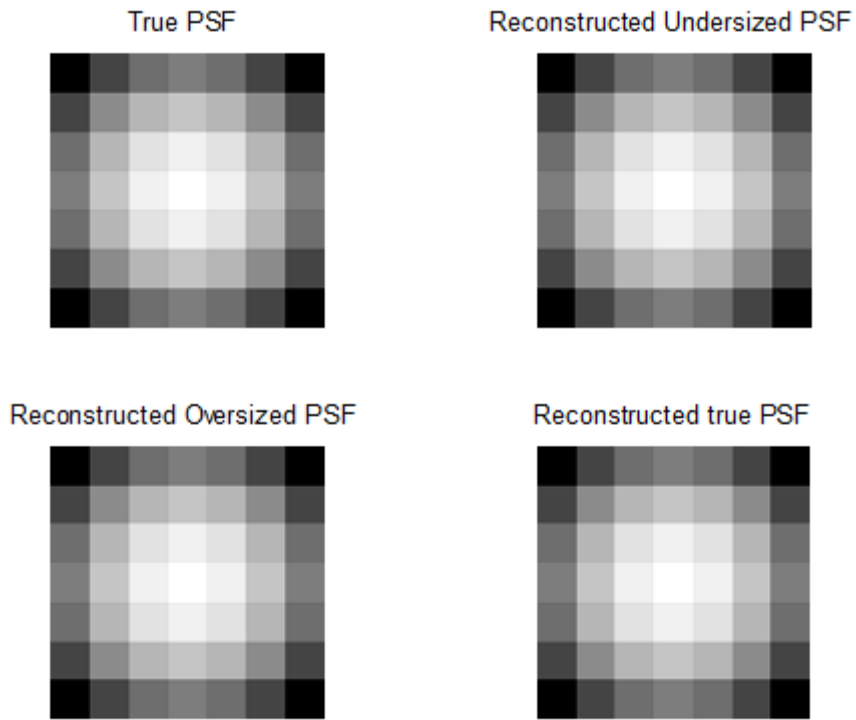Weight array
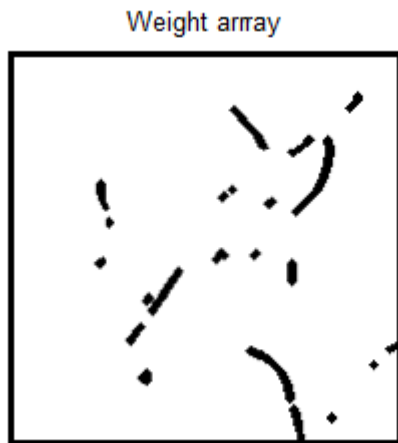
Deblurred Image



**Fig. 12 Weight Array**

**Fig. 13 Deblurred image**
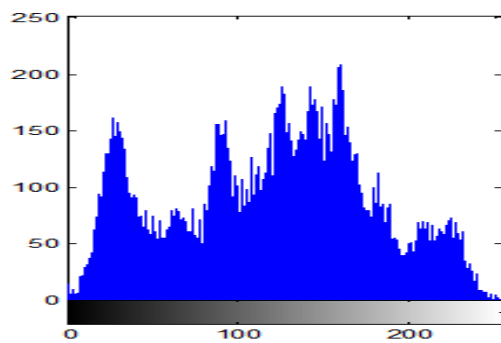


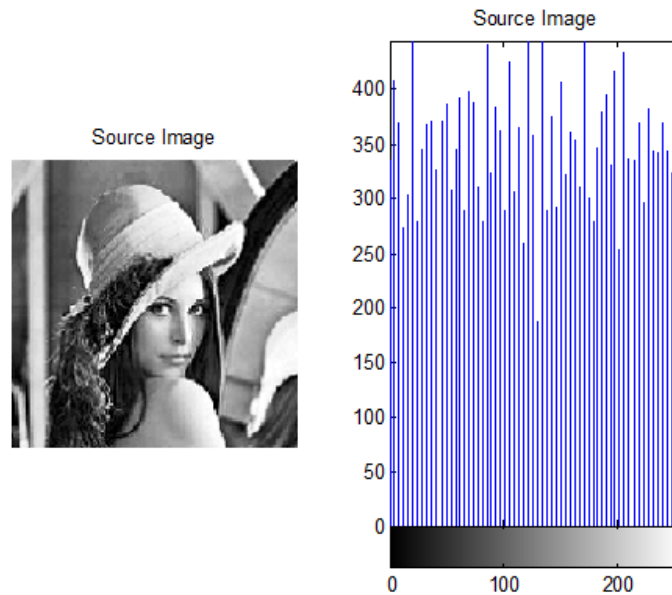**Fig. 14 Histogram of Image**

**Fig. 15 Result image**

| MSE | 30.5420 |
|------|---------|
| PSNR | 27. 7295 |

## CONCLUSION

In our research our main focuse on Gaussian blur suppression from images. A new two-step filter which uses a fuzzy detection and an iterative filtering algorithm has been presented and this filter is especially developed for reducing all kinds of blur. Its main feature is that it leaves the pixels which are noise-free unchanged. Experimental results show the feasibility of the new filter. Numerical measures such as PSNR and visual observations show convincing results for grayscale images.  But the filter does not give good result for the Gaussian blur. Finally, this new method is easy to implement and has a very low execution time. To conclude this thesis, following are some points that may lead to some better and interesting results. In this thesis, blur image detection is mostly covered and for noise filtration iterative filtering algorithm is used. Future scope of this dissertation could leads to better and more robust filtration techniques. This technique together with a best detection technique can result in optimal restoration of degraded image. As we know for gauusian blur this technique is not optimized. Development of parallel algorithms can also be done to counter attack the computational overhead.

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