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A Simple Fuzzy Method to Enhance Colour Images

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ABSTRACT: The term digital image refers to processing of a two dimensional picture by a digital computer. In a broader context, it implies digital processing of any two dimensional data. A digital image is an array of real or complex numbers represented by a finite number of bits. Noise reduction is an important block in the image pipeline. Noticing noise in an image is unpleasant. A good noise reduction method can reduce the noise level and preserve the detail of the image.In this work We propose a simple method to remove mixed impulse and Gaussian noise from color images which is based on fuzzy logic. According to our proposal, each image pixel is filtered only once using the same operation: a simple weighted average over the pixels in a filtering window

KEYWORDS: Impulse noise, Gaussian Noise, Fuzzy logic ,Image denoising and filtering of images.

I. INTRODUCTION

Digital images are often corrupted by noise during their acquisition and transmission. a fundamental problem in image processing is to effectively suppress noise while keeping intact the desired image features such as edges, textures, and fine details. in particular, two common sources of noise are the so called additive gaussian noise and impulse noise which are introduced during the acquisition and transmission processes, noisy images can be found in many today's imaging applications. tv images are corrupted because of atmospheric interference and imperfections in the image reception. noise is also introduced in digital artworks when scanning damaged surfaces of the originals. digital cameras ma introduces noise because of ccd sensor malfunction, electronic interference or flaws in data transmission. cdna microarray image data contains imperfections due to both source and detector noise in microarray technology, etc in the past years, many methods have been introduced in the literature to remove either gaussian or impulse noise. however, not all methods are able to deal with images which are simultaneously corrupted with a mixture of gaussian and impulse noise.

II. RELATED WORK

In [2] authors used a new partial differential equation based method is presented with a view to denoising images having textures. The proposed model combines a nonlinear anisotropic diffusion filter with recent harmonic analysis techniques. A wave atom shrinkage allied to detection by gradient technique is used to guide the diffusion process so as to smooth and maintain essential image characteristics. Two forcing terms are used to maintain and improve edges, boundaries and oscillatory features of an image having irregular details and texture. Experimental results show the performance of our model for texture preserving denoising when compared to recent methods in literature. In [1] The total variation based regularization method has been proven to be quite efficient for image restoration. However, the noise in the image is assumed to be Gaussian in the overwhelming majority of researches. In this paper, an extended ROF model is presented to restore image with non-Gaussian noise, in which the locations of the blurred pixels with high level noise are detected by a function and two estimated parameters of noise, while the fidelity and smoothness terms can be adaptively adjusted by updating these parameters. In contrast to the previous method, our model can give a much better restoration in some particular cases, such as the blurred image corrupted by impulsive noise and mixed

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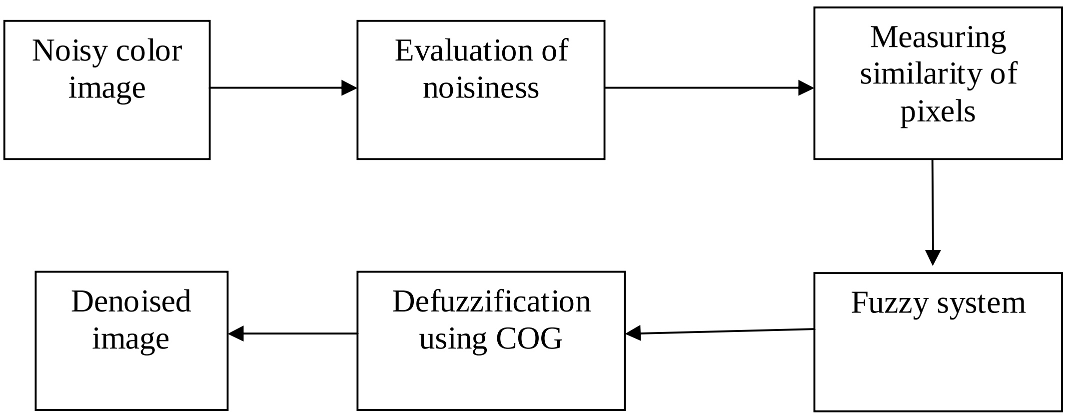
noise. Moreover, the proposed minimization problem is solved by the split Bregman iteration, which makes our algorithm very fast. We provide some experiments and comparisons with other methods to illustrate the high efficiency of our method.In [3] The problem addressed in this work is restoration of images that have several channels of information. We have studied color images so far, but hopefully the ideas presented here apply to other types of images with more than one channel. The suggested method is to use a probabilistic scheme which proved rather useful for image restoration and to incorporate into it an additional term which results in a better correlation between the color bands in the restored image. Results obtained so far are good; typically, there is a reduction of 20 to 40% in the mean square error, compared to standard restoration carried out separately on each color band. The contributions suggested in this work are the introduction of ''correlation terms,'' which augment ''standard'' regularization, and the process of choosing *two* regularization hyper parameters. Also, a relation between the algorithm suggested here and the recently introduced ideas of smoothing by diffusion in color space is explored.in [4] A partition-based adaptive vector filter is proposed for the restoration of corrupted digital color images. The novelty of the filter lies in its unique three-stage adaptive estimation. The local image structure is first estimated by a series of center-weighted reference filters. Then the distances between the observed central pixel and estimated references are utilized to classify the local inputs into one of preset structure partition cells. Finally, a weighted filtering operation, indexed by the partition cell, is applied to the estimated references in order to restore the central pixel value. The weighted filtering operation is optimized off-line for each partition cell to achieve the best tradeoff between noise suppression and structure preservation. Recursive filtering operation and recursive weight training are also investigated to further boost the restoration performance. The proposed filter has demonstrated satisfactory results in suppressing many distinct types of noise in natural color images. Noticeable performance gains are demonstrated over other prior-art methods in terms of standard objective measurements, the visual image quality and the computational complexity.

III. PROPOSED ALGORITHM

We propose a simple method to remove mixed impulse and Gaussian noise from color images which is based on fuzzy logic. According to our proposal, each image pixel is filtered only once using the same operation: a simple weighted average over the pixels in a filtering window. The adaptive nature of the method relays on how the weights involved are computed, for which we use a fuzzy-rule based system. This fuzzy system takes as input two sources of information on the pixels in the filtering window: (i) the degree of noisiness (from the impulsive point of view) computed using a statistical method and (ii) the degrees of similarity between the central pixel and the rest of the pixels in the window that is used for the filtering operation. From this information, the proposed method computes the weights that allow processing each pixel in an appropriate way, reducing the noise and preserving the image structures appropriately.

OVERALL DIAGRAM:



Block diagram for proposed system

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1. Evalution of noiseness:

we evaluate how noisy each image pixel is. So, we assign a certainty degree _(Fi) for the vague statement "Fi is noisy" to each Fi as follows. We order the pixels Fj in a window W′ centered at Fi which is also taken, for simplicity, of size n _ n in the way F(0);F(1);………. ;F(n2−1) according to a distance measure ρ, so that _(Fi;F(0)) <=(Fi;F(1)) <=…………<=(Fi;F(n2−1)), where obviously F(0) = Fi. As the distance measure ρ we use the metric L∞ given by

$$L_{\infty}(F_i, F_j) = \max\{|F_i^R - F_j^R|, |F_i^G - F_j^G|, |F_i^B - F_j^B|\}$$
$$ROD_s(F_i) = \sum_{j=0}^{s} L_{\infty}(F_i, F_j)$$

A low value of RODs(Fi) means that the selected s + 1 pixels F(j) in W′ are close to Fi which in turn means that Fi is expected to be noise-free. Moreover, higher values of RODs(Fi) indicate a higher noise degree for Fi, since no close pixels are found.
The vague statement is

$$\delta(F_i) = f(x) = \begin{cases} 0 & x \le k1 \\ \frac{x-k1}{k2-k1} & k1 < x < k2 \\ 1 & k2 \le x \end{cases}$$

2. Measuring of Similarities between the pixels:

In the second step we are interested in analyzing the similarity between the pixel under processing F0 and the rest of the pixels in the sliding window *W*. To measure the
Similarity between two pixels we now use the metric *L*1:

$$L_1(F_i, F_j) = |F_i^R - F_j^R| + |F_i^G - F_j^G| + |F_i^B - F_j^B|$$

The similarities observed, we will assign to certain selected pixels of W, denoted by Fi, a certainty degree in the vague statements: the similarity between Fi and F0 is "high", "medium" and "low", denoted by _H(F0;Fi), _M(F0;Fi) and _L(F0;Fi), respectively.
Using the distance L1(F0;Fj) between each pixel Fj of W and the pixel under processing F0 we introduce a new ordering for the n2 pixels of W in the ordered set W = {F0;F1; : : : ;Fn2−1g }.
To assign the certainty degrees of the three vague propositions above we perform as follows: we put x = L1 (F0;Fi) and we define _H(F0;Fi) = gH(x) by

Similarity is high

$$gH(x) = \begin{cases} 1 & x \le a \\ -\frac{x}{3a} + \frac{4}{3} & a < x < 4a \\ 0 & 4a \le x \end{cases}$$

Similarity is low

L(F0;Fi) = 1 -H(F0;Fi).

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Similarity is medium

$$gM(x) = \begin{cases} (x-a)/a & a < x < 2a \\ 1 & 2a \leq x < 3a \\ (4a-x)/a & 3a < x < 4a \\ 0 & elsewhere \end{cases}$$

3. FUZZY TECHNIQE

Fuzzy system and computation of weights:
To compute the weights involved in the filtering average operation we now use a fuzzy rule based system and fuzzy inference. The fuzzy system use the vague statements described in the previous subsections to decide whether each weight in (1) should be large, medium or small. Finally, defuzzification is used to obtain the particular value for each weight.
The objective of the rules in the fuzzy system can be summarized in two main ideas: (i) pixels that are noisy should be assigned to a small weight, and (ii) pixels that are noisefree can only be associated to a larger weight if either they are similar to the central pixel or if the central pixel is noisy. This latter idea, for the different cases to be found, is summarized in the following tree fuzzy rules:

1) IF (Fi is not noisy AND F0 is noisy AND the similarity between F0 and Fi is medium)
THEN wi is a medium weight

2) IF (Fi is not noisy AND F0 is noisy AND the similarity between Fi and F0 is low) OR (Fi is not noisy AND F0 is not noisy AND the similarity between Fi and F0 is high)
THEN wi is a large weight

3) IF (Fi is noisy) OR (Fi is not noisy AND F0 is noisy AND the similarity between Fi and F0 is high) OR (Fi is not noisy AND F0 is not noisy AND the similarity between Fi and F0 is medium) OR (Fi is not noisy AND F0 is not noisy AND the similarity between Fi and F0 is low)
THEN wi is a small weight

4. Defuzzification using COG

Now, for computing the certainty degree of the antecedents of the Fuzzy Rules, following the usual procedure in fuzzy logic, we apply the conjunction operation AND and the disjunction operation OR by means of a t-norm _ and its associated s-norm _′, respectively. In this paper we use the usual product as the t-norm and the probabilistic addition as the s-norm. The certainties of the antecedents are assigned to the consequents, and finally, by defuzzification.
Finally, defuzzification is used to obtain the particular value for each weight. We have used the centroide technique, or center of gravity (COG), which is the most popular defuzzification method.

5. Denoising

Replacing every pixel of the image by a pixel which is the weighted average within the certain selected pixels in window. Finally the noise removed image is obtained.
Taking the surface in each of the mentioned triangles and under each one of the three constant functions, respectively, three trapeziums are built. The poligonal line constituted by the tops and sides of these trapeziums determines a fuzzy set A on [0; 1] which is integrable in the Riemann (classical) sense.

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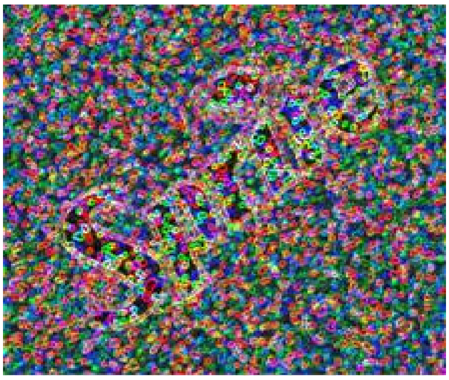
IV. SIMULATION RESULTS

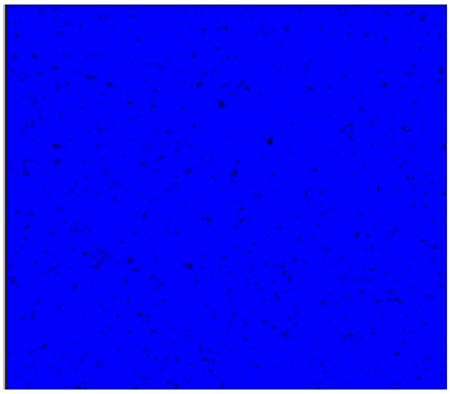
The simulation is done in matlab software .We used an image sprite as input to chek the functionality of the proposed fuzzy logic model , salt and pepper and Gaussian images ,ROD image ,fuzzy output images are produced as part of the simulation .After supplying the input image the noise image and the out put fuzzy image are produce so that there will be easy comparison of the results .

(a)

(b)

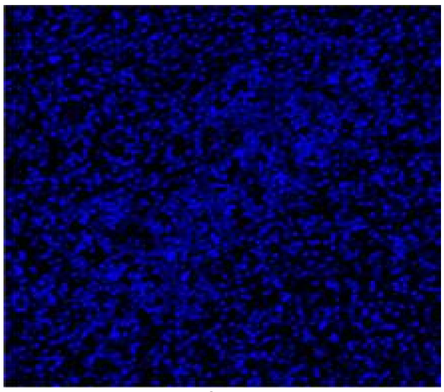


(c)



(d)

(e)



(f)

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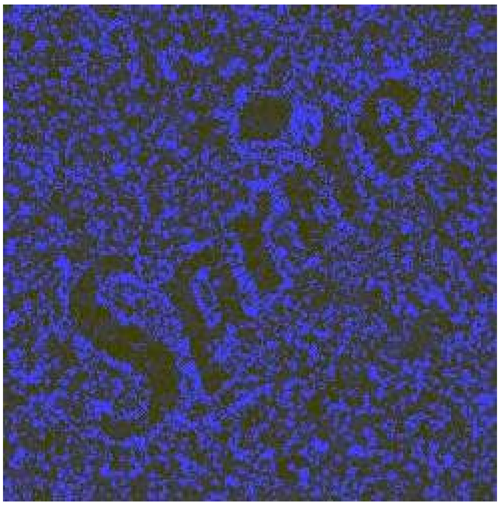

(a) Input image
(b) Noisy image
(c) ROD image
(d) Gaussian noise distance image
(e) Similarity low
(f) Similarity high
(g) Similarity medium
(h) Output image

V. CONCLUSION AND FUTURE WORK

We propose a simple and effective fuzzy method to reduce Gaussian and impulsive noise from color images. The method uses one only filtering operation, a weighted averaging, which uses a set of weights Computed by a fuzzy rule system. In turn, the fuzzy rule system uses two sources of information on the Pixels in each filtering window: (i) their degrees of noisiness (from the impulsive point of view) computed Using a statistical method, and (ii) the degrees of similarity between the central pixel and the rest of the pixels in the window.

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