Image enhancement Using Intuitionistic Fuzzy Reconstruction

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Abstract : Image improvement is the fundamental stage for pre-processing of digital images which alters an image to makes clearer to human observers. Many of the image segments are vague in nature due to lots of uncertainties are present. Fuzzy intuitionistic can work with image for image analysis. Fuzzy enhancement is a preprocessing method which improves the brightness of the image. This paper proposes a novel image enhancement method using fuzzy morphological intuitionistic reconstruction function.

Key words: fuzzy, enhancement, morphology, reconstruction.

I. INTRODUCTION

The image quality is an important factor for the human vision point of view. The image usually has noise which is not easily eliminated in image processing. Image enhancement can be treated as transforming one image to another so that the look alters an image to makes its meaning clearer to human observers [1] . Enhancement of noisy image data is a very challenging issue in research and application fields. One of the most widely used algorithms for image enhancement is global histogram equalization [2], which adjusts the intensity histogram to approximate a uniform distribution. The main disadvantage of global histogram equalization is that the global image properties may not be appropriately applied in a local context. Global stretching and histogram equalization techniques do not always produce good results, especially for images with large spatial variation in contrast. In order to address the problem, a good number of local contrast enhancement methods have been proposed. These techniques can be divided into three broad categories:

(a) Spatial (multi-scale) domain methods, which operate directly on pixels.

(b) Frequency (multi-resolution) domain methods, which operate on the Fourier transform of an image. (c) Fuzzy domain methods, which involves the use of knowledge-base systems that are capable of mimicking the behavior of a human expert.

The nature of this ambiguity (fuzziness) in the image arises due to the uncertainty present [3, 4]. When the regions of an image are ill defined, it is appropriate to use fuzzy domain method .Fuzzy logic provides a good mathematical framework to deal with uncertainty of information [3,5]. Fuzzy techniques have already been applied in several domains of image processing filtering, interpolation [6], and morphology [7]. A gray tone picture possesses inherent vagueness and ambiguity due to variable lighting conditions of the object. So intuitionistic fuzzy set theory is introduced into image processing. The concept of intuitionistic fuzzy sets (IFS) proposed by Atanassov[8] in 1986 is found to be highly useful to deal with vagueness. The major advantage of IFS over fuzzy set is that IFSs separate the degree of membership and the degree of non membership of an element in the set.

Membership function is user defined and it may be Gaussian, triangular, Gamma membership function or any other. So there is some hesitation while defining the membership function .Attanassov.s intuitionistic**[9]** fuzzy set define two values, one is membership values μ and another is non-membership values V of the elements of a set. $\{x, \mu_A(x), V_A(x) / x \in X\}$

Where, $\mu_A(x) \rightarrow [0,1], V_A(x)) \rightarrow [0,1]$ with the condition $0 \leq \mu_A(x) + V_A(x) \leq 1$ where, $\mu_A(x)$ and $V_A(x)$ are themembership and nonmembership degrees of an element x to the set A.

For all intuitionistic fuzzy sets, Attanassov**[9]** also indicated an hesitation degree $\prod_A(x)$ which arises due to lack of knowledge about the membership degree, of each element x in A and is given by: $\prod_A(x) = 1 - \mu_A(x) - V_A(x)$ Obviously, $0 \leq \prod_A(x) \leq 1$.

In the present work, fuzzy morphological image processing is described. Based on the mathematical morphology rules, fuzzy sets and fuzzy logic theorem, fuzzy morphology operations are defined. In general, mathematical morphology operation definitions have similar structures as that of set theory and set operations definitions. For this reason fuzzy set theory is easily applied to the mathematical morphology. Since the gray scale images are discrete structures having 1 and 0 sets, fuzzification process can be a good application for transforming the discrete set to the fuzzy set. In the present study, a gray scale image is fuzzified with modified membership functions. Basic mathematical fuzzy morphology operations like "EROSION" , "DILATION", 'OPEN' and 'CLOSE' are implemented and inspected via the fuzzy membership functions. So in this paper fuzzy mathematical morphology with of intuitionistic fuzzy set applied to enhance the images.

The organization of the paper is as follows. Literature survey of different methods are described in Section 2 and Fuzzy image processing methods are introduced in Section 3. The proposed algorithm is described in Section 4 and we have compared the fuzzy intuitionistic simulation results with that of the fuzzy methods in Section 5. At the end, conclusions and future prospects of the works are presented in Section 6.

II. LITERATURE SURVEY

Many methods are there for removing noise from images. Cheng and Xu [10] applied heuristic knowledge to build fuzzy rule based operators for smoothing, sharpening and edge detection. They can perform smoothing efficiently but not in brightness.Cheng and Chen [11] used a powerful robust approach to image enhancement based on fuzzy logic approach, which can remove impulse noise, smoothing out non-impulse noise, and preserve edge well . Laxmikant Dash and Chatterji [12], shown that direct contrast enhancement method enhance the image by measuring the contrast. However, over enhancement and under-enhancement occur sometimes due to uncertainty. Pal and King [4] used contrast intensification operations for smoothing images. Histogram hyperbolization proposed by Tizhoosh [13] is also an approach to image enhancement. Fuzzy IF-THEN rules use the concept of INT operation that Fuzzification is done that dark pixels become darker and bright pixels become brighter. Szmidit [14] presented a similarity measure of IFSs for supporting medical diagnostic reasoning. Later, Huang [15] also presented a similarity measure of IFSs based on Hausdorff distance metric and applied it to pattern recognition Cornelis [16] revised sinha's axiom, and proposed an inclusion for intuitionistic fuzzy set. Bustince [17] investigated the inclusion grade for interval-valued fuzzy sets. Intuitionistic fuzzy contrast enhancement is also suggested by Vlachos [18] where intuitionistic fuzzy entropy is used. In this paper, a novel idea is presented using intuitionistic fuzzy set theory to increase the contrast of images. The algorithm is tested on several images and the results are found to be quite better.

III. FUZZY IMAGE MORPHOLOGY

Fuzzy image processing is a collection of different fuzzy approaches to image processing that represent and process the imaages.It has three main stages, namely image fuzzification, modification of membership values, and image defuzzification. The main Power of fuzzy image processing lies in the membership plane, as shown in Figure 1.

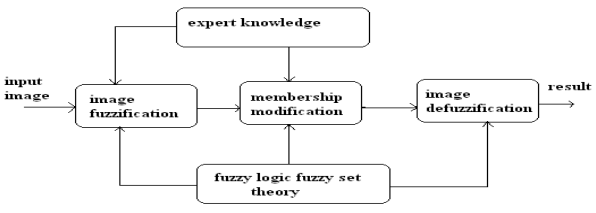

Fig.1

Fuzzy image Morphology is a mathematical framework for the analysis of spatial structures and is based on set theory. It is a strong tool for performing many image processing tasks. Mathematical morphology is completely based on set theory[20]. Morphological sets represent important value. By using set operations many useful operators can be defined. The important morphological operations are basically dilation, erosion, open and close operations. Then dilation, an increasing transformation, is defined as

$B \oplus M = \cup_{x \epsilon B} M(x)$,

Whereas, erosion, a decreasing transformation, is defined as

$B \ominus M = \{x | M(x) \subseteq B\}$.

In the same manner, opening and closing of set B by structuring element M are respectively defined as

$B \circ M = ((B \ominus M) \oplus M)$,

And $B \bullet M = ((B \oplus M) \ominus M)$.

IV. PROPOSED WORK

In this section, enhancement method for the images using intuitionistic fuzzy set is described. The image is considered fuzzy and so gray levels are imprecise.Next task is to compute membership and non membership degrees to create an intuitionistic fuzzy image.

Step1: Read the original image.

Step2: Fuzzify the input image with the membership function $r = \frac{d - mn}{mx - mn}$

Where d=double (image), mn=min (min (image)), mx=max (max (image)).

Step 3: Define structure element, strel('disk',15);

Step 4:Apply OPEN operation to the fuzzify image.

Step 5:Use TOP HAT function to enhance the image.

Step 6: Sugeno type intuitionistic fuzzy generator [21] applied in fuzzy top hat image is follows as:

$Sr = \frac{1-t}{1+\lambda t}$

Where t=top hat image and Sr is the Sugeno type intuitionistic fuzzy generator is used for finding the non-membership function. In the experiment, λ , = 1 is used. Because, as, increases, the fuzzy complement or the Sugeno generator will decrease thereby the non-membership value will decrease and the hesitation degree will increase.

Step 7: Find hesitation degree of the window is written as Hr=1-r-Sr

Step 8: Calculate mean of image g=mean (mean(r)).

Step 9: Finally the modified membership value is written as:

$\mu = r-(g*Hr)$.

V. EXPERIMENTAL RESULTS AND DISCUSSION

Experiments are performed on several images such as rice images and human image. The proposed method is compared with fuzzy method. First, RICE image is processed. The main image is shown in Fig. 2. The fuzzy smoothed image shown in Fig. 3. Finally, the image extracted by the proposed algorithm is shown in Fig 4. As the Figure shown, the proposed algorithm detects much more enhanced, and superiority of the proposed algorithm is clear. In the present scheme, fuzzy intuitionistic morphology operations are performed with the help of fuzzy membership functions.

Fig. 5 is an image of a human of size 255*255. Fuzzy enhanced image in Fig. 6 contains enhanced with dark background. Proposed fuzzy proposed intuitionistic method Fig. 7 produces bright background.

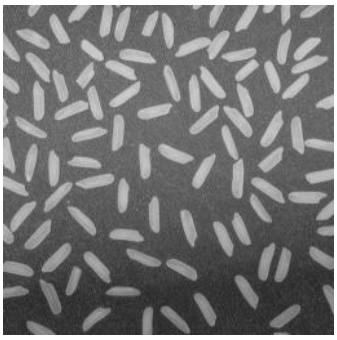

Fig.2 (original rice image)

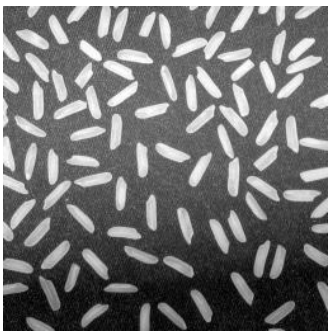

Fig.3 (fuzzy rice image)

Fig.4 (proposed fuzzy intuitionistic rice image**)**

Fig.5 (original human image)

Fig.6 (fuzzy human image**)**

Fig.7 (proposed fuzzy intuitionistic human image**)**

VI. CONCLUSION

This paper presents a new a novel approach using intuitionistic fuzzy set based enhanced technique to enhance the image. It uses Sugeno type intuitionistic fuzzy generator to create an intuitionistic fuzzy image. Experimental results show the ability and high performance of proposed algorithm **.**Fuzzy set and fuzzy logic theory is a new research area for defining new algorithms and solutions in the mathematical morphology environment.

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