Image Enhancement using Fuzzy Set Theory

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ABSTRACT

Image processing techniques becomes common in the medical diagnostics like radiology, tomography, emission tomography and etc. These instruments use electromagnetic signals like X-Rays, Gamma Rays, and Magnetic Values for analyzing the results of the patients. These images help in predicting the severity of the concerns. In such cases the appearance of the images predicts the severity. An image enhancement technique increases the appearance of the images either by increasing the several features like Intensity, Sharpness, Contrast and etc. or by decreasing the impulse noise in the images. Several techniques are adopted to increase the appearance of the images. Some of common method increases the intensity are Nonlinear Dynamic Range Adjustment (NDRA), Variation High-Order Derivatives (Variation-HOD), Histogram Equalization, Intensity Histogram Equalization (IHE), Fuzzy Techniques. Fuzzy techniques manage the undefined and imperfect images in smoother way using the fuzzy set values. This paper focuses on the contrast enhancement using the Fuzzy set Theory. Three steps are followed in enhancing the images using fuzzy set theory. They are encoding, modification and decoding. The image data are encoded in the first part, encoded data (pixels values) is further modified using the fuzzy techniques where the enhancement is improved and finally undergoes the decoding process which leads to an enhanced image.

1. Introduction

In the current scenario, processing the image becomes the essential part of the human life. Many medical images like MRI images, CT images is not able to predict the severity of the deceases. Henceforth, many image improvement techniques tries to improve with different facts.

A novel method [1] that enhances the edges of medical image followed by edge detection using intuitionistic fuzzy set theory is suggested. Edge enhancement helps in recovering the structures in the image that are not properly visible. It initially creates an intuitionistic fuzzy image and then calculates the optimal value of the parameter in the membership and non-membership degree using intuitionistic fuzzy entropy. It then computes the total variation of the image pixel with respect to the central pixel of the median filter. This enhanced image is then

edge detected for obtaining a clear boundary of the cells and also increases the accuracy while counting the number of the cells or blood vessels or segmenting abnormal lesions and so on.

In electron tomography the reconstructed density function [2] is typically corrupted by noise and artifacts. Under those conditions, separating the meaningful regions of the reconstructed density function is not trivial. Despite development efforts that specifically target electron tomography manual segmentation continues to be the preferred method. Based on previous good experiences using a segmentation based on fuzzy logic principles (*fuzzy segmentation*) where the reconstructed density functions also have low signal-to-noise ratio, we applied it to electron tomographic reconstructions. We demonstrate the usefulness of the fuzzy segmentation algorithm evaluating it within the limits of segmenting electron tomograms of selectively stained, plastic embedded spiny dendrites. The results produced by the fuzzy segmentation algorithm within the framework presented are encouraging.

A novel approach to enhance medical images using Type II Fuzzy set [3] to increase the contrast of the medical images. Hamacher T co norm is used as an aggregation operator to form a new membership function using upper and lower membership function of Type II fuzzy set. To show the efficacy of the proposed method, the proposed method is compared with non fuzzy, fuzzy, intuitionistic fuzzy, and existing Type II fuzzy methods and the results using the proposed method are found to be better. Also, to show the advantage of the proposed image enhancement scheme, enhanced images are segmented to detect or extract abnormal lesions or blood vessels. Segmented images on the proposed enhancement method are observed to be better as compared to the segmented images using other existing enhancement algorithms.

2. Fuzzy set Theory

Knowledge-based systems support decisions by knowledge base and an inference engine. The knowledge base systems are the expert knowledge. There are different ways to acquire and store expert knowledge. The most frequently used way to store this knowledge are if–then rules. These are then considered as ‘logical’ statements, which are processed in the inference engine to derive a conclusion or decision. Generally, these systems are called ‘expert systems’. Classical expert systems processed the truth values of the statements.

Human visual system is perfectly adapted to handle uncertain information in both data and knowledge. It will be hard to define quantitatively how an object, such as a car, has to look in terms of geometrical primitives with exact shapes, dimensions and colors. A descriptive language is used to define features that eventually are subject to a wide range of variations.

The fuzzy set function (1) works on the each pixel point and which enhances the images from the denoised image.

$$\mu_a = X \rightarrow [0,1] \qquad (1)$$

where [0,1] means real numbers between 0 and 1 (including 0 and 1).

3. Conclusion:

Image processing techniques becomes common in the medical diagnostics like radiology, tomography, emission tomography and etc. These instruments use electromagnetic signals like X-Rays, Gamma Rays, and Magnetic Values for analyzing the results of the patients. These images help in predicting the severity of the concerns. In such cases the appearance of the images predicts the severity. An image enhancement technique increases the appearance of the images either by increasing the several features like Intensity, Sharpness, Contrast and etc. or by decreasing the impulse noise in the images. The fuzzy set theory is used to enhance the images in an efficient way.

References

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