Chapter 69
Intuitionistic Fuzzy Filters for Noise Removal in Images

C. Radhika
Vellallar College for Women, India

R. Parvathi
Vellallar College for Women, India

N. Karthikeyani Visalakshi
Kongu Engineering College, India

ABSTRACT

Image processing is any form of information processing in which both input and output are images. Most of the image processing involves in treating the image as two dimensional representations and applying standard techniques to it. Images contain lot of uncertainties and are fuzzy/vague in nature. Various fuzzy filtering techniques are defined for noise removal in image processing and these existing filters helps to enhance the image using only the membership values. Further, by incorporating intuitionistic fuzzy filters, vagueness and ambiguity are managed by taking the non-membership values also into consideration. In this paper, light is thrown on some important types of noise and a comparative analysis is done. This paper also presents the results of applying different noise types to an image and investigates the results of various intuitionistic fuzzy filtering techniques. A comparison is made on the results of all the techniques.

1. INTRODUCTION

Digital image processing is a technique of enhancing the images which are prone to noise. Noise is the undesirable effect that contaminates an image, which is the result of errors in the image acquisition process, that result in pixel values not reflecting the true nature of the scene. During image acquisition or transmission, several factors are responsible for introducing noise in the image which affects the accuracy of the results. Depending on the type of disturbance, the noise can affect the image to different extent. The main objective of processing an image is to extract clear information from the images corrupted by

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noise. Such technique for noise removal is called filtering or denoising. Denoising by appropriate filters increases the brightness and contrast and wide variety of special effects to an image. In order to get a noise free image, several linear and non linear filtering techniques are used.

Fuzzy set, introduced by Zadeh (1965), provide a tool to deal theory of imprecision. In recent years, many fuzzy filters have been developed to give better results than traditional filters in noise removal. In literature, there are several other authors Mike Natchtegael, Dimitri Van de Ville, Etinne E. Kerre were working on fuzzy filters and on its extension. There is another way of generalization where fuzzy sets are generalized into intuitionistic fuzzy sets by taking into account non- membership values in addition to membership values. Among extensions of FSs, Atanassov's (1999) IFSs deal vagueness from imprecise information.

In this paper, statistical tools for data in intuitionistic fuzzy environment are defined which are helpful in designing IF filtering algorithm in image processing. This paper is an initiation to model the vagueness associated with the image which will find applications in noise removal in image processing.

1.1 Literature Review

Now-a day, researches are going in filtering technique from non-fuzzy to fuzzy. Gonzalez (1998) has defined traditional statistical filters in digital image processing.

Mike Natchtegael, Dimitri Van de Ville, Etinne E. Kerre (2003), Russo (1996) were working on fuzzy filters and on its extension. Nguyen and Berlin Wu defined new statistical approach for fuzzy data (2006). Ioannis et.al (2005) initiated an attempt towards intuitionistic fuzzy image processing and presented an intuitive approach for intuitionistic fuzzification of images. Moreover, an issue of applying the theory of IFSs in the field of image processing is discussed, which is the first stage of IF image processing.

Ioannis and George (2005) have worked on IF contrast enhancement. Tamalika Chaira (2008) have proposed a new method for IF segmentation and edge detection of medical images. Parvathi, et. al (2005) have developed an algorithm on intuitionistic fuzzy approach for image enhancement using contrast intensification operator. Also some attempt was made to define theoretical concepts in IF statistical tools for filters by Parvathi, et. al (2012), which is an initiative to define theoretical concepts.

The remaining part of the paper is organized as follows. Section 2 gives basic definitions of IFS operators. Section 3 deals about the framework of intuitionistic fuzzy image processing (IFIP) and Section 4 describes intuitionistic fuzzy filters in image processing with the proposed algorithm. The results and performance analysis are discussed in Section 5. Section 6 concludes the paper.

1.2 Types of Noise

Noise is an unwanted effect produced in an image. It degrades the image to different extend during image acquisition or transmission. A noisy image can be modeled as follows (Gonzalez, 1998):

$$C\left(X,Y\right) = A\left(X,Y\right) + B\left(X,Y\right)$$

where *A(X,Y)* is the original image and *B(X,Y)* is the noise in the image and *C(X,Y)* is the resulting noise image. To remove different types of noise, different filtering techniques are applied. Various types of noise in an image are discussed below.