Noise Reduction in Color image using Interval Type-2 Fuzzy Filter (IT2FF)

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Abstract:
Reducing noise from the images is a very active research area in image processing. In this paper, a new interval type-2 fuzzy based color image filtering algorithm is proposed for reducing additive noise. The proposed Interval Type-2 Fuzzy Filter (IT2FF) consists of two sub filters. The first sub filter computes the distance between the color components of the central pixel and its neighborhood, which determines the degree by which each component should be corrected. The second sub filter computes the local difference with in the color component. Simulation results shows that the proposed filter IT2FF effectively removes the additive noise by preserving fine details in the image.

Keywords: Interval Type-2 fuzzy, Noise reduction, KM algorithm.

1. Introduction:

Image restoration is a major research area in image processing. Images can become corrupted during any of the phase take acquisition, pre-processing, compression, transmission, storage and/or reproduction phases of the processing [1]. Noise reduction is a preprocessing step in image enhancement. Last one decade research in the image restoration of noise affected image into original image is going on. Image detail preservation and impulse noise attenuation are difficult to achieve simultaneously in the area of image restoration design. The types of the noise are: additive and multiplicative. The major category in additive noise is Impulsive noise and Gaussian noise. Speckle noise is the multiplicative noise.

Generally the noise reduction process has two phases. The first phase is called noise detection, which is used to identify whether the pixels are corrupted by noise or not. The second phase is noise reduction. Before applying the filter, the identified pixel is discriminated by either the pixel is noise or image fine details like edge, texture, color, etc. Then the noise affected pixel is replaced by the filter value. Almost all noise reduction algorithms are executed in two steps, i) detect the corrupted pixels and ii) correct the pixels by replacing the filter estimated values.

A digital color image [10] (denoted as C) can be modeled in certain color space (e.g., RGB, HSV, L*a*b*). As in most applications, the RGB color space is used here as basic color space. By mixing red, green, and blue light in different proportions it is possible to obtain a wide range of colors. For that reason, colors in the RGB model are represented by a 3-D vector, with the first element being the red, the second being the green and the third being the blue, respectively. These pigments are called the three primary components, each quantized to the range [0-2m-1] mostly m=8. In practice, a digital color image can be represented by a 2-D array of vectors where an address defines a position, called a pixel or picture element. If C(i,j,1)denotes the red component, C(i,j,2) the green component and C(i,j,3) the blue component of a pixel at a position in an (noise-free) image, then we can denote the noisy color image N at position (i,j) as follows:
[N(i,j,1) N(i,j,2) N(i,j,3)]=[(C(i,j,1)+n1) (C(i,j,2)+n2) (C(i,j,3)+n3)].

In [2], Type-1 fuzzy set (T1 FS) theory was first introduced by Zadeh in 1965 and has been successfully applied in many areas, including image processing, modeling and control, data mining, time-series prediction, etc. An example of a T1 FS is shown in Fig.1