



## Use of Fuzzy Logic in Various Applications of Digital Image Processing

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**Abstract**— This paper explains the use of fuzzy logic in image processing . Various applications of image processing have been discussed where fuzzy logic has been used . The use of fuzzy logic has increased the application of image processing many fold. Image information and image concept models incorporate uncertainty. Fuzzy logic represents a good mathematical framework to deal with this uncertainty of information. It is the collection of all approaches that understand, represent and process images, their segments and features as fuzzy sets .The representation and processing depend on the selected fuzzy technique and on the problem to be solved. In this paper we have tried to show that how fuzzy sets can be applied to the various parameters of images and then these fuzzified images can be used in various applications. This methodology is generated to manipulate uncertainty in image concepts like brightness, edges and geometric features. This methodology can be used in numerous fields like medical, textile industries, detection of defects in various objects etc.

**Keywords**— Fuzzification, Defuzzification, Crisp Set, Dermascopy Images, Neural Networks

### I. INTRODUCTION

Fuzzy Image Processing is the collection of all approaches that understand, represent and process images, their segments and features as fuzzy sets. The representation and processing depend on the selected fuzzy technique and on the problem to be solved. [1] The coding of image data (fuzzification) and decoding of the results (defuzzification) are steps that make possible to process images with fuzzy techniques. The main power of fuzzy image processing is in the modification of membership values. After the image data are transformed from gray-level plane to the membership plane (fuzzification), appropriate fuzzy techniques modify the membership values. [2] Fuzzy image processing has three main stages: image fuzzification, modification of membership values and if necessary image defuzzification. [3]

The advantages of using fuzzy logic in image processing are as follows: [4]

1. Fuzzy Logic overcomes the requirement of special features of pattern description used in various algorithms.
2. Fuzzy Logic allows Easy inclusion of human intentions in process of algorithm goal formulation.
3. Fuzzy Logic provides good output even if the image is blurred.
4. Fuzzy Logic easily manages the grayness ambiguity.

### II. Applications of Image Processing Using Fuzzy Logic

The various applications of fuzzy logic in image processing are as follows:

#### A. Dermatology

In dermatology, Fuzzy Logic can be applied to the demascopy images. This can be used in diagnosis of various skin diseases. The fuzzy based homogeneity measure makes a reliable fusion of the colour features and the texture features of the dermascopy images to properly segment the image and makes it easy for the doctor to analyze the image. [5] The flowchart used for segmentation of dermascopy image is shown in figure 1.

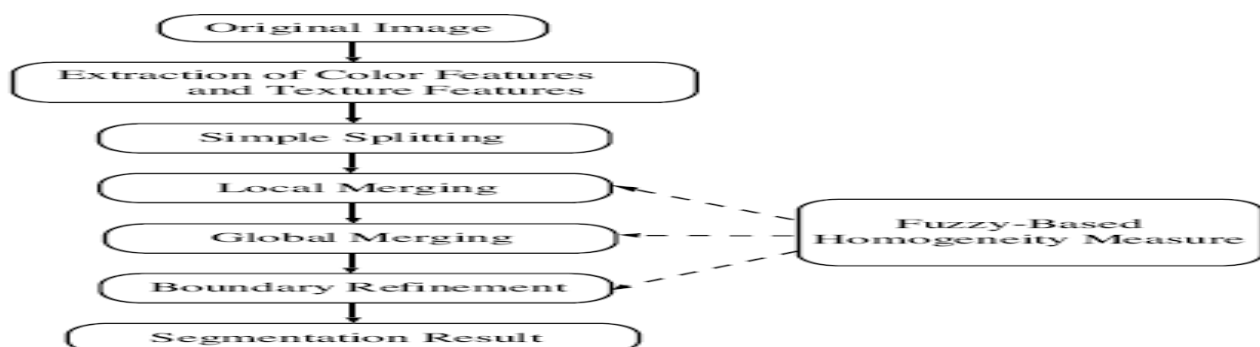


Figure.1: Flowchart for segmentation of dermascopy images. [5]

**B. Textile Industries**

In Textile industry, Fuzzy Logic can be applied to the images of the fabric. This can be used for various purposes like analyzing the quality of the fabric, detection of defects in the fabric etc. The fuzzy approach will not only detect the defect in the fabric but will also tell its position. [6] Simulation experiments show that the fuzzy method can achieve a robust and accurate detection of fabric defects. The block diagram of fuzzification applied to fabric is shown in figure 2.

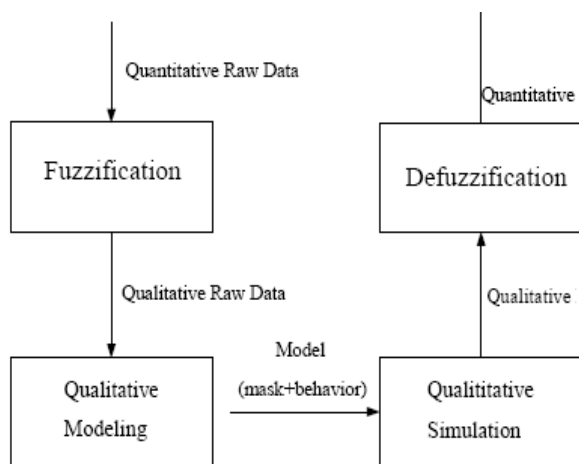


Figure 2 : Block Diagram Showing Fabric Fuzzification [6]

**C. Edge Detection**

Fuzzy logic can be used in identifying the edges in an image. The edge strength values used as fuzzy system inputs can be fuzzified using Gaussian membership functions. Fuzzy if then rules are applied to modify the membership to one of low, medium, or high classes. Finally, Mamdani defuzzifier method is applied to produce the final edge image. The simulation results, show that the fuzzy is far less computationally expensive, its application on the image improve the quality of edges as much as possible.[7] This edge detection is suitable for applications in various areas of digital image processing such as face recognition, fingerprint identification, remote sensing and medical imaging where boundaries of specific regions need to be determined for further image analysis.

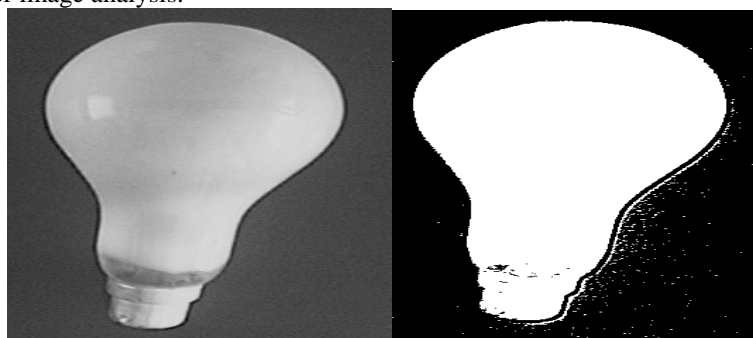


Figure 3(a) : Original Image

Figure 3(b) : After Fuzzy Edge Detection [7]

**D. Diagonosis of X Ray Images**

Since the X-ray images contain sensory noise and objects in X-ray images are often distorted by various effects such as uneven lighting classical image processing techniques and methods based on ordinary crisp set theory are poor at detecting small low contrast objects. Therefore fuzzy logic can be used to alter the image by using local image characteristics. [8] This approach can be used to detect internal weld defects from radiographic films which are taken from steel.

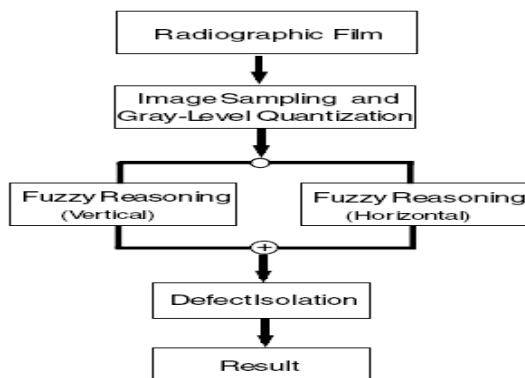


Figure 4: Flow Chart for Detection [8]

### E. ARTIFICIAL NEURAL NETWORKS

When fuzzy logic is applied to artificial neural network, the system becomes more efficient as it utilizes the advantages of both the fuzzy logic and the neural networks. The use of neuro fuzzy logic helps in efficient segmentation of the images which can be used to extract information from various images.[9] The block diagram showing fuzzy neuro logic is shown in figure 5.

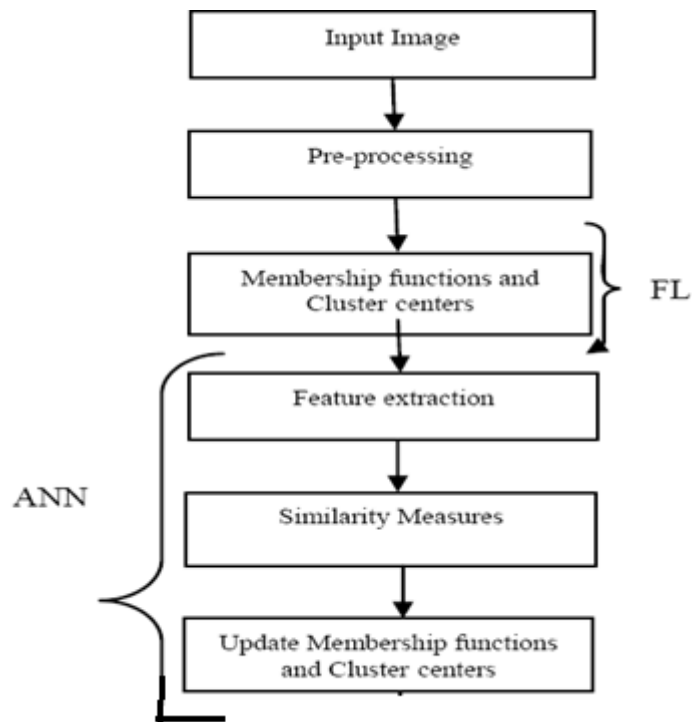


Figure 5 : Flow Chart of Neuro Fuzzy Logic [9]

## II. WOOD INDUSTRY

### F. Wood Industry

Wood defects influence on the wood production quality. Image Processing of wood defects is important for wood defects detection. The collected images with defects can be processed by using fuzzy logic. First the images can be segmented properly by using some morphological tool and then various features can be extracted from that segmented image then those features can be fuzzified and used in defect detection. The experimental results show that the results of image processing can recognize wood defects effectively. It will not only provide reliable evidences for features extraction of wood defects, but also it lays a foundation for automatic detection. [10] It is helpful for wood reasonable selection and scientific utilization. The results show that the wood defects images after image processing are recognized easily.

### III. Conclusion

It has been concluded that use of fuzzy logic has simplified image processing to a great extent and has made image processing applicable in various fields like medical, electronics, textile industries etc. The various parameters of the image can be easily modified by using Fuzzy Logic.

### Future Work

Detection of defects can be done more accurately. More parameters of image need to be used in order to improve the performance of the system. Then the system will be able to work well even with noise affected images. Using different parameters of an image in the fuzzy rule base will provide better defect detection which will work accurately on 2D and 3D images.

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