© 2014 IJEDR | Volume 2, Issue 3 | ISSN: 2321-9939

Image Quality Assessment based on Fuzzy Logic

[1]Baljinder , [2]Anuj Mehta

[1]Research Scholar, [2]Assistant Professor
SKIET, Department of Computer Science & Engineering
Kurukshetra University

***Abstract* - This paper presents algorithm for image quality assessment based on fuzzy logic. First, a simple model of human visual system, consisting of a nonlinear function and a 2-D filter, processes the input evaluates detail losses and additive impairments for image quality assessment. The detail loss refers to the loss of useful visual information which affects the content visibility, and the additive impairment represents the redundant visual information whose appearance in the test image will distract viewer's attention from the useful contents causing unpleasant viewing experience.. Noise is usually quantified by the percentage of pixels which are corrupted. Corrupted pixels are either set to the maximum value or have single bits flipped over. So the main objective of this dissertation work is to get almost an actual image from the corrupted image and then finding the fine edges in the image using fuzzy logic.**

***Keywords* - Image Quality Assessment, HVS Model, Image Noise, Fuzzy**

I. INTRODUCTION

Image quality assessment can be divided into two groups: subjective and objective. The only subjective measure is mean opinion score (MOS) where quality of an image is judged by several individuals and then the men value of their scores is used as the measure. Since human observer is ultimate receiver of the information contained in an image, this is the best way to assess image quality.

The HVS value can be computed on a block-by-block basis for the processed input images. Finally, the denoising images are there of different parameters and then we select the best image of one parameter by the use of fuzzy logic. The original image is taken then denoising with the different noises now we take one by one noise to denoise it by various filters with different parameters. After that we chose the best filter of some parameter that is suitable for denoising the image by the fuzzy logic technique. Objective measures try to assess image quality and express it as a number. The goal in developing objective (quantitative) measures is to find the one that correlates well with image quality as perceived by human visual system (HVS). These measures are used to assess Quality of different algorithms for image enhancement and coding.

Quality measures can also be used to optimize image processing algorithms. For example in image coding the goal is to represent images with as few bits as possible with the minimal loss of image quality. Quality measure is used as a criterion in a sense that the bits that contribute more significantly to the used quality measure are coded first. There are various measure elements of the quality of image in the measurement of image. In the image quality the measure of image can be taken as the index of measure. There are various measures such as mean squared to error, peak signal noise to ratio. The quality of image is taken as the parameters of image to error. These are also called image quality metrics. The original image is taken then denoising with the different noises now we take one by one noise to denoise it by various filters with different parameters. After that we chose the best filter of some parameter that is suitable for denoising the image by the fuzzy logic technique.

II. HVS MODEL

Digital images are represented using a finite number of intensity levels. For example, gray scale images with 8 bits/pixel are represented by 256 intensity levels, where 0 corresponds to the darkest level and 255 corresponds to the brightest level. Intensities between these two extremes represent various shades of gray level. Brightness perceived by HVS is not a linear function of intensity represented by integers from 0 to 255. This can be shown by the following experiment. First we create an image which consists of uniform background of intensity I and a small square in the center of intensity I+ I, and then we repeat this for different values of background intensity I while keeping I constant. When the background intensity is very low (for example I=10) or very high (I=240) the difference in perceived brightness is between the background and the center square is smaller than in the case when the background intensity is in the mid range (I=125). Since the intensity difference between the background and the center square is the same in each case, perceived brightness must be a nonlinear function of intensity. In other words equal increases in intensity do not correspond to equal increases in perceived brightness. This phenomenon is well known but it is very difficult to model it because we do not know how to measure perceived brightness. Usually, this is modeled by transforming input intensities by some nonlinear function, such as logarithmic or cube root function. If we denote perceived brightness by B and input intensity by I, then by using logarithmic function they are related as:

$$B = K \log I \qquad (1)$$

Where K is a constant. This is known as Weber's law and is cited in many books on image processing (for example [4] and [8]). The second formula, which is used in [9], is obtained using cube root function:

$B = K(I)^{0.33}$ (2)

$$B = \begin{cases} \frac{B_{MAX}}{2}\left(\frac{2I}{I_{MAX}}\right)^{2.5} & \text{if } 0 < I < I_{MAX}/2 \\ B_{MAX} - \frac{B_{MAX}}{2}\left(\frac{2(I_{MAX}-I)}{I_{MAX}}\right)^{2.5} & \text{if } I_{MAX}/2 < I < I_{MAX} \end{cases} \quad (3)$$

Noise and Various Types of Noise

In common use, the word noise means any unwanted sound. In both analog and digital electronics, noise is an unwanted perturbation to a wanted signal; it is called noise as a generalization of the audible noise heard when listening to a weak radio transmission. Signal noise is heard as acoustic noise if played through a loudspeaker; it manifests as snow' on a television or video image. Noise can block, distort, change or interfere with the meaning of a message in both human and electronic communication. In Information Theory, however, noise is still considered to be information in a broader sense, film grain or even advertisements encountered while looking for something else can be considered noise. In many of these areas, the special case of thermal noise arises, which sets a fundamental lower limit to what can be measured or signaled and is related to basic physical processes at the molecular level described by well-established thermodynamics considerations, some of which are expressible by simple formulae.

2.2.1 *Image Noise*

Image noise is the random variation of brightness or color information in images produced by the sensor and circuitry of a scanner or digital camera. Image noise can also originate in film grain and in the unavoidable shot noise of an ideal photon detector. Image noise is generally regarded as an undesirable by-product of image capture. Although these unwanted fluctuations became known as "noise" by analogy with unwanted sound. They are inaudible and actually beneficial in some applications, such as dithering.

2.2.2*Salt-and-Pepper Noise*

An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions. This type of noise can be caused by dead pixels, analog-to-digital converter errors, bit errors in transmission, etc

Figure2.1 Lena Image with MSE=225 in Impulsive Salt Noise

2.2.3*ImpulseNoise*

Noise consisting of random occurrences of energy spikes having random amplitude and and spectral content.

2.2.4Additive White Gaussian Noise (AWGN)

AWGN is a channel model in which the only impairment to communication is a linear addition of wideband or white noise with a constant spectral density (expressed as watts per hertz of bandwidth) and a Distribution of amplitude. The model does not account for fading, frequency selectivity, interference, nonlinearity or dispersion. However, it produces simple and tractable mathematical models which are useful for gaining insight into the underlying behavior of a system before these other phenomena are considered. The AWGN channel is a good model for many satellite and deep space communication links. It is not a good model for most terrestrial links because of multipath, terrain blocking, interference, etc. mutate background noise of the channel under study, in addition to multipath, terrain blocking, interference, ground clutter and self interference that modern radio systems encounter in terrestrial operation.

Figure2.2Lena Image with MSE=229 in Additive White Noise

III. FUZZY LOGIC TOOLBOX

Working with the Fuzzy Logic Toolbox The Fuzzy Logic Toolbox provides GUIs to let you perform classical fuzzy system development and pattern recognition. Using the toolbox, you can:

- Develop and analyze fuzzy inference systems
- Develop adaptive neurofuzzy inference systems
- Perform fuzzy clustering

Fuzzy Logic Examples using Matlab

Consider a very simple example:

We need to control the speed of a motor by changing the input voltage. When a set point is defined, if for some reason, the motor runs faster, we need to slow it down by reducing the input voltage. If the motor slows below the set point, the input voltage must be increased so that the motor speed reaches the set point.

Let the input status words be:

– *Too slow*
– *Just right*
– *Too fast*

Let the output action words be:

– *Less voltage (Slow down)*
– *No change*
– *More voltage (Speed up)*

Define the rule-base:

1. If the motor is running too slow, then more voltage.
2. If motor speed is about right, then no change.
3. If motor speed is to fast, then less voltage

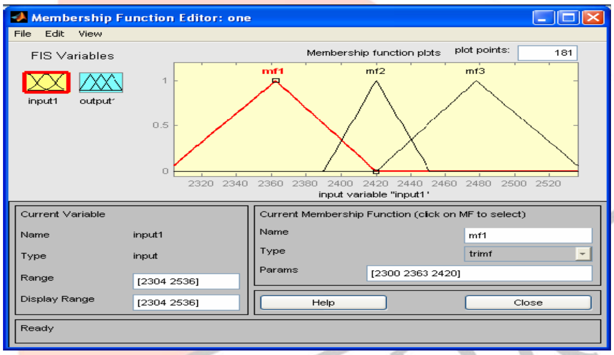


Figure 3.1 Input Membership Function

IV. PURPOSED WORK

Algorithm for Proposed Model

1. Given the original image.
2. Add different noises salt and pepper noise, Multiplicative Speckle Noise and Additive White Noise to the original image and make noisy image.
3. Apply different type of filters like Median filter, Adaptive Filter and Average Filter to the the noisy image with some types of parameters.
4. Find the image quality measure
5. Use of Fuzzy Logic to describe the quality of an image.

V. IMPLEMENTATION RESULT OF IMAGE DENOISING TECHNIQUE FOR GRAY SCALE IMAGES

This Section shows the results of different approaches and compares the Quality of denoised image. Following are the results of denoising algorithms for the techniques discussed.

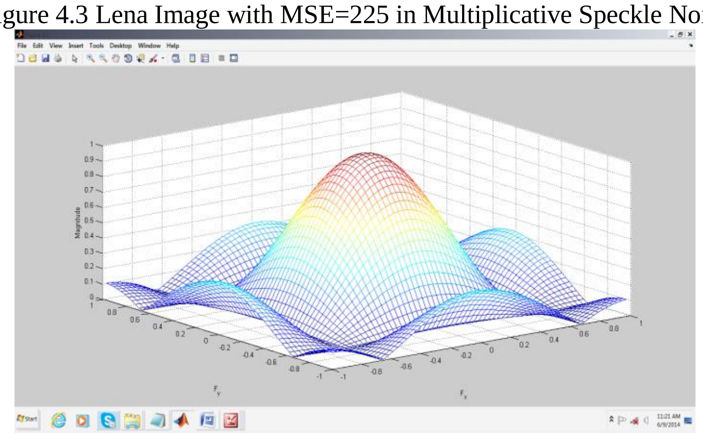
4.1.1 Result of test image "Lena"

This Section presents the result of changing the noises and applying that filter on the image to observe the quality of image. The noisy images are simulated by adding Gaussian white Noise, Impulsive Salt pepper Noise and speckle noise on the original images

Figure 4.1 Lena Image with MSE=225 in Impulsive Salt Noise

Figure 4.2 Lena Image with MSE=225 in Additive White Noise

Figure 4.3 Lena Image with MSE=225 in Multiplicative Speckle Noise



All the Filters technique ids implemented using MATLAB (7.9) and its image processing toolbox. Denoising technique has been applied to image such as “Lena” of size 512*512 with different noiselevel. Noise model used is salt and pepper, speckle noise and AWGN. The filter are used like median filter, adaptive filter and average filter. The HVS value can be computed on a block-by-block basis for the processed input images. Finally, the denoising images are there of different parameters and then we select the best image of one parameter by the use of fuzzy logic. The original image is taken then denoising with the different noises now we take one by one noise to denoise it by various filters with different parameters. After that we chose the best filter of some parameter that is suitable for denoising the image by the fuzzy logic technique.

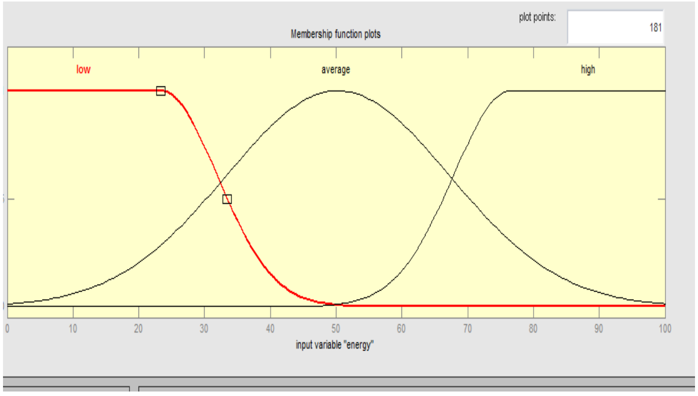


Fig:4.4 Fuzzy Cost

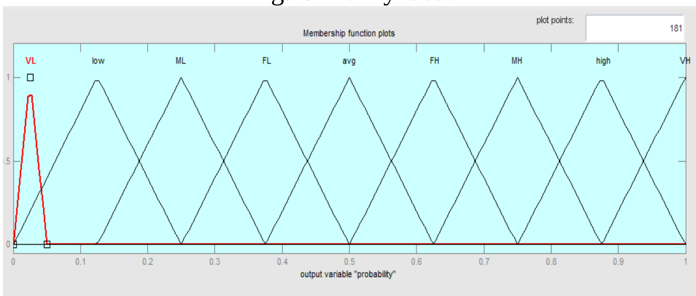


Fig4.5 : Fuzzy Probability

VI. Conclusion

In this paper, a framework for image quality simple HVS model, which is used to process input images. HVS used in this model is not fixed; it has one user-defined parameter, which controls attenuation at high frequencies. This way it is possible to get better results than in the case when filters different parameters is used. This is due to the fact that HVS treats very differently high frequency components present in the original image than those of noise. A framework for denoising based on prior knowledge of noise statistics has been presented. It has been seen that the filters like median, adaptive and average is an effective technique of denoising of noisy signal.

In future, for the denoising purpose, more images can be taken as from the different application field so that it becomes clearer for transmission of images for which particular technique is better for gray-scale images. Future, Gaussian based model can be used to perform combined denoising and compression for natural image and performance of these methods can be compared with fuzzy logic scenario.

REFERENCES

[1] Z. Wang and Qiang Li "Reduced-reference image quality assessment (RRIQA) using Divisive Normalization-Based Image Representation" VOL. 3, NO. 2, APRIL 2009.
[2] Z. Wang and A. C. Bovik, *Modern Image Quality Assessment*. SanRafael, CA: Morgan & Claypool, Mar. 2006.
[3] N. Damera-Venkata, T. D. Kite, W. S. Geisler, B. L. Evans, and A.C. Bovik, "Image quality assessment based on a degradation model,"*IEEE Trans. Image Process.*, vol. 9, no. 4, pp. 636–650, Apr. 2000.
[4] E. C. Larson and D. M. Chandler, "Most apparent distortion: Full-reference image quality assessment and the role of strategy," *J. Electron. Imag.*, vol. 19, no. 1, pp. 1–21, 2010.
[5] Goran Ivkovic and Ravi Sankar "AN ALGORITHM FOR IMAGE QUALITY ASSESSMENT" at 2004 IEEE.
[6] Songnan Li, *IEEE*, Fan Zhang, Lin Ma, and King Ngi Ngan "Image Quality Assessment by Separately Evaluating Detail Losses and Additive Impairments" VOL. 13, NO. 5, OCTOBER 2011.
[7] Chunlei Shi and Longxu Jin "A Fast and Efficient Multiple Step Algorithm of Iris Image Quality Assessment" V2- 2010 2nd International Conference on Future Computer and Communication.
[8] Buades, b.Coll, and J Morel, "On image denoising methods," Technical Report 2004-15, CMLA, 2004.
[9] J. Daugman, "How Iris Recognition Works," IEEE Transactions on Circuits and Systems for Video Technology, vol. 2, pp. 21-30, 2004.
[10] Yijian Pei, Jiang Yu, Huayu Zhou and Guanghui Cai "The Improved Wavelet Transform Based Image Fusion Algorithm and The Quality Assessment" 2010 3rd International Congress on Image and Signal Processing.