

-

/ /

(Average Filter) (Median Filter)

.

NxN

(x,y)

NxN

(x,y)

.

,

(RGB)

(gray scale)

.

:

.

,

,

,

,

Images Enhancement Using Fuzzy Median-Average Filter

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Abstract

The aim of this paper is to enhancement the digital noisy image by using proposed fuzzy filter depending on two known filters: median and average filters which are spatial domain techniques.

The proposed using filter fuzzy logic to determine which filter (median or average) is best for each window $N \times N$ from image by compute divergent of the local element in the window $N \times N$ from image which center at (x,y) and compute the absolute of the difference between the results of the median and average filter for the same window which are represent the inputs to the fuzzy system and stored in point (x,y) for enhanced image.

To insurances the effectiveness of the proposed fuzzy filter, it is tested on aset of grayscale and **RGB** images and for two noises, then compared its results with the results of median and average filters. The results are validated and the fuzzy filter gives best results from other filters for both type of images and the two types of noises.

Keywords: smoothing filter, medain filter, average filter, filtering of truecolor image , fuzzy logic.

:[Buxey,1994]

. : *

. : *

(image processing)

,

.[Gonzale,1992]

.

.

Image restoration

:

-

(degradation)

.[Gonzale,1992]

Image enhancement

-

. [Buxey,1994]

Image compression

-

.[David,1998]

Smoothing filters

(Low pass filter)

[Vertan,1999,Gomes,1997]

:

Average Filter (AF)

-

(mean filter)

(x,y)

.[Shah,2005,Dmuth,1998] $N*N$

(smoothed)

$N*N$

. [Shah,2005](additive noise)

Median filter (MF)

-

. [Bjorkman,2000](edges)

$N*N$

.[Gamez,2001]

(middle)

Fuzzy Logic

,(Linguistic Value)

(Linguistic Variable)

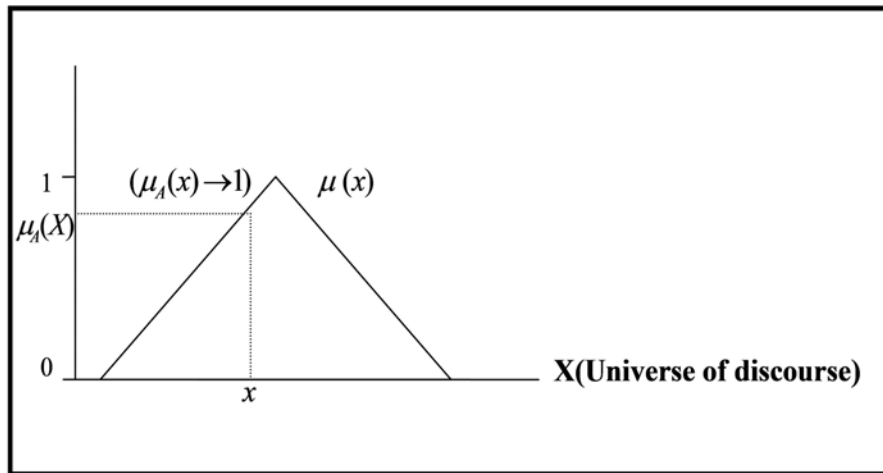
.[Passion, yurkovich,1998]

X A X , , x

$$A = \{x, \mu_A(x) / x \in X\}$$

A x Membership function $\mu_A(X)$ (1)

$(\mu_A(x) \rightarrow 1)$ $[0,1]$, A x $(\mu_A(x) \rightarrow 0)$



شكل (1) دالة الانتماء

Membership Function

. $[0,1]$

$\mu(x_i)$

$$0 \leq \mu(x_i) \leq 1$$

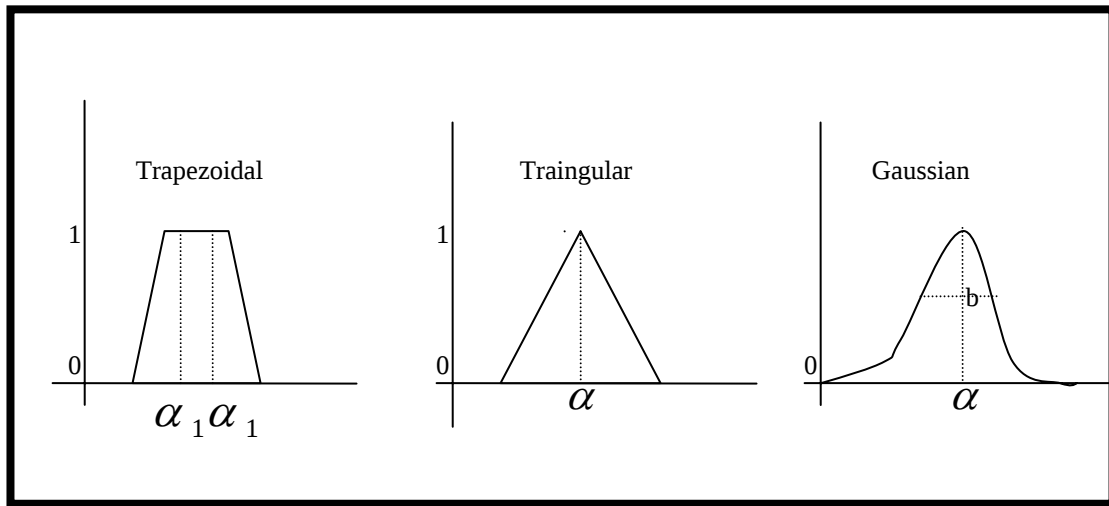
Triangular ,Gaussian)

(3)

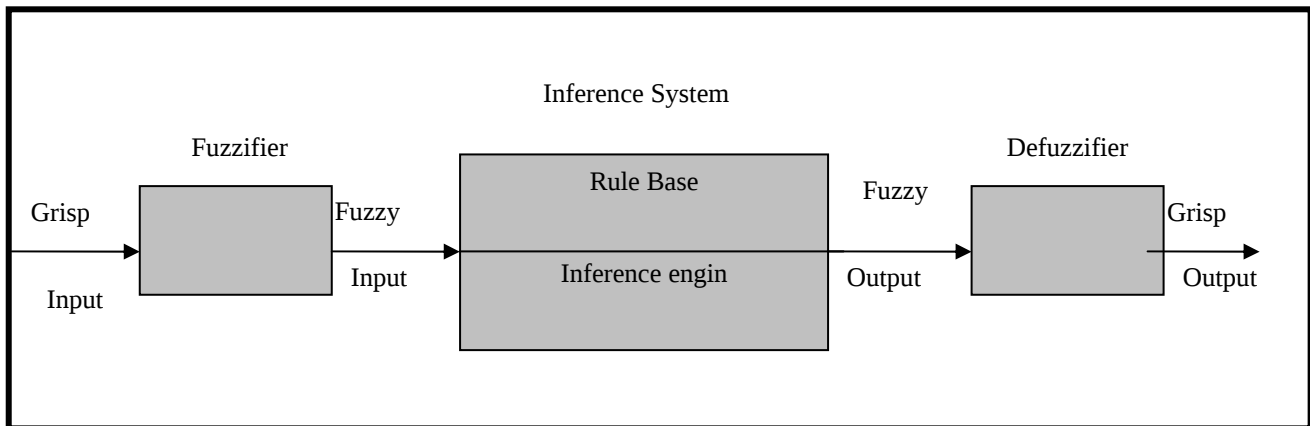
(2)

(,Trapezoidal

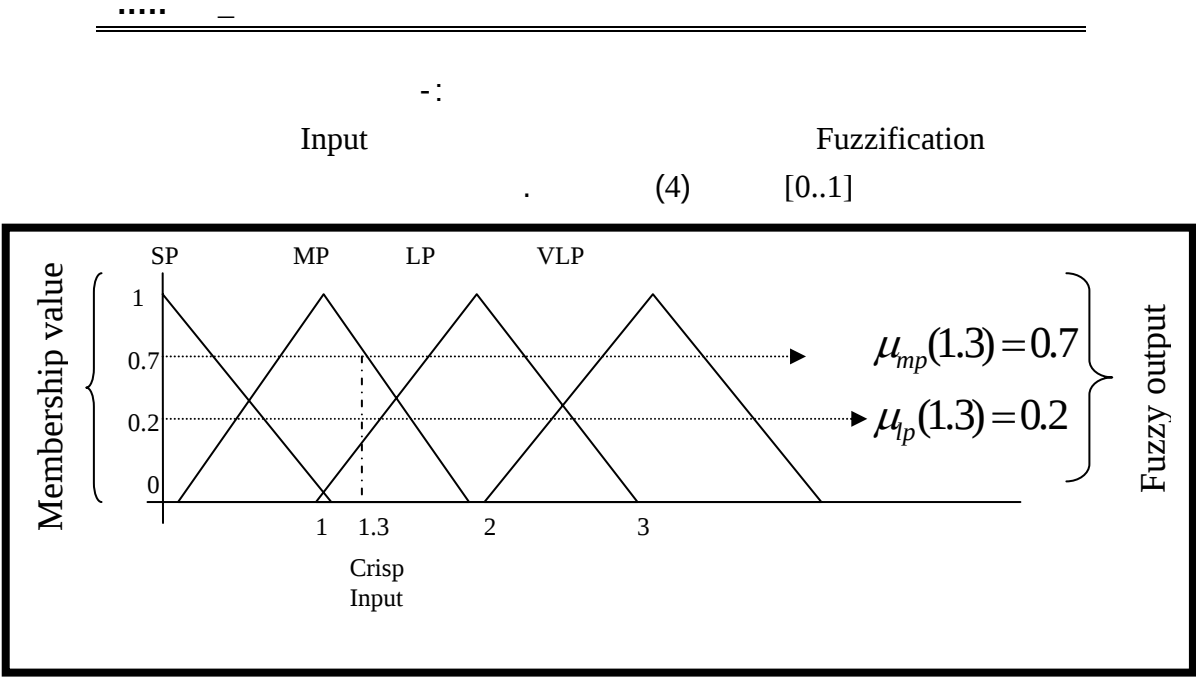
. [Reznik,1997]



(2)



(3)



(4)

Inference System

- ∴
- ∴ Rule Base -1
- ∴
- If-Then
- ∴ Inference engine_ -2
- ∴
- ∴
- ∴ Defuzzifier
- ∴

∴ Center-of-area/Gravity defuzzification

—

The proposed fuzzy median-average filter

NxN

(x,y)

(x,y) NxN

(5) .(x,y)

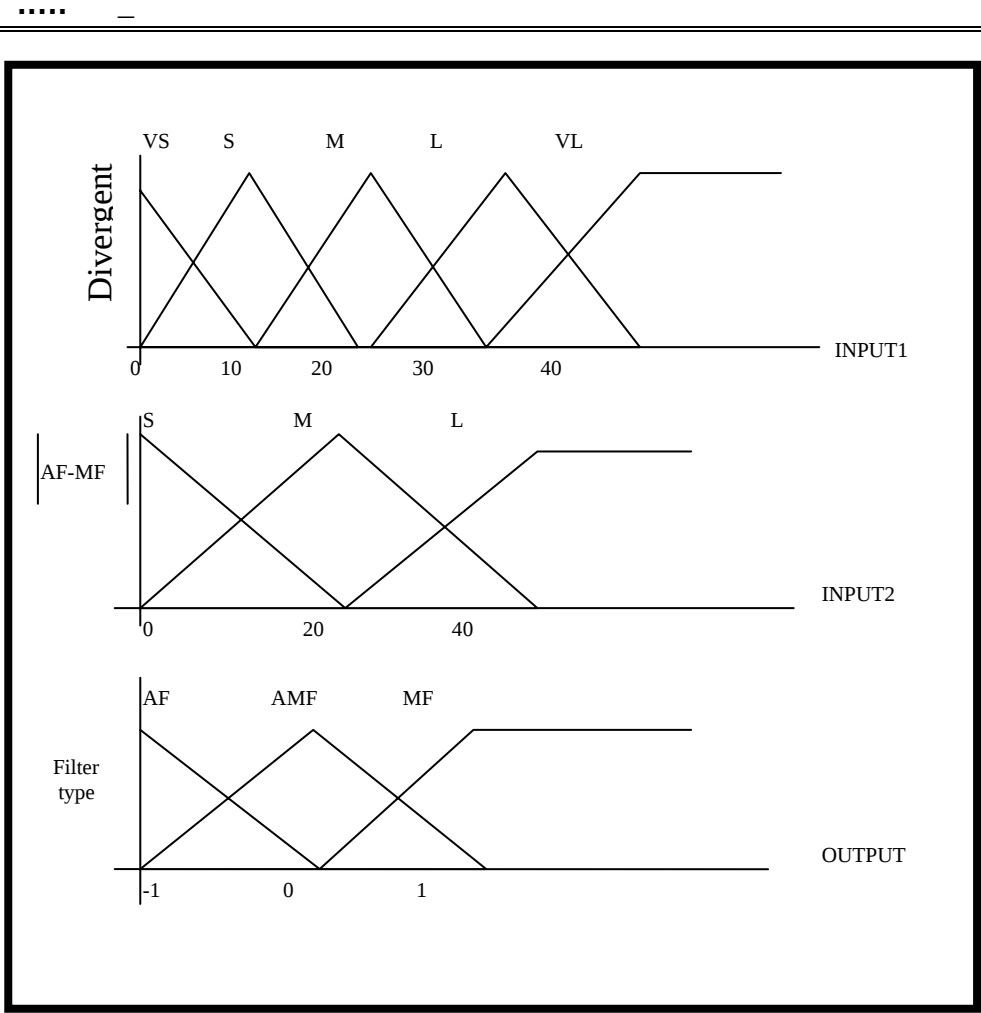
(6) ,

```

Procedure      Fuzzy-avg-med-filter
Begin
  For x=1 to no. of rows
    For y=1 to no.of columns
      W is a windows N*N from noisy image A and his
        center is (x,y)
      C is the Divergence the local element in window W
      AAF=AF(W)
      MMF=MF(W)
      Fuzzy-System(C,AAF,MMF,filtertype)
      Apply filter with filter type for window w
      Save the result in enhanced image B at point (x,y)
    End
  End
End.

```

(5)



(6)

(1)

Divergent AF-MF		vs	S	M	L	VL
S		AF	MF	AMF	MF	MF
M		AF	AF	AMF	AMF	MF
L		AMF	AMF	AF	MF	MF

(1)

:

()

-

(poisson)

()

,[Baker,1999]

Peak (psnr))

(Signal to Noise Ratio

:[Rabbain,1991]

$$MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} (I(i, j) - K(i, j)) \dots (1)$$

$$PSNR = 10 \log_{10} \left(\frac{MAXI}{MSE} \right) = 20 \log_{10} \left(\frac{MAXI}{\sqrt{MSE}} \right) \dots (2)$$

:

 $2^B - 1$

:MAXI

.(256 1)

.(mean squared error)

:MSE

:I,K

[40..20]

(decibel(dB))

PSNR

(2) .[David,1998]

(7) .

.(lena)

PSNR			(PSNR)	
	31.987	31.789	Gray1 26.16	
	27.961	26.812	Gray2 27.25	
	32.521	31.117	Gray3 26.25	
	28.176	26.812	Gray1 20.10	
	27.176	26.313	Gray2 20.12	
	28.127	27.282	Gray3 20.57	

(2)

(RGB)

-

(base color)

.(RGB)

)

.[Bjorkman,2000]

(RGB)

PSNR

MSE

MSE

MSE

RGB

(3)

(8)

PSNR			(PSNR)	
32.90	32.02	32.11	RGB1 26.33	
29.12	28.87	27.45	RGB2 26.92	
28.34	27.09	20.28	RGB1 20.26	
25.87	25.36	25.86	RGB2 20.33	

RGB

(3)

Noisy image(poisson)



PSNR=26.16 dB

Average Filter(AF)



PSNR=31.987 dB

Median Filter(MF)



PSNR=31.789 dB

Fuzzy Filter(FF)



PSNR=31.989 dB

(lena)

(7)

Noisy image(gaussian)



PSNR=20.33 dB

Median Filter(MF)



PSNR=25.86 dB

Average Filter(AF)



PSNR=25.36 dB

Fuzzy Filter(FF)



PSNR=25.87 dB

(8)

RGB

-: ()

() -1

-2

-3

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