IJABBR- 2014- eISSN: 2322-4827

International Journal of Advanced Biological and Biomedical Research

Journal homepage: www.ijabbr.com

Original Article

Performance Comparison of Gaussian and Elliptic High Pass Filter

Anush Dogra[1*], Ayush Dogra[2]

[1]Btech Student (Ece), India
[2]M.Tech (Ece), India

ARTICLE INFO

Article history:
Received: 09 Dec, 2014
Revised: 30 Jan, 2015
Accepted: 28 Feb, 2015
ePublished: 30 Mar, 2015

Key words:
Gaussian
Elliptic
Image sharpening
Frequency domain
High pass filter

ABSTRACT

In this paper, Gaussian and elliptic high pass filters are analyzed for image sharpening qualitatively and quantatively . The filters are implemented in frequency domain using matlab software. Experiments are performed to compare the performance of both the filters ,processed images are presented. The results demonstrate that elliptic yields better results.

1.INTRODUCTION

A filter that attenuates high frequencies while passing low frequencies is called low pass filter. Low pass filter are usually used for smoothing while high pass filter is used for sharpening.

In literature, Ayush dogra proposed an enhancement method for CT & MR images using guassian & butterworth high pass filter and done comparative analysis of both the filters(Ayush Dogra 2013 , DOGRA, AYUSH, and PARVINDER BHALLA) Similarly Zwirn & akselrod (Zwirn G 2004) proposed an enhancement for echocardiography. Nijad, sara tedmory(Yusuf 2014) proposed & exploited hybrid method for enhancing digital x-ray images. Clustering filter approach proposed by wong(Wong Y 1994).

In this paper, we performed image sharpening on the data set of MR image by gaussian & elliptic high pass filter and evaluated their performance. These sharpened images show increased diagnostic details, and used for many other applications like image registration (Dogra, A 2014, DOGRA, AYUSH, and PARVINDER BHALLA, ayush dogra GJMR (2013) and image fusion(DOGRA, AYUSH 2014).

2. GAUSSIAN HIGH PASS FILTER

The Gaussian high pass filters attenuates frequency components that are near to image centre. The Gaussian high pass is given by(Ayush Dogra 2013 , DOGRA, AYUSH and PARVINDER BHALLA).

$$H(u,v) = -e^{-D^2(u,v)/2\,D_0^2} \quad 1$$

3. ELLIPTIC HIGH PASS FILTER

An elliptic filter is also known as a Cauer filter, named after Wilhelm Cauer, or as a Zolotarev filter, after Yegor Zolotarev is a signal processing filter with equalized ripple (equiripple) behavior in both the

***Corresponding Author:** Anush Dogra, Btech Student (Ece), India (anushdogra17@gmail.com)

passband and stopband(http://en.wikipedia.org/wiki/Elliptic_filter).
The gain for elliptical filter is:

$$G_n(\omega) = \frac{1}{\sqrt{1 + \epsilon^2 R_n^2(\xi, \omega/\omega_0)}} \quad 2$$

where R_n is the *n*th-order elliptic rational function (sometimes known as a Chebyshev rational function) and ω_0 is the cutoff frequency ϵ is the ripple factor ξ is the selectivity factor.

4. MEAN SQUARE ERROR (MSE)

The mean square error (MSE) is the error metric used to compare image quality. The MSE represents the cumulative squared error between the compressed and the original image, mean square error (MSE) is given by(mathwork, accelerating the pace of engineeringandsciencehttp://www.mathworks.in/help/vision/ref/psnr.html, B. Girod 1993)

$$MSE = \frac{\sum_{M,N}[I_1(m,n) - I_2(m,n)]^2}{M * N} \quad 3$$

M and N are the number of rows and columns in the input images.

5. METHODOLOGY

Filtering in frequency domain consist of following steps (Yusuf 2014).
1.Pre processing - multiplying the input image by *(-1)x+y* to centre the transform.
2.Computing *F(u,v),* using any of the transformation methods.
3.Multiplying *F(u,v)* by a filter function *H(u,v).*
4.Computing the inverse transformation of the result.
5. Post processing – multiplying the result by *(-1)x+y.*

6. RESULTS AND DISCUSSION

Here we will only demonstrate the image sharpening using gaussian & elliptic high pass filter by varying cut off frequency d0 =10,20,30,40,50. Figure 1 shows MR image.Figure 2 shows the results of GHPF with d0=10,20,30,40,50. For elliptic high pass filter the order n is set at 2 , whereas selectivity factor & ripple factoris set at 1, and varying the cutoff frequency d0= 10,20,30,40,50. Figure3 shows results of elliptical high pass filter.

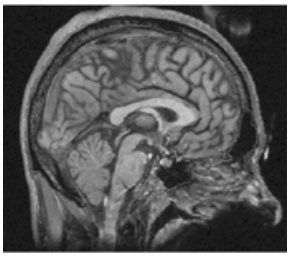
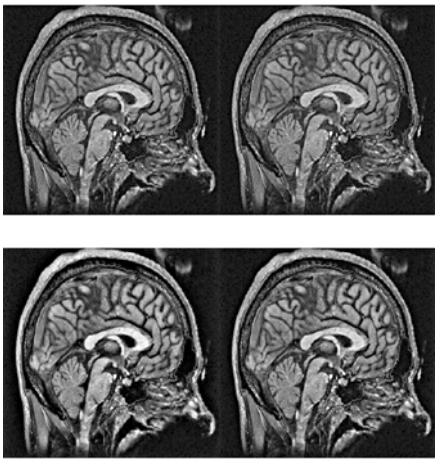
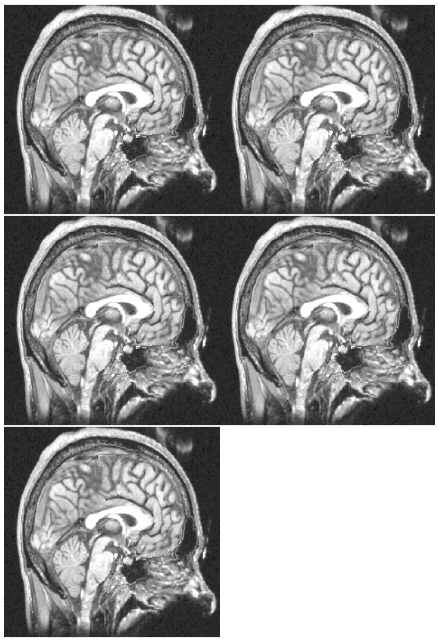


Figure 1: Mr Image



GHPF(d0=10) GHPF(d0=20) GHPF(d0=30) GHPF(d0=40) GHPF(d0=50)

FIGURE.2 (SHARPENED MR IMAGES BY GHPF)



GHPF(d0=10) GHPF(d0=20) GHPF(d0=30)
GHPF(d0=40) GHPF(d0=50)

FIGURE 3;(SHARPENED MR IMAGES BY CAUER FILTER)

7. QUANTATIVE ANALYSIS

For quantative analysis, computed the MSE between original input image and reconstructed images using equation 3. The following calculation value for MSE between input image and reconstructed images are shown in table 1.

Table 1.

MSE for MR images at different cutoff frequencies

MSE between original MR & sharpened MR images	GHPF	ELLIPTIC HPF
d0=10	716.9992	2.5023e+03
d0=20	449.4283	2.5023e+03
d0=30	317.5338	2.5023e+03
d0=40	242.7772	2.5023e+03
d0=50	194.6673	2.5023e+03

8. CONCLUSION

Gaussian and 2nd order elliptic with d0= 10,20,30,40,50 is used. The difference between gaussian & elliptic filter is that the later provides much sharper image than former. In GHPF high pass filters, as the cutoff frequency increases the sharpening decreases but in elliptical filter the sharpening remains same as cutoff frequencies d0 increases. Computing MSE between input image & reconstructed sharpened images depicts that the elliptic high pass filter shows sharper image than GHPF. MSE here indicates change and this change is greater in elliptic high pass filter as compare to GHPF. MSE in elliptic high pass filter remains constant as d0, cutoff frequency is increased.

9. FUTURE SCOPE

Other frequency domain filter like chebyshev type 1, chebyshev type 2 & butterworth can also implemented in frequency domain using matlab software on various medical modalities like CT ,MRI,X-RAY,PET,SPECT,etc

REFERENCES

Ayush Dogra, Dr. Manjeet Singh Patterh; "Performance Comparison of Gaussian and Butterworth High Pass Filters", Punjabi University, Patiala (Punjab), India, International Journal of innovations in Engineering and Management, vol.2; No2: ISSN: 2319-3344(July-Dec.2013).

B. Girod, “What’s wrong with mean-squared error,” in Digital Images and Human Vision (A. B. Watson, ed.), pp. 207–220, the MIT press, 1993.

DOGRA, AYUSH, and PARVINDER BHALLA. "Image Sharpening By Gaussian And Butterworth High Pass Filter."

Dogra, A., and M. S. Patterh. "CT and MRI Brain Images Registration for Clinical Applications." *J Cancer Sci Ther* 6 (2014): 018-026.

DOGRA, AYUSH, and PARVINDER BHALLA. "CT and MRI Brain Images Matching Using Ridgeness Correlation."

DOGRA, AYUSH, and PARVINDER BHALLA ‘’ An efficient data level fusion of multimodal medical images by cross scale fusion rule’’issue 4, vol.5 (September-october 2014)

Feature Based Matching of CT & MRI Brain Images Ayush dogra GJMR (2013) Volume 13 Issue 2; 1-3.Category: WL 368 · Added: Feb 9th, 2014 http://en.wikipedia.org/wiki/Elliptic_filter

mathwork, accelerating the pace of engineering andsciencehttp://www.mathworks.in/help/vision/ref/psnr.html

Wong Y., "Image Enhancement by Edge- Preserving Filtering," in Proceedings of the 1st IEEE International Conference on Image Processing, USA, pp. 522-524, 1994.

Yusuf, Nijad, Sara Tedmory "Exploiting hybrid methods for enhancing digital X-ray images".The International Arab Journal of Information Technology, Vol. 10, No.1, January 2013.

Zwirn G. and Akselrod S., " A Histogram- Based Technique for Echocardiographic Image Enhancement," IEEE Journal of Computers in Cardiology, vol. 31, pp. 81-84,2004.