International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-4, February 2020

Wavelet Transform Based Estimation of 1 Dimensional Signal

Koteswara Rao Mallaparapu, K.V.Ramarao , Shaik Masthan

Abstract: ***The key idea of this manuscript is denoising of noisy biological signals. For this wavelet thresholding technique is suggested. To eliminate the noise existing in the signal, mixed thresholding function is considered which is the median of Hard, Soft and Garrote functions. The mixed thresholding function is applied by degraded white gaussian noise Electrocardiogram signal. Two methods that are used to calculate the threshold value is FDR technique and Visu shrink technique. The outcomes of mixed functions are compared with remaining functions using Signal to Noise Ratio (SNR) and Mean Square Error (MSE). It is obvious that the mixed function performs superior than remaining functions using Visu shrink technique and performs better than only Hard function using FDR technique.***

I. INTRODUCTION

Collecting information increases quickly from last few years. Biological information or signals are also applicable to this. Noise is added to the signal while receiving information. This information will be lost because of the noise present in the signal,. Deterioration is essential for these biological signals. Many methods are available to remove the noise. Parametric and non parametric deterioration methods are of two different types. Wavelet transform is commonly used technique in non parametric regression. And wavelet thresholding technique is very popular for regression.

In this work, a mixed thresholding function is suggested. Using global thresholding method and visu shrink method this mixed thresholding function is applied on wavelet factors for denoised biological signal. The results of this function are related by offered hard, soft and garrote functions limits.

II. WAVELET THRESHOLDING

To denoise the signal, wavelet thresholding technique is used. The noisy Electrocardiogram signal is conceded through wavelet transform in this method. A signal into detailed coefficients was decomposed by this method. Using thresholding function, these coefficients are modified. In this function, the threshold value is calculated using thresholding function.

Revised Manuscript Received on February 28, 2020.
* Correspondence Author
Koteswara Rao Mallaparapu*, Assistant Professor of ECE, CIET, Guntur, AP,India. Email: raodecs@gmail.com
Dr.K.V.Ramarao, Associate Professor of ECE, CIET, Guntur,AP, India. Email: kvramarao88@gmail.com
Shaik Masthan, Assistant Professor of ECE, CIET, Guntur, AP,India. Email: shaikmasthan470@gmail.com

These customized detailed coefficients are conceded through inverse wavelet transform. Noiseless ECG signal is obtained by reconstructing the coefficients. For caluculating threshold value, global thesholding method, visu shrink method and block JS method are proposed in this paper. For wavelet transform and inverse wavelet transform Coiflet wavelet is preferred.

A. False Discovery Rate method

For one-dimensional data, minimizing false discovery rate technique was introduced by B. Vidakovic. Below a given portion p, it determines the same global threshold for all shrinkage functions by keeping the predictable value of the portion of coefficients inaccurately incorporated in the restoration. Known the M wavelet coefficients (ωn, n = 1, 2... M), initially it calculates x-values

$$Xn = 2[1-\Phi(|wn|/\sigma)]$$

Here σ is an estimation of the noise-standard deviation and Φ (.) is the cumulative distribution function of the standard normal distribution. Then xn outputs are prearranged as x(1) ≤x(2) ≤x(3)….≤x(M). Starting with n = 1, let q be the largest index such that

$$x_{(q)} \leq \frac{q}{M} p$$

The obtained threshold output is written as

$$\lambda = \sigma\, \Phi^{-1}(1- (x_{(q)}/2))$$

B. Visu shrink method

Visu Shrink method was developed by donoho and johnstone. This is a universal thresholding method and it is not depending on thresholding function selected. The calculated threshold value is given by

$$\lambda = \sigma\sqrt{2 \log L}$$

where L is the length of the signal, λ is the threshold value and σ is the standard deviation.

C. Thresholding function

The noisy detailed coefficients are used to modify the thresholding functions. To modify the coefficients, proposed work contains Hard, Soft and garrote thresholding functions. Donoho and Johnstone proposed this hard thresholding function. It can be shown as

$$H(e,\lambda) = e \text{ for } |e| > \lambda$$

$$= 0 \text{ else}$$

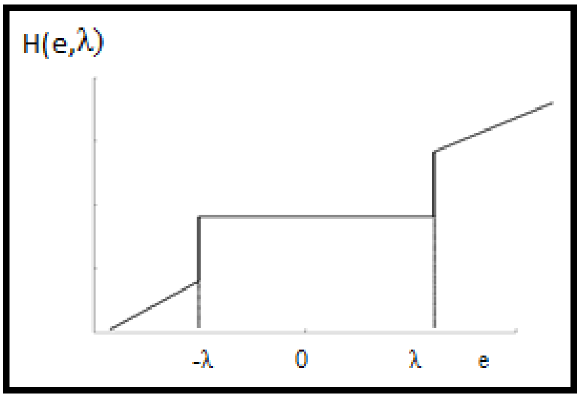


Figure 1: Hard Thresholding Function

Soft thresholding function

$S(e,\lambda)$ =sgn (e)(|e|-| λ|) for |e|> λ = 0 else

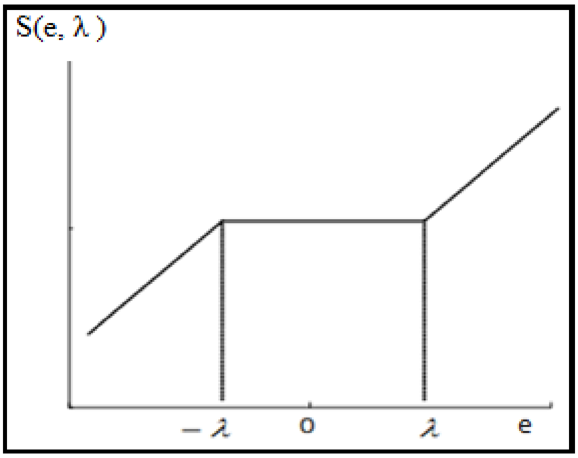


Figure 2: Soft Thresholding Function

Garrote function

$G(e,\lambda) = \left(e - \frac{\lambda^2}{e}\right)$ for all |e|>λ = 0 else

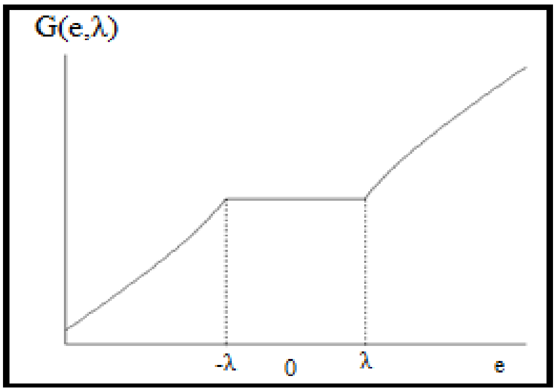


Figure 3: Garrote Thresholding Function

Where λ represents threshold value and e is the detailed coefficients

III. MIXED THRESHOLDING FUNCTION

Mixed thresholding function is newly desined function to modify the detailed coefficients. By taking the median of hard, soft and garrote functions for more than threshold value this function is designed. For less than threshold value, 0.2% of detailed coefficient value is proposed.

This is given as

$M(e,\lambda)$ = median($H(e,\lambda)$ $S(e,\lambda)$ $G(e,\lambda)$) for all |e| > λ = 0.2*e else.

Where λ is the threshold value and e represents detailed coefficients

IV. RESULT AND DISCUSSION

In the proposed work using hard function, soft function, garrote function and mixed function the results are obtained on noise effected ECG signal are placed. Different noise standard deviation values of ECG are simulated and it is polluted with gaussian noise and the length of the ECG siganl is 1024.

To decay the noisy ECG signal with detailed coefficients Coiflet wavelet is used in wavelet transform. Using thresholding function these detaled coefficients are modified. The threshold value is fixed using FDR technique, visu shrink technique in thresholding filter. To rebuild the modified detailed coefficients into denoised ECG signal, inverse wavelet transform is used. To compare the results MSE and SNR parameters are used.

$$\text{MSE} = \frac{1}{t}\ \sum_{i=1}^{t}\left(n(i) - \hat{n}(i)\right)^2$$

$$\text{SNR} = 10\ \log_{10}\ \frac{\sum_{i=1}^{t} n(i)^2}{\sum_{i=1}^{t}\left(n(i)-\hat{n}(i)\right)^2}$$

n(i) is original signal, t represents number of samples and $\hat{n}(i)$ is denoised signal. After repeating the simulation process for 100 times then take the average values of MSE and SNR. The same results are obtained when this process is performed on different ECG signals. In MATLAB environment this work is implemented. Using existing functions and mixed thresholding function with FDR method and visu shrink method the Mean Square Error and Signal to Noise Ratio values of ECG signal for standard deviation 10, 20 and 30 are shown in Table 1 and Table 2. Using mixed thresholding function with FDR method and visu shrink method the original ECG signal and denoised ECG signals are shown in Figures 3-6. The comparison of Mean Square Error and Signal to Noise Ratio values of FDR method, visu shrink technique are shown in Graph 1-4.

MSE value of 44.3586 and SNR value of 25.9515 are obtained for standard deviation 10. MSE value of 125.2162 and SNR value of 21.4520 are obtained for denoised ECG signal with hard thresholding function. With garrote thresholding function using FDR method For denoised ECG signal with soft thresholding function and MSE is 51.5357 and SNR is 25.3013 are obtained. MSE is 46.6343 and SNR is 25.7345 are obtained in (Table 1) using mixed thresholding function. It is clear that the performance of mixed thresholding function is better than soft and garrote thresholding functions. The performance of standard deviation 20 and 30 is obtained in (Table 1) which will be same. MSE value of 51.8379 and SNR value of 25.2753 are obtained using visu shrink method, for standard deviation 10, for denoised ECG signal with hard thresholding function.

Retrieval Number: D9063019420/2020©BEIESP
DOI: 10.35940/ijitee.D9063.029420
Journal Website: www.ijitee.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-4, February 2020

MSE value of 190.9958 and SNR value of 19.6114 are obtained for denoised ECG signal with soft thresholding function and with garrote thresholding function MSE of 75.1200 and SNR of 23.6654 are obtained. In (Table 2), MSE of 65.5301 and SNR of 24.2576 are obtained Using mixed thresholding function. From the above results, the performance of mixed thresholding function is better than soft and garrote thresholding functions. The performance of standard deviation 20 and 30 is obtained in (Table 2) which will be same.

Table 1: For different thresholding functions using FDR method the values of MSE and SNR are

	σ =10		σ =20		σ =30	
	MSE	SNR	MSE	SNR	MSE	SNR
Noisy signal	100.722	22.3778	401.1091	16.3766	898.986	12.8711
Hard function	44.3586	25.9515	130.998	21.251	279.06	17.9664
Soft function	125.216	21.452	365.29	16.803	708.299	13.925
garrote function	51.5357	25.3013	169.291	20.148	345.066	17.054
Mixed function	46.6343	25.7345	154.682	20.528	327.678	17.27

Table 2: Using visu shrink thresholding method the values of MSE and SNR for different thresholding functions are

	σ =10		σ =20		σ =30	
	MSE	SNR	MSE	SNR	MSE	SNR
Noisy signal	100.722	22.377	401.109	16.376	898.986	12.871
Hard function	51.8379	25.275	159.469	20.403	331.257	17.226
Soft function	190.995	19.611	549.910	15.018	982.789	12.498
garrote function	75.1200	23.665	242.058	18.588	495.283	15.484
Mixed function	65.5301	24.257	217.243	19.058	447.239	15.925

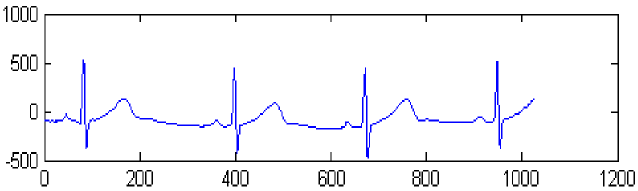


Figure 4: Original ECG signal

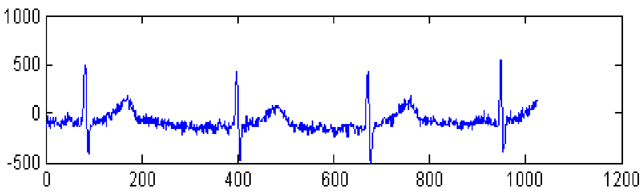


Figure 5: ECG signal effected by noise

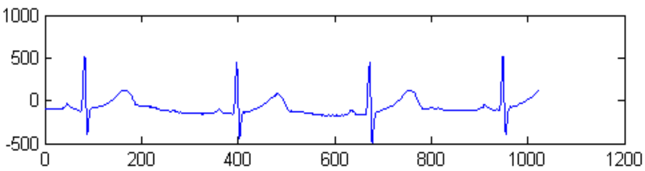


Figure 6: Using mixed thresholding function with FDR method Denoised ECG signal

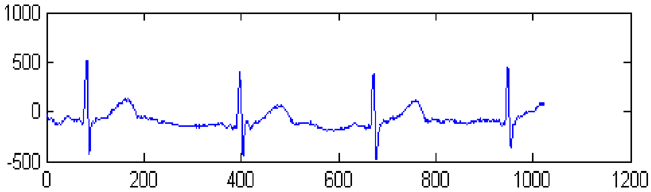
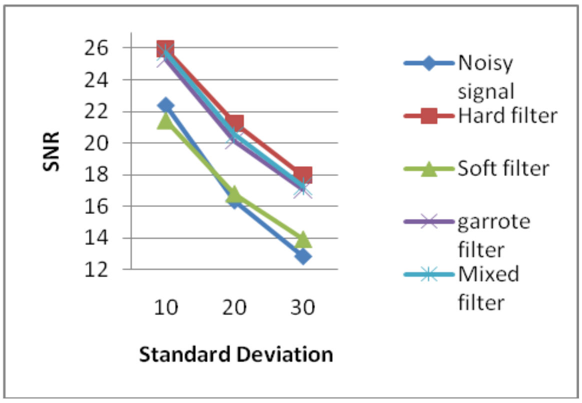
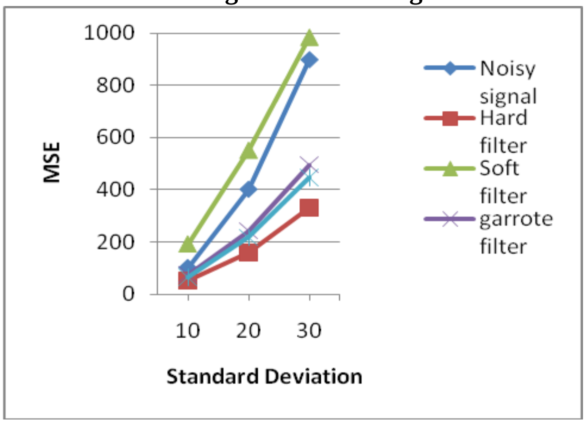


Figure 7: Using mixed thresholding function with visu shrink method Denoised ECG signal

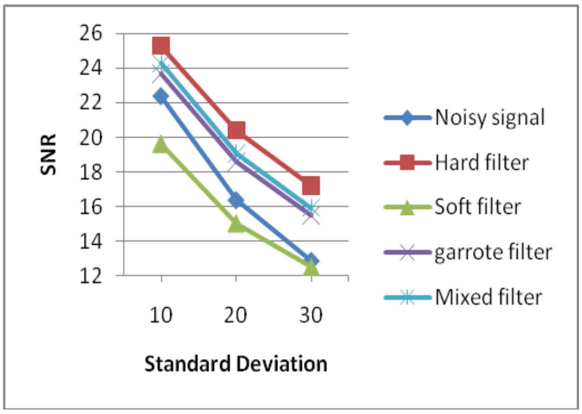
Graph 1: Comparison of MSE values for different functions in FDR method.



Graph 2: Comparison of SNR values for different functoions in global thresholng method



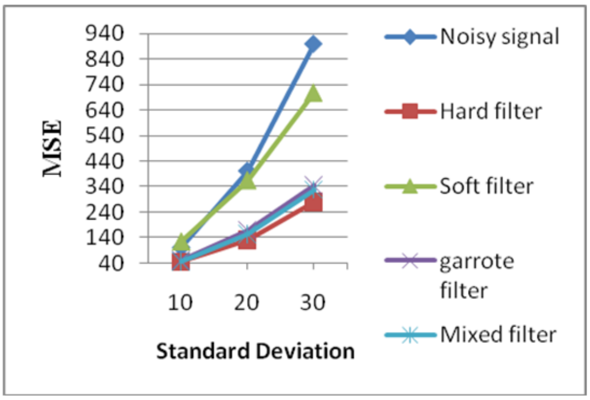
Graph 3: Comparison of MSE values for different functions in visu shrink method



Graph 4: comparison of SNR values for different functions in visu shrink method

Retrieval Number: D9063019420/2020©BEIESP
DOI: 10.35940/ijitee.D9063.029420
Journal Website: www.ijitee.org

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)



V. CONCLUSION

In this paper to denoise the noisy biological signal a mixed thresholding function is proposed. Using ECG signals the performance of this function is evaluated. With existing hard filter, Soft function and garrote function these results are compared. From the obtained results, the performance of mixed thresholding function is better than soft and garrote functions with visu shrink method and FDR method.

ACKNOWLEDGMENT

The biographers place on record their appreciations to the authorities of CIET, Lam, Guntur, and A.P for the facilities they provided.

REFERENCES

1. Donoho, D. L., and Johnstone, I. M., Ideal spatial adaptation via Wavelet Shrinkage, Biometrika, Vol. 81, 1994, pp 425- 455.
2. M. Koteswara Rao, Dr.B.Anada Krishna, SK.Masthan, Ch.Diviya Susmitha "Analysis of Denoising on Different Signals Using New Thresholding Function" IEEE conference on Signal processing and communication Engineering Systems (SPACES-2018) is being organized by the Department of Electronics and Communication Engineering, KLU,Vijayawada, during 4th & 5th January, 2018
3. KOTESWARARAO M, Dr.V.V.K.D.V.PRASAD, "Decimated and Undecimated Wavelet Transforms Based Estimation of Images" "International Journal of Innovative Research in Science, Engineering and Technology", vol.3, Issue 10, pp 16981-16988, October 2014
4. KOTESWARARAO M 'Estimation of Images Using Decimated Wavelet Transform', International Journal of Image Processing and Applications Volume 5, Issue 2, Pages 223-228, Publisher International Science Press.
5. Sk. Ayesha, M. V. R. Amara Lingeswara Rao, Koteswararao M, "Wavelet Transform based Estimation of Images using different Thresholding Techniques" , "International Journal of Computer Applications " (0975 – 8887) Volume 167 – No.8, June 2017.
6. Dr. KV Ramarao, Dr.V saminadan "Assessment of Wave Transmission Algorithms in Atmosphere" International Journal of Technology & Engineering Science" Volume 5, Issue 1, March 2017, pp: 9014-9019.

AUTHORS PROFILE

Koteswararao Mallaparapu, presently working assistant Professor of ECE in Chalapathi institute of engineering and technology, received the M.Tech degree in Digital Electronics and Communication Systems from Gudlavalleru engineering college in 2015, B.tech degree in Electronics and Communication Engineering in Nalanda institute of engineering & technology in 2011, Current area of research in denoising of signals and images using wavelet transforms.

Dr.K.V.Ramarao presently working Associate Professor of ECE in Chalapathi institute of engineering and technology, received Ph.D degree from Pondicherry University, Current area of research is Wireless Communication and Image Processing.

SHAIK MASTHAN, presently working as Assistant Professor of ECE in Chalapathi Institute of Engineering and Technology. He received the M.Tech degree in Digital Electronics and Communication Systems from Gudlavalleru engineering college in 2015, B.tech degree in Electronics and Communication Engineering in Nimra institute of Science & technology in 2011, Current area of research is Wireless Communication and Image Processing.