DENOISE OF THE PCG SIGNAL USING HYBRID MODEL

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Abstract—The Objective of this paper is to Denoise the PCG by using Hybrid method, Hybrid method is used the wavelet transform and Hilbert transform. wavelet transforms method in analysis of one and two dimension signal. The Hilbert transforms method is a Denoising proposed method for heart sound signal based on empirical mode decomposition (EMD).Performance measurement is done of the basis of the SNR value obtained by changing various wavelet transform and Hilbert transform.

Keywords — PCG signal, WT , EMD , Classification, Denoising , Decomposition level etc.

I. INTRODUCTION

Heart is the essential component of the body. It is responsible for the proper operation of each and every part of the body including brain, because the flow of blood to every part of the body is the main task that any heart performs, fading to which whole body gets affected leading to improper functioning of various part of the body. Various abnormalities in the heart are categorized as Aortic Stenosis, Miteral Stenosis, Aortic Regurgitation and Miteral Regurgitation . In recent years, it is seen that the deaths have highly increased due to heart disease all over the world. The most of accurate detection of heart disease has forced researchers to develop a system which can help to detect the disease and cure it as soon as possible. PCG (Phonocardiogram) signal is becoming a very general and reliable alternative to ECG. The discovery of PCG signal gained the attention of researchers towards this area. Even from the heuristic point of view, which the cardiologist do while analyzing the disease is hearing the heart sound using a stethoscope, which is nothing but listening to the PCG signal generated by the heart while transferring the blood form one chamber of the heart to another chamber. The blood flows from heart to lungs and then from lungs to heart and to different parts of the body. This flow of bloods with specific pressure and volume produces the heart sound. Phonocardiogram signal is non-stationary signals with a frequency of 10 KHz. Although ECG signal has been analyzed to a greater level, it is not efficient to detect the heart disease because it deals with the electrical manners of the heart, while abnormalities in heart are mostly due to change in shape of the chambers of the heart. This change in the heart's shape leads to production of going against nature sound in the heart, and is the key to detect the abnormalities in the heart . These sounds provide the very important information to the cardiologist to identify the disease. The talent which a cardiologist must have, to detect the disease exactly can be imagined by the complexity of the task. A skilled cardiologist emerges by frequently working for a long time in the field of cardiac systems. This is where a beginner cardiologist may fail. There always exists a chance of wrong detection of disease because of the doctor's powerlessness to hear the sound properly, his perseverance and his experience. Due to not have of experience and skill they may not be able to handle the case and refer the patient to more experienced and skilled cardiologist. Although they have the theoretical knowledge 2 to cure the disease but that is not enough. The skill of the doctor coupled with the experience can only detect the disease right and correctly. This leads to the need of developing a decision support system (DSS) that can support doctors independent of their experience and any hostile physical conditions, which forced researchers to work and come up with a better system. The system developed here provides such a method. The system includes the feature extraction of PCG signal, using discrete wavelet transform specially Daubechies wavelet because this can provide better information than other wavelets like Haar, Symlet, Coiflet etc. Phonocardiogram signal is a nonstationary signal. We could do with to apply discrete wavelet transform to analyze it . Then for the purpose of classification of PCG signal, Adaptive Neuro Fuzzy Inference System (ANFIS) has been used . The training of the system is done by the heart sound available in various website of medical science on the World Wide Web. Although we are available with echocardiography for heart examinations, cardiac auscultation remains the mainly important and viewing diagnostic method for early diagnosis of heart valve diseases. Phonocardiography shows the graphical representation of the heart sounds. It is easy to use and non-invasive. It provides the diagnostic information for detection of the unusual function of the cardiac valves in clinical put into practice.

Methodology

WhereverTimesisspecified, The proposed methodology involves heart sound denoising using wavelet transform and Hilbert transform. Be-fore the description of the applied method, some generalization on wavelet And Hilbert denoising are summarize in this section.

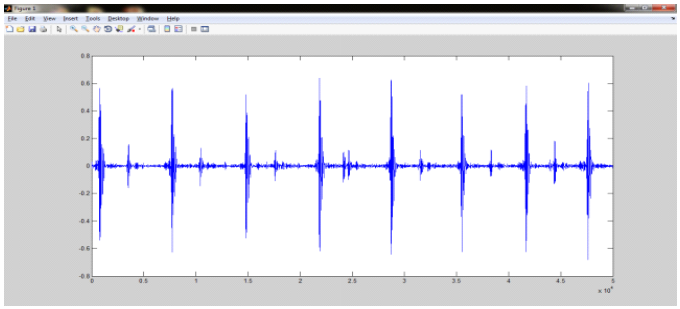


Fig-1 original heart sound signal

A. *Denoising of heart murmurs*: As stated above, the proposed method for denoising PCG signals is the WT and HT. Matlab routine provides built WT and EMD by decomposing a signal into wavelet coefficient as well as Hilbert coefficient and then reconstructs the signal.

B. *selection for wavelet denoising of PCG:* When using wavelet and Hilbert to denoise PCGs, there are many factors that must be considered. Examples of such factors are respectively which mother wavelet to choose, which level of decomposition to fix, and which thresholding methods to use.

Various families of wavelets are provided in Matlab including the Morlet , Mexican hat, Meyer, Haar, Daubechies, Symplets, Coiets and others .

These wavelets are the Haar, Daubechies, Coiffets, and Symlets.

The two common methods of thresholding a signal are soft and hard thresholding which are use in Matlab. The two methods can be defined as below .

1.Hard Thresholding

2.Soft Thresholding

Although hard thresholding is a simplest method, soft thresholding can produce better results as compare to hard thresholding.

C. *Denoising using wavelet transform:*

There are four principal rules to compute threshold in wavelet

Sqtwolog , Rigrsure, Heursure and Minimaxi.

First method threshold or global thresholding method and it is computed as the square root of two times the logarithm of the length of the signal.

In the second method, the selection of threshold is based on Steins unbiased estimate of risk (SURE). This method estimates the risk for a certain threshold value and then by minimizing the risks in a selection of the threshold value is obtained.

Rigrsure: Selection using the principle of Steins Unbiased Risk Estimate (SURE)

Sqtwlog: Fixed form threshold logarithm equal to the square root of two times the logarithm of the length of the signal

Heursure: Selection using a mixture of the first and the second rules.

Minimaxi: Threshold selection using the minimaxi principle.

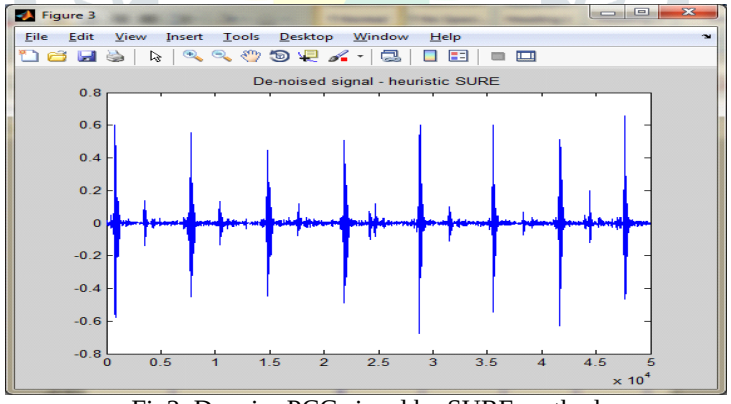


Fig2: Denoise PCG signal by SURE method

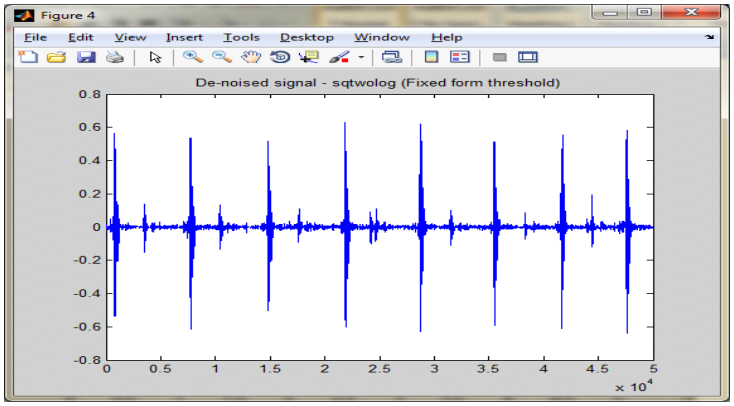


Fig3 :Denoise PCG signal By using Sqtwolog

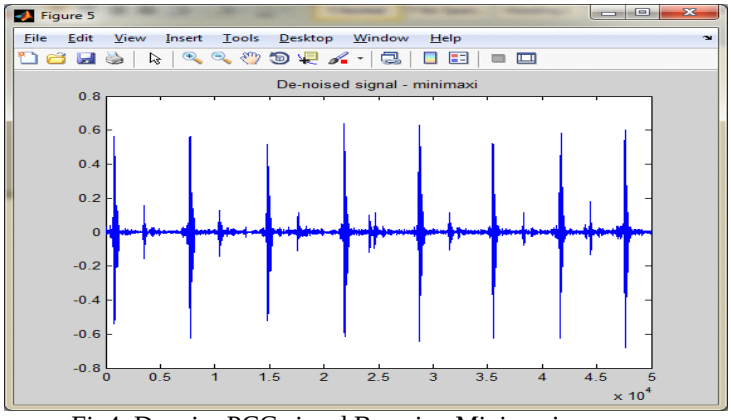


Fig4: Denoise PCG signal By using Minimaxi

D. Denoising Using Hilbert Transform

However, as mentioned above the empirical mode decomposition course of action takes a long computation time compared with decomposition on wavelets transform. Also, we noticed that the WT process is not perfectly studied in HSS.

1. The Hilbert Huang transform:

An alternative data analysis tool has been proposed by Norden E. Huang called the Hilbert-Huang Transform (HHT) . The HHT technique for analyze data consists of two components: a decomposition algorithm called empirical mode decomposition (EMD) and a spectral analysis tool called Hilbert spectral analysis. Both tools will be introduced and described henceforth. It will be shown that HHT can provide a local portrayal of the oscillating components of a signal, whether nonstationary or nonlinear.

Two component of HHT:

(a) Hilbert Spectral Analysis:

The purpose of HHT is to demonstrate an alternative method to present spectral analysis tools for providing the time-frequency energy description of time series data. Also, the method attempts to describe non stationary data locally. Rather than a Fourier or wavelet based transform, the Hilbert transform was used, in order to compute instantaneous frequencies and amplitudes and describe the signal more locally.

(b)Empirical Mode Decomposition:

The EMD algorithm is the other component to the HHT method. The algorithm attempts to decompose nearly any signal into a finite set of functions, whose Hilbert transforms give physical instantaneous frequency values. These functions are called intrinsic mode functions (IMFs). The algorithm utilizes an iterative sifting process which successively subtracts the local mean from a signal. The sifting process is as follows:

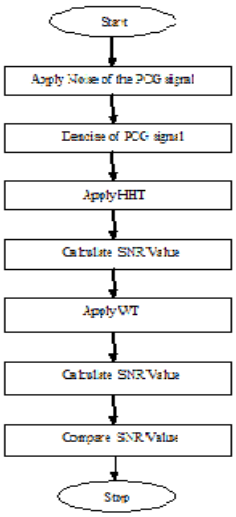
successively subtracts the local mean from a signal. The sifting process is as follows:

1. Determine the local extrema (maxima, minima) of the signal.
2. Connect the maxima with an interpolation function, creating an upper envelope about the signal.
3. Connect the minima with an interpolation function, creating a lower envelope about the signal.
4. Calculate the local mean as half the difference between the upper and lower envelopes.
5. Subtract the local mean from the signal.
6. Iterate on the residual.

The sifting process is repeated until the signal meets the definition of an IMF, which will be explained shortly. Then, the IMF is subtracted from the original signal, and the sifting process is repeated on the remainder. This is repeated until the final residue is a monotonic function. The last extracted IMF is the lowest frequency component of the signal, better known as the trend. Previously, the sifting process was said to stop when the signal met the criteria of an IMF.

FLOW CHART :

Proposed methodology in this paper is given Below:



II. RESULT & DISCUSSION:

Using proposed method the comparison of SNR value of the denoise signal will be obtained based on different wavelet, using Wden and Hilbert transform method. we can see that the SNR processed by soft thresholding is raised much more than that processed by hard thresholding.

III. CONCLUSIONS:

It is Aspected that denoising using Hilbert transform will give higher SNR value than the other denoising method. controlling image processing functions are applied to the subject, with which we can put into practice software denoising and therefore pay compensation for the shortage of hardware denoising. Multi-level wavelet transform is adopted to deal with each level of detail coefficients thresholding to do away with noise and interference of every frequency band.

REFERENCES

[1] Feng Liu, Yutai Wang, Yanxiang Wang, "Research and Implementation of Heart Sound Denoising," *Elsevier B.V. Selection and/or peer-review under responsibility of Garry Lee*. London Physics Procedia 25 (2012) 777 – 785.

[2] Tahar Omari and Fethi Bereksi-Reguig, "An automatic wavelet selection scheme for heart sound denoising ," Proceedings IWBBIO 2014. Granada 7-9 April, 2014.

[3] Ritola J, Doyle DJ, "Comparsion of time –frequency distribution in the heart sounds analysis [J], "Med Biol Eng Comput,1996,34(5):89-90.

[4] Liang H, Lukkarinen S, Hartimo I, "Heart sound segmentation algorithm based on heart sound envelogram[J],"Computers in Cardiology,1997,24(7):105-108.

[5] Oskiper T, Wartous R, "Detection of the first sound using a time-delay neutral work [J], "Computers in Cardiology,2002,29(10):537-540.

[6] Hebden J E, Torry J N, "Neural network and conventional classifiers to distinguish between first and second heart sounds [C], "In:IEEE Colloquium on Aritfical Intelligence Methods for Biomendical Data Processing[C],1996:1-10.

[7] Kumar D, Carvalho P, Antunes M, eral, "Thitd heart soud derection using wavelet transform-simplicity fiter [C], "In:2 9th Annal Internation Conference of the IEEE-EMBS[C],2007:1227-1290.

[8] Changhong Dong,Xiaohua Yu, Cheng Gao, "Signal processing and applications based on matlab[M], "Beijing:National Defence Industry Press, 2005,1:12-138.

[9] Lizhi Cheng,Hongxia Wang, Yong Luo, "Theories and applicatons of wavelet[M], "Beijing:Science Press, 2004,9:164-188.

[10] Aqi Zeng, Yi Cao, Yang Zhao, "A course in using matlab[M], "Beijing:Electrical Industry Press, 2004,5:265-285.