International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2017 IJSRCSEIT | Volume 2 | Issue 2 | ISSN : 2456-3307

Noise Reduction Methodology for Audio and Speech Signal

M. Nishanthi, M. Subha, B. Subetha, G. Bharatha Sreeja

Department of Electronics and Communication Engineering, PET Engineering College, Vallioor, Tamil Nadu, India

ABSTRACT

The speech signal is plays an important role in multimedia system. In this paper, Main objective is to reduce noise from audio signal which is heavily dependent on the specific context and application. Noise acts as the disturbance in any form of communication which degrades the quality of the information signal . Noise reduction is the process of removing background noise from speech signal. Many methods have been widely used to eliminate noise from speech signal like thresholding , discrete wavelet transform. The audio signal corrupted with white Gaussian noise which is especially hard to remove because it is located in all frequency, where Gaussion noise is inserted into an audio signal, this noise is used at different SNR levels .Discrete Wavelet technique is effectively reduces the unwanted higher or lower order frequency components in a speech signal. Soft and hard thresholding are used for denoising the signal. Soft thresholding method performs better than hard thresholding at all input SNR levels. The different wavelet types such as coiflet, daubechies, symlet are used to measure the performance. Wavelet are localized both in time and frequency. It is implemented by using different parameters such as SNR, Elapsed time.

Keywords : Discrete wavelet transform , hard thresholding , soft thresholding , signal to noise ratio, audio denoising, Gaussian noise.

I. INTRODUCTION

Speech denoising is a field of engineering that studies methods used to recover an original speech from noisy signals corrupted by different types of noises [1]. The application areas of wavelet transform are 1D or 2D biomedical signal analysis, producing & analyzing irregular signals or images, wavelet modulation in communication channels. Recently, various wavelet based methods have been proposed for the purpose of speech denoising [3]. De-noising will be performed in the transformation domain and the improvement in de-noising is achieved by using various types of wavelet transform [8]. Wavelet denoising algorithm is used for reduction of noise from speech signal [10] .Noise reduction in speech signals is a field of study to recover an original signal from its noise corrupted signal. The noise can be of various types like white, impulsive or even other types of noise usually found in speech signals [8] .Human Speech signals are in acoustic signal form so for the purpose of communication it's a necessary to convert into the electrical signal with the help of instruments called 'Transducers' [9] . The process of removing such noise from audio signals is audio denoising.

II. METHODS AND MATERIAL

PROPERTIES OF THE SPEECH SIGNAL

Sounds created in the vocal tract have an effective frequency range of 300 Hz to 3400 Hz. Although speech has a wider frequency range, the band of 300 Hz to 3400 Hz encompasses a range sufficient for understanding speech and is considered as a standard for speech transfer in telephony .The fundamental frequency of an adult male voice ranges between 85

and 180 Hz, while this range in an adult female voice is 165 to 255 Hz. Vowels with a high fundamental frequency have a wide harmonic range in the speech signal spectrum, instead of a spectral peak [9]. Based on the frequency properties described, it is possible to reduce different sounds in the speech signal. In certain situations, the difference between speech and noise is obvious. For instance, all noises below 300 Hz and above 3400 Hz may be suppressed by filtering out the speech signal through the filter band.

NOISE

Noise is defined as an unwanted signal that interferes with the communication or measurement of another signal. A noise is an information-bearing signal that conveys information regarding the sources of the noise and the environment in which it propagates. Noise can be categorized of different types .In which white noise is defined as an uncorrelated random noise process with equal power at all frequencies.

Audio Noise Audio

Noise reduction system is the system that is used to remove the noise from the audio signals. Audio noise reduction systems can be divided into two basic approaches. The first approach is the complementary type which involves compressing the audio signal in some well-defined manner before it is recorded (primarily on tape). On playback, the subsequent complementary expansion of the audio signal which restores the original dynamic range, at the same time has the effect of pushing the reproduced tape noise (added during recording) farther below the peak signal level—and hopefully below the threshold of hearing. The second approach is the single-ended or non-complementary type which utilizes techniques to reduce the noise level already present in the source material—in essence a playback only noise reduction system . This approach is used by the LM1894 integrated circuit, designed specifically for the reduction of audible noise in virtually any audio source. Noise reduction is the process of removing noise from a signal. All recording devices, both analogue or digital have traits which make them susceptible to noise. Noise can be random or white noise with no coherence, or coherent noise introduced by the device's mechanism or processing algorithms. Their is an Active noise control (ANC), also known as noise cancellation, or active noise reduction (ANR), is a method for reducing unwanted and unprocessed sound by the addition of a second sound specifically designed to cancel the first[12].

WAVELET

Wavelets are a more general way to represent and analysis multi resolution signal. It is also applied to 1D signal. It is used to remove the noise from the signal. The Wavelet function should be quite smooth and concentrated in both frequency and time domain. Wavelet allows complex information such as speech, signal. Wavelets are used to compute the 2D wavelet transform. After the transform, compute the inverse transform. In signal processing, wavelets make it possible to recover weak signals from noise . This has proven useful especially in the processing of X-ray and magnetic-resonance images in medical applications. Images processed in this way can be "cleaned up" without blurring or muddling the details.

VARIOUS WAVELET USED FOR SPEECH SIGNAL ANALYSIS

Several families of wavelets that have proven to be especially useful are included in the wavelet toolbox. This paper has used three wavelets: Symlets and Daubechies wavelets are used for speech signal denoising [13] .

Daubechies wavelet transform

The Daubechies wavelet transforms are defined in the same way as the Haar wavelet transform by computing the running averages and differences via scalar products with scaling signals and wavelets the only difference between them consists in how these scaling signals and wavelets are defined. The Daubechies wavelet is more complicated than the Haar wavelet. Daubechies wavelets are continuous; thus, they are more computationally expensive to use than the Haar wavelet, Audio de-noising and compression is more sonically pleasing with the Daubechies wavelet than with the Haar wavelet. The Daubechies 4 filter can be used to perform the Daubechies wavelet transforms.

Symlets Wavelets

The Symlets are nearly symmetrical wavelets proposed by Daubechies as modifications to the db family. The properties of the two wavelet families are similar. There are 7 different Symlets functions from sym2 to sym8.

WAVELET THRESHOLDING

The wavelet denoising technique is called thresholding. It is divided in three steps.

- The first one consists in computing the coefficients of the wavelet transform (WT) which is a linear operation.
- The second step consists in thresholding these coefficients.

The last step is the inversion of the thresholded coefficients by applying the inverse wavelet transform, which leads to the denoised signal.

III. RESULTS AND DISCUSSION

SOFT AND HARD THRESHOLDING

The soft and hard thresholding methods are used to estimate wavelet coefficients in wavelet threshold denoising [3]. Hard thresholding zeros out small coefficients, resulting in an efficient representation. Soft thresholding softens the coefficients exceeding the threshold by lowering them by the threshold value. When thresholding is applied, no perfect reconstruction of the original signal is possible [3].The process of removing such noise from audio signals is audio denoising.

Signal to noise ratio (SNR)

The global SNR values are determined by the ratio of square of clean speech to the square of the difference between the clean speech and the enhanced speech. If the summation is performed over the whole signal length, the operation is called as global SNR.

Table 1 : Comparison of wavelet transform techniques with AWGN at Soft thresholding Technique

S. No	Method	Types of wavelet	Noisy SNR	Denoised SNR
1	Discrete Wavelet technique [3]	Db9	5.00151	13.1161
2	DWT with thresholding and types of wavelet[4]	Coif5	1.00144	12.1227
3	wavelet transform[13]	Db13	5.0263	6.2431
4	wavelet transform[13]	Sym13	5.0105	6.2462

Table 2: Comparison of wavelet transform techniques with AWGN at hard thresholding Technique

S. No	Method	Types of wavelet	Noisy SNR	Denoised SNR
1	Discrete Wavelet technique[3]	Db10	4.99452	15.0841
2	DWT with thresholding and types of wavelet[4]	Coif5	1.96955	4.9958
3	wavelet transform [13]	Db13	5.0047	6.7701
4	wavelet transform[13]	Sym13	4.9981	6.2558

IV.CONCLUSION

This paper presents a removing Gaussian noise from speech signals . It found that by using DWT, threshold, It can get the better results of de-noising, especially for low level noise. During different analysis found that soft thresholding is better than hard thresholding because soft thresholding gives better results than hard thresholding. In DWT soft threshold results are best as compared to hard threshold. Speech de-noising is performed in wavelet domain by different types of

wavelet with different thresholding. During different analysis, soft thresholding is better than hard thresholding because soft thresholding gives better results than hard thresholding. Higher threshold removes noise well, but the part of original signal is also removed with the noise. It can analyze the de-noised signal by signal to noise ratio (SNR), Efficiency and elapsed time analysis.

V. REFERENCES

[1]. Rajeev Aggarwal ,Sehore M.P, Jai Karan Singh, Mukesh Tiwari ,Vijay Kumar Gupta ,Ghaziabad U.P. Anubhuti Khare '' Noise Reduction of Speech Signal using Wavelet Transform with Modified Universal Threshold'' International Journal of Computer Applications (0975 – 8887) Volume 20– No.5, April 2011.

[2]. Shajeesh K.U, Amrita Vishwa Vidyapeetham, Ettimadai, K. P. Soman ''Noise Cancellation Method for Robust Speech Recognition'' International Journal of Computer Applications (0975 – 8887) Volume 45– No.11, May 2012 .

[3]. Nishan Singh1, Dr. Vijay Laxmi2 , Talwandi Sabo, Bathinda '' Audio Noise Reduction from Audio Signals and Speech Signals'' International Journal of Computer Science Trends and Technology (IJCST) – Volume 2 Issue 5, ISSN: 2347-8578 ,Sep-Oct 2014

[4]. Manjeet Singh, Er.Naresh Kumar Garg ''audio noise reduction using wavelet types with thresholding techniques'' International Journal of Engineering Science, Issue December 2014, Vol. 3 ISSN:2320-0332 December 2014.

[5]. Srashti, Chourasiya "Audio Noise Removal – Literature review" JETIR1509001 Journal of Emerging Technologies and Innovative Research(JETIR, Volume 2, Issue 9 JETIR (ISSN-2349-5162) , September 2015.

[6]. I Jashanpreet Kaur, Seema, Sunil Kumar , Yadavindra "Audio Noise Reduction Using Discrete Wavelet Transform and Filters" International Journal of Advanced Research in Computer Science & Technology (IJARCST 2016) 165 Vol. 4, Issue 2 (Apr. - Jun. 2016) ISSN : 2347 - 8446 . (Apr. - Jun. 2016)

[7]. M.A.Josephine Sathya , Dr.S.P.Victor" Noise Reduction Techniques and Algorithms For Speech Signal Processing" International Journal of Scientific & Engineering Research, Volume 6, Issue ISSN 2229-5518 September -2015.

[8]. Priyanka Khattar1 , Dr. Amrita Rai2 ,Mr. Subodh "Audio De-noising using Wavelet Transform" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 07 | July-2016 .

[9]. KamyaDubey,Vikas Gupta "A Review on Speech Denoising Using Wavelet Techniques" International Journal of Engineering Trends and Technology (IJETT) – Volume 4 Issue 9- ISSN: 2231-5381, - Sep 2013

[10]. Neeraj Kumari1, Shelly Chugh, Lakshmikanth.S1, Natraj.K.R2 , Rekha.K.R3 "Reduction of noise from audio signals using wavelets'' International journal for advance research in engineering and technology wings to your thought . Volume 3, ISSN 2320-6802 Issue VI, June 2015

[11]. Lakshmikanth.S1, Natraj.K.R2 , Rekha.K.R3 "Noise Cancellation in Speech Signal Processing" International Journal of Advanced Research in Computer and Communication Engineering Vol. 3, Issue 1, January 2014 .

[12]. Manjeet Singh, Er.Naresh Kumar ''Audio Noise Reduction Using Butter Worth Filter'' International Journal of Computer & Organization Trends – Volume 6 ISSN: 2249-2593 Number 1 – Mar 2014 .

[13]. V.S.R Kumari1, Dileep Kumar '' Wavelet Based Denoising of Speech Signal'' International Journal of Engineering Trends and Technology (IJETT) – Volume 5 ISSN: 2231-5381 number 2 - Nov 2013