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TO PERFORM THE 16 ORDER SUB-BAND ADAPTIVE NOISE CANCELLATION USING LMS & RLS.

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ABSTRACT

Noise is the form of unwanted signal which attenuate the flow of information signal. So some techniques are used to avoid noise. Noise cancellation technology is aimed at reducing unwanted ambient sound. Adaptive filtering plays an important role in the field of signal processing and has various applications in fields of speech processing & communications. In signal processing, the function of a filter is to remove unwanted parts of the signal, such as random noise, or to extract useful parts of the signal, such as the components lying within a certain frequency range. In the process of transmission of information from the source to receiver side, noise from the surroundings automatically gets added to the signal. This acoustic noise picked up by microphone is undesirable, as it reduces the perceived quality or intelligibility of the audio signal. The problem of effective removal or reduction of noise is an active area of research.

KEYWORDS: Filters, Analysis filter bank, Synthesis filter bank, Lms & Rls Filter

I. INTRODUCTION

Noise problem in environment have gained attention due to the rapid growth of technology that has led to noisy engines, heavy machinery, pumps, high speed wind buffering etc. The problem of controlling the noise level in communication is tremendous amount of research over the year. Passive silencing techniques such as sound absorption and isolation are inherently stable and effective over a broad range of frequencies. However, these tend to be expensive, bulky and generally ineffective for canceling noise at the lower frequencies. Various signal processing techniques have been proposed over the years for noise reduction in the environment. . The first approach is passive electrical noise reduction techniques, such as those applied in hearing aids. This is not applied when the ambient noise has very large amplitude. In such situations, the second approach of Adaptive Noise Cancellation (ANC) is applicable. Adaptive Filtering is an important concept in the field of signal processing and has many applications in speech processing and communications. Adaptive filter is a filter that self-adjusts its transfer function according to an optimizing algorithm. The adaptive algorithms should be: simple, computationally efficient, implementable on the existing hardware platform and cost effective. One .of the main objectives within adaptive signal processing is noise suppression. Various adaptive algorithms are developed for noise cancellation they are implementation of LMS (Least Mean Square) and RLS (Recursive Least Square) algorithms on MATLAB**.**

II. NOISE

Noise is any undesired signal in a communication circuit. Noise is unwanted disturbances superimposed on a useful signal, which tends to obscure its information content. Sound which are listeners want to hear, is the information and that which causes pain and annoyance is noise.

Types of Noise

White noise

White noise is a random signal or process with a flat power spectral density, so it is a noise in which the frequency and power spectrum is constant and independent of frequency. Its name comes from a similarity to white light, which has equal quantities of all colors.

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Thermal noise

This type of noise occurs in all transmission media and communication equipment, including passive devices. It arises from random electron motion and is characterized by a uniform distribution of energy over the frequency spectrum with a Gaussian distribution of levels. Whenever molecules heat above absolute zero, thermal noise will be present.

Atmospheric Noise

Atmospheric noise is radio noise caused by natural atmospheric processes, primarily lightning discharges in thunderstorms

Applications of Adaptive Noise Cancellation

Adaptive noise cancellation can be usefully applied in situations where it is required to cancel an interfering noise from a given signal that is a mixture of the desired signal an interference noise. Some useful applications of the adaptive noise cancellation operation are presented in the following section.
Adaptive Canceling ECG in Heart-Electrocardiography.
Adaptive Acoustic Echo Cancellation.
Noise Canceling in Cell Phones.
Adaptive Noise Control in Jet Aircraft.

Objectives of study

- This work involves the study of different adaptive algorithm.
- Modeling and simulation of full band adaptive noise cancellation.
- Comparison of 16 sub-bands adaptive noise cancellation.

III. METHOD AND DATA ANALYSIS

The Research Methodology & data Analysis will focused on the study of 16 order sub-band Adaptive noise cancellation. The necessary information will be collected from Matlab Software. The collection of data about different type of filters, sub bands will collect from different literatures and algorithms.

Adaptive Filters (ANC)

An Adaptive Noise cancellation utilizes a reference input, ideally containing just noise, which is passed through an adaptive filter and later subtracted from a primary input containing both the desired signal and components of the noise present in the reference input. The output becomes the primary signal with the noise attenuated or cancelled altogether.

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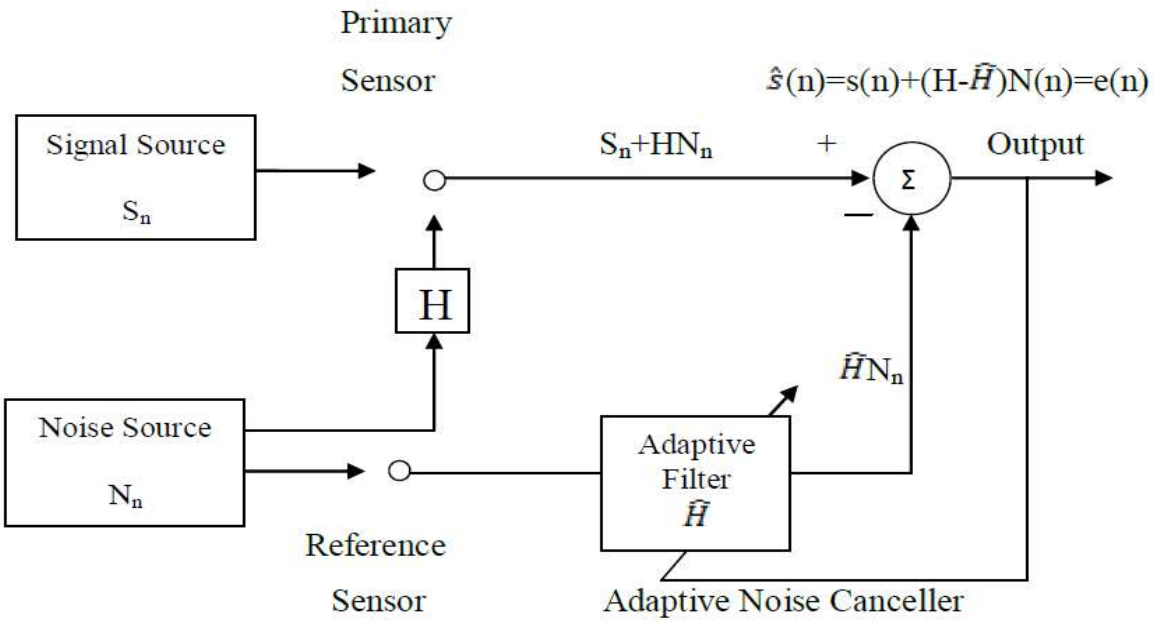

Adaptive Noise Cancellations

Adaptive filter algorithm

There are two types of algorithm are used:

1. **1 Least mean squares algorithm**
2. **2 RLS algorithm**

Implementation of the LMS algorithm

Each iteration of the LMS algorithm requires the following distinct steps in the given order:

1. Initially, set each weight Wn (i), where i= 0, 1,..,N-1, to an arbitrary fixed value such as 0.
2. Compute filter output
   N-1
   Y(n) = ∑ w(n)xx(n-i) =x(n)
   I=0
3. Compute the error estimate
   E (n) =d (n)-y (n)
4. Update the next filter weights
   W (n+1) =w (n) +2μe (n) x (n)

The main reason for the LMS algorithms popularity in adaptive filtering is its computational simplicity, making it easier to implement than all other commonly used adaptive algorithms, For each iteration the LMS algorithm requires 2N additions & 2N+1 Multiplication. (N for calculating the output, y (n), one for 2μe (n) for and an additional N for the scalar by vector multiplication).

RLS algorithm

The RLS algorithms are known for their excellent performance when working in time varying environments but at the cost of an increased computational complexity and some stability problems. The RLS algorithm performs at each instant an exact minimization of the sum of the squares of the desired signal estimation errors. These are its equations: To initialize the algorithm **P** (*n*) should be made equal to δ-1 where δ is a small positive constant.

Y (n) = (n).u (n)
α (n) = d(n)-(n-1)u(n)
Π (n) = (n).P (n-1)
K (n) = λ + π (n).u (n) K (n) = (n-1) + α*
P' (n-1) = k (n) .π (n) P (n) = (P (n-1) - P (n-1)

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In the RLS Algorithm the estimate of previous samples of output signal, error signal and filter weight is required that leads to higher memory requirements.

IV. RESULTS AND DISCUSSION

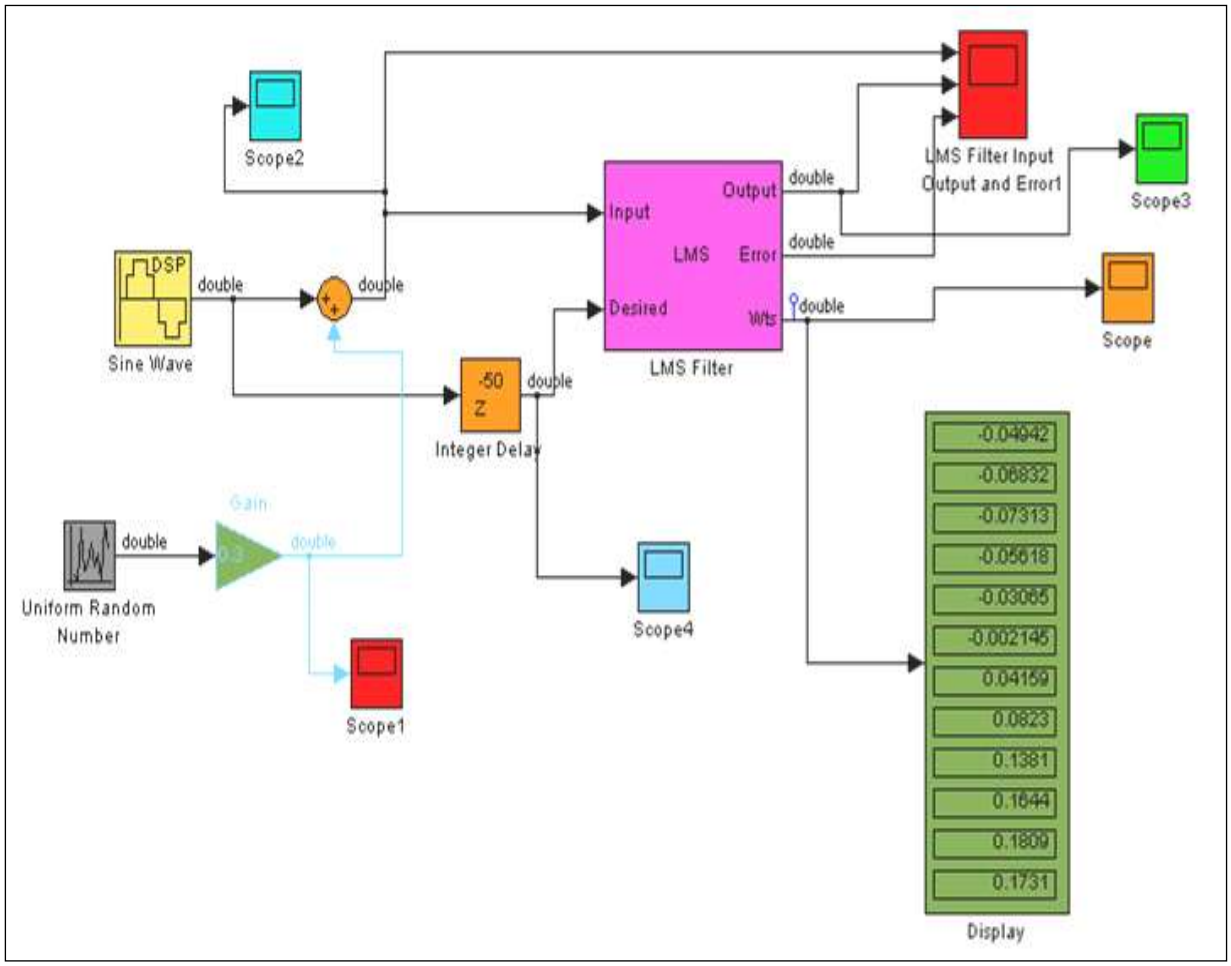
Simulation

Tool used

We use the MATLAB simulink tool for the simulation purpose.

Matlab Simulink Model

The name MATLAB stands for Matrix Laboratory is a high performance programming language for technical computing. This software is used for a wide variety of scientific and engineering calculations, especially for automatic control and signal, image processing, it has extensive graphical capabilities, and algorithm development. Matlab allows easy matrix manipulation,



Matlab Simulink Model of Full Band Adaptive Noise Cancellation

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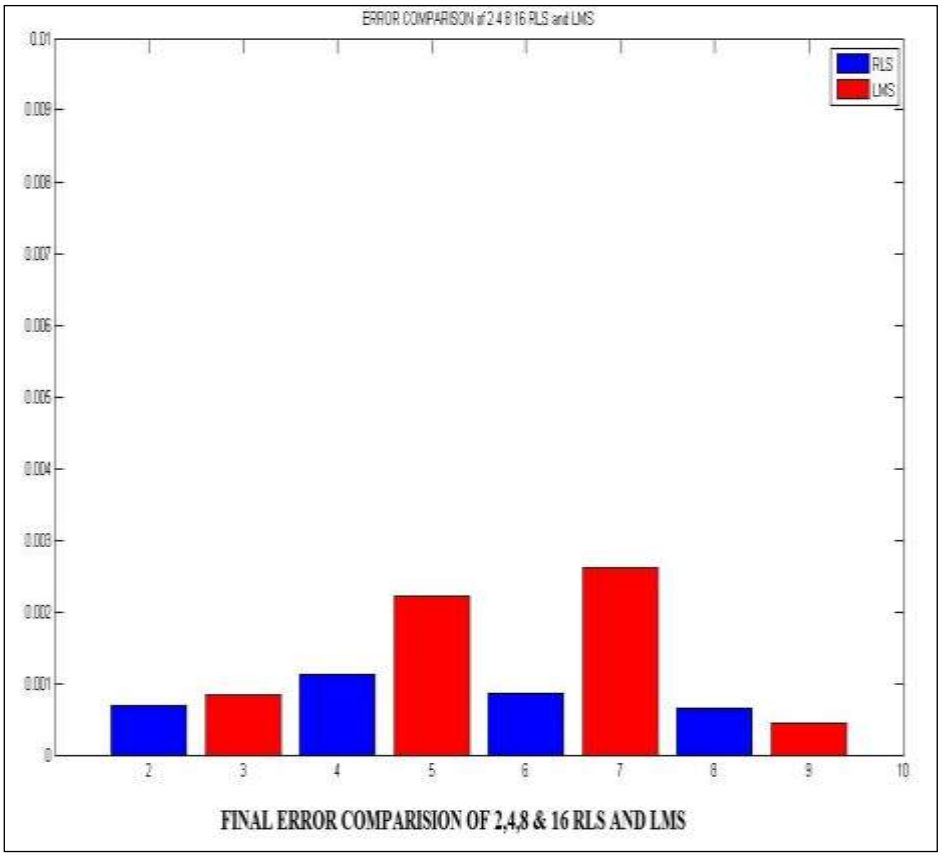
Comparison of error between LMS and RLS



V. CONCLUSION

Attempts were made to find best method among all. Results shows that 16th order sub band have less error. By study the effects of LMS and RLS. It concludes that LMS shows minimum error.

From the observations, it is concluded that:-

- LMS algorithm is the best as compare to RLS.
- By increasing the order of sub band, error signal will be low so signal output will be more correct.
- 16th order sub band shows best result.

VI. FUTURE SCOPE

In this paper comparison of different sub band algorithms includes LMS and RLS have been performed and find out that LMS is better but it have problem of complexity.

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