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Performance Comparision of Adaptive Algorithms in Denoising of ECG Signals

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Abstract:-For decades now in the communication system it has undergone advancement for estimation the noise and correcting the errors in the communication system. In this project we are using the multi-amplitude signals in wireless OFDM system. It needs to track the fading ratio i.e, the noise and tries to remove it. Here we will address two type of estimators namely LMS (Least mean square) and RLS (Recursive least square). These channel estimator uses the adaptive estimator method that is it requires the knowledge of received signal and the noise signaled for the output.

Keywords: - *RLS, OFDM, LMS, Channel estimation*

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INTRODUCTION

In wireless communication the channel estimation is important, as the channel can append noise to the signal which in turns changes the received signal which is not at all feasible when communication is concerned. In this project we are using OFDM (Orthogonal Frequency Division Multiplexing). In OFDM the high bit rate data stream is divided in small low bit rate streams and is transferred over the channel. The main advantage of using OFDM is that it can provide multipath and more spectrum efficiency. Since the signal is divided the impact of noise is low but it is still present. In this project the signal will be transmitted through the channel which can use AWGN (Additive white Gaussian noise), Rayleigh, Rician or AWCN + Raylein. The signal at the receiving end will again go through the OFDM and again a high bit rate signal is generated and then the signal is tested with the channel estimator CE and the received signal is fetched.

The CE has namely two phases first is the training and the other is the testing. In the testing phase we will use two techniques to compare the signal namely Least Mean square (LMS) and Recursive least square (RLS). Here both the methods are compared for analyzing the more efficient system from the two.

The two techniques are explained as follows:

A. LMS(Least Mean Square):

LMS algorithm are type of adaptive filter for the CE. The LMS finds the weights that can relate to the error signals that is if we plot the graph the difference between the weigh and the received point is the noise.

The LMS starts with an assumption that are the weights calculated which can be zero or any value. At every step the mean square is applied and through the weight the actual graph is plot and if the received plot differs the step is changed. The output from the channel can be expressed as:

$$R(m)=\sum_{l=0}^{L-1} W(m,l)\, S(m-l)+ Z(m) \qquad (1)$$

HereS(m-l) is the complex symbol drawn from aconstellation s of the lth paths at time m-l, L is the channel length, Z(m) is the AWGN with zero mean and variance σ^2.

The Vector notation of the equation is as follows:

$$R(m) = W(m)S(m) - Z(m), \qquad (2)$$

The output of the adaptive filter is

Y (m) =West (m) S(m) (3) Where West(m) is the estimated channel coefficients at time m.

B. RLS (Recursive Least Square):

RLS algorithm is again an adaptive filter which recursively finds the coefficient which can help in minimizing weights. The RMS is considered as deterministic and is exhibits very fast convergence.

In RLS there is a single equation to determine the coefficient vector which minimizes the cost function. The recursive solution of the form is as follows:

$$\mathbf{w}_n = \mathbf{w}_{n-1} + \Delta\mathbf{w}_{n-1}$$

Where ▲W_{n-1} is a correction factor at time n-1. The cross Covariance $r_{dx}(n)$ is

$$R_{dx}(n) = \sum_{i=0}^{n} \lambda^{n-I} d(i)x(i)$$

IMPLEMENTATION

This system is divided into two phases first is the training phase and the second is the testing phase. The training phase is as follows. Firstly the channel estimator (CE) is created using LMS technique or the RMS technique. The CE is inputted with the original signal and the noisy signal then the coefficient is calculated that is the weight by which the denoised signal will be produced. The following figure shows the training phase.

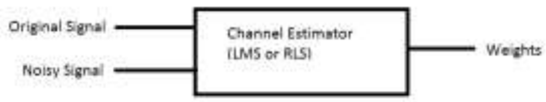

Figure 1. Training Phase of the CE

The testing phase is as follows. The analog signal is taken as the input. The signal is then converted to the binary form. The binary signal is then inputted to the OFDM block where the high bit rate signal is normalized and a low bit rate signal is generated. The low rate signal is then passed over a channel (Tx is the signal which is given as the input to the channel). The channel can use AWGN (Additive white Gaussian noise), Rayleigh, Rician or AWCN + Raylein. The output is termed as $Tx^{|}$. All these processes were at the senders end.

The signal received $Tx^{|}$is then again send to the OFDM block and again the high bit rate signal is generated from the low bits which were send to minimize the noise effect on the signal. The signals are then send to the Channel Estimator (CE). Here the channel estimator estimates the error by plotting BER to SNR ratio. Where SNR stands for signal to noise ratio and BER is ((T-R)/T)*100. Now the plots are multiplied with the weights and a plot is created. If there is distance between the resulting steps the plots are changed and thus we get the resulting output. This output is again sent to the decimal to analog converter and the resulting output is found. The following figure shows the block diagram of the testing phase.

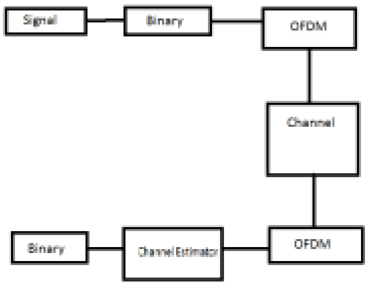

Figure 2. The Testing Phase of Channel Estimator

RESULT

The implementation is done using MATLAB. The outputs are as follows. The following figures shows the Matlab output. That is the transmitted signal which is normalized and how the channel estimation works.

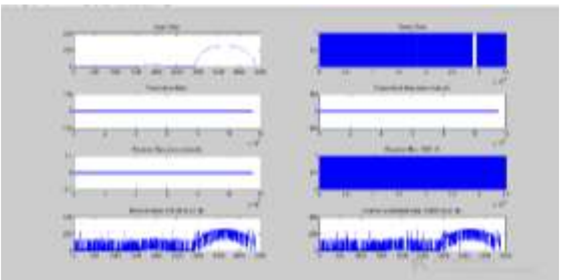

Figure 3. Channel Estimator using RLS

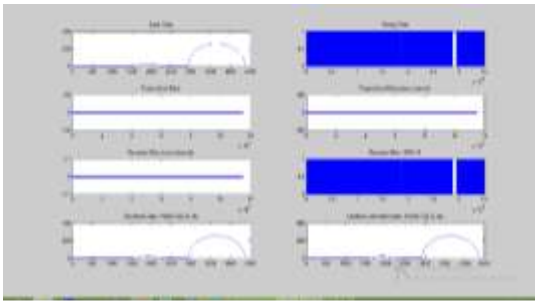

Figure 4. Channel Estimator using LMS

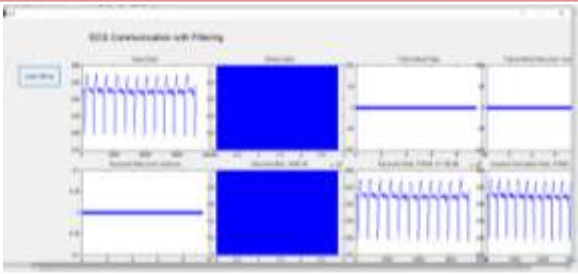

Figure 5. GUI interface of LMS

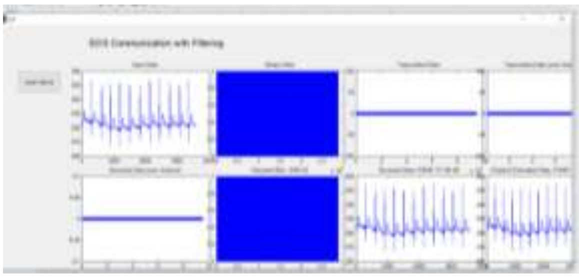

Figure 6. GUI interface of RLS

The following are the graphs plotted using the RLS and the LMS channel estimator. Fig. 7 and Fig. 8 shows the performance of two algorithms in estimating the desired signal under similar conditions. From Table 1 and Table 2 we can say that RLS algorithm is better than LMS algorithm for denoising ECG signal with lesser computational complexity.

FOR BIT-MIH SAMPLE 103			
LMS		**RLS**	
SNR	**BER**	**SNR**	**BER**
10	**0.266461893**	**10**	**0.012253541**
11	**0.157208966**	**11**	**0.007851181**
12	**0.108776240**	**12**	**0.005208237**
13	**0.072411498**	**13**	**0.003365419**
14	**0.027826102**	**14**	**0.001229234**
15	**0.016590187**	**15**	**0.000569846**
16	**0.006976856**	**16**	**0.000226144**
17	**0.002171798**	**17**	**0.000105487**
18	**0.001810247**	**18**	**0.000002774**
19	**0.000012888**	**19**	**0.000000644**
20	**0.000012888**	**20**	**0.000000644**

Table. 1 BER calculation of MIT-BIH ECG sample 103

FOR BIT-MIH SAMPLE 111			
LMS		**RLS**	
SNR	**BER**	**SNR**	**BER**
10	**0.203909132**	**10**	**0.014662522**
11	**0.131752977**	**11**	**0.009166669**
12	**0.075704150**	**12**	**0.006201755**
13	**0.037542067**	**13**	**0.003746988**
14	**0.037542067**	**14**	**0.001984025**
15	**0.013575652**	**15**	**0.0007937422**
16	**0.004736944**	**16**	**0.000313004**
17	**0.000738050**	**17**	**0.000090691**
18	**0.000800131**	**18**	**0.000000631**
19	**0.000012616**	**19**	**0.000000631**
20	**0.000012616**	**20**	**0.000000631**

Table. 2 BER calculation of MIT-BIH ECG sample 111

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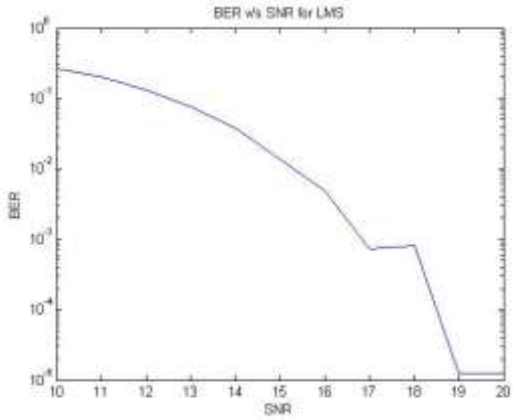

Figure 7. Plot of SNR vs BNR for LMS algorithm

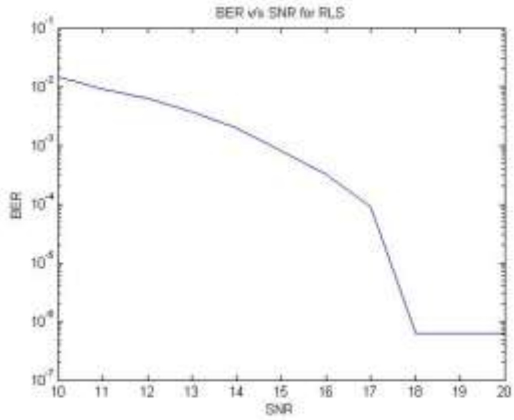

Figure 8. Plot of SNR vs. BNR for RLS algorithm

BER COMPARISION OF RLS AND LMS ALGORITHM				
		BER		
MITBIH DATABASE SAMPLE	**SNR RANGES**	**LMS**	**RLS**	**BER IMPROVEMENT**
100	10-20	0.062626856	0.00296506	0.059661795
101	10-20	0.048844451	0.002401423	0.046443028
103	10-20	0.060023597	0.002801196	0.057222401
105	10-20	0.049933864	0.002497149	0.047436715
106	10-20	0.046615098	0.002357324	0.044257774
107	10-20	0.047920284	0.002356091	0.045564193
108	10-20	0.053538992	0.002741872	0.05079712
109	10-20	0.045045148	0.00246141	0.042583738
111	10-20	0.061153952	0.003360117	0.057793834
112	10-20	0.061225574	0.003069175	0.058156399
113	10-20	0.047205431	0.002354807	0.044850625
114	10-20	0.04586402	0.002419472	0.043444548
115	10-20	0.046917191	0.002397166	0.044520025
116	10-20	0.04772648	0.002279145	0.045447335
117	10-20	0.066186546	0.003490201	0.062696345
118	10-20	0.047204778	0.002426786	0.044777991
119	10-20	0.045448044	0.002239325	0.043208719
121	10-20	0.05954241	0.003177953	0.056364457
122	10-20	0.049782213	0.002337179	0.047445034
123	10-20	0.048670811	0.003330804	0.045340007
124	10-20	0.047485022	0.002422103	0.045062919
200	10-20	0.067476019	0.003365156	0.064110863
201	10-20	0.066359602	0.003232466	0.063127136
202	10-20	0.049180509	0.002706274	0.046474235
203	10-20	0.05083687	0.002372325	0.048464545
205	10-20	0.051653023	0.002625826	0.049027198
207	10-20	0.067191027	0.003229205	0.063961822
208	10-20	0.050070977	0.002559445	0.047511533
209	10-20	0.050027725	0.002477172	0.047550554
210	10-20	0.063542053	0.003033736	0.060508317
212	10-20	0.049454793	0.002698323	0.04675647
213	10-20	0.043924895	0.002482645	0.04144225
214	10-20	0.068073633	0.003103856	0.064969777
215	10-20	0.067678783	0.003216697	0.064462086
217	10-20	0.05416904	0.002520037	0.051649003
219	10-20	0.048984738	0.002495234	0.046489503

220	10-20	0.049186364	0.002321697	0.046864667
221	10-20	0.068641942	0.0033838	0.065258141
222	10-20	0.072540629	0.003583266	0.068957363
223	10-20	0.04436126	0.00231005	0.04205121
228	10-20	0.072078074	0.003335144	0.06874293
230	10-20	0.046850768	0.002400728	0.044450039
231	10-20	0.07411421	0.003534364	0.070579846
232	10-20	0.069067262	0.003414777	0.065652485
233	10-20	0.056721776	0.002897346	0.05382443
234	10-20	0.064593934	0.00350627	0.061087664

Table 3. result of SNR vs. BNR for RLS algorithm and LMSalgorithms

For the execution of performance comparision process the ECG signal is aacquired from MIT BIH Arrhythmia data base.Ressult shown in above table is taken as average result of bit error rate of signal in which SNR ranges from 10 to 20.then finally showing result in parameter of bit error rate.

CONCLUSION

In this paper,two types of adaptive filtering have been used .This work investigate that the performance of implementation of RLS and LMS adaptive filtering method for denoising ECG signals recorded in noisy condition.
Result shows that using RLS adaptive filtering method shows superior result in terms of bit error rate with SNR .

REFERENCES

[1]. Comparison of RLS&LMS Algorithms for OFDM Systems by VidyaS.Bhosale, V. N. Ghodke in International Journal of Emerging Technology and Advanced Engineering.
[2]. On Channel Estimation in OFDM Systems by Sarah Kate Wilson† Per Ola B¨orjesson
[3]. Adaptive RLS Channel Estimation in MIMOOFDMSystemsbyYongmingLiangt,HanwenLuot, JianguoHuangt in IEEE
[4]. Sandeep Kaur‖ Orthogonal Frequency Division Multiplexing in Wireless Communication Systems: A Review International Journal of Advanced Research in Computer Engineering & Technology Volume 1, Issue 3, May 2012
[5]. Titus Eneh,Predrag Rapajic and Kwashie Anang ″Adaptive MMSE Multiuser Receivers In MIMO OFDM Wireless Communication″2010 IEEE.