SGN-21006 Advanced Signal Processing
Adaptive noise canceling project

Md Facihul Azam
student Id: 238949
date: 24.11.2014

This project is a partial fulfillment of the course SGN_ 21006 Advanced signal processing.

Introduction:

In this project there are 3 different kinds of adaptive noise canceling algorithm simulated, such as Normalized Least Mean Squared (NLMS),Least Squared (LS) and Recursive Least Squared (RLS) algorithm. Three different test sound ware used in the simulation. The simulation results are discussed here below.

1. Normalized Least Mean Squared Algorithm(NLMS):

Algorithm:
Given data
u(1), u(2), u(3), . . . , u(N) and
d(1), d(2), d(3), . . . , d(N)
1.Initialize w (0) = 0
For each time instant, n = 1, . . . , N
2.1 $k(n) = u(n)mu/(a + ||u(n)||^2)$
2.2 $\alpha(n) = d(n) - w(n-1)u(n)$
2.3 $w(n) = w(n-1) + \alpha(n)k(n)$

Here 1 (281s to 282s) second of each test sound were used. In this simulation it was observed that how average squared error is behaves in accordance with the adaptation constant mu. Here estimated signal of test sound 2 is given when mu=0.2.

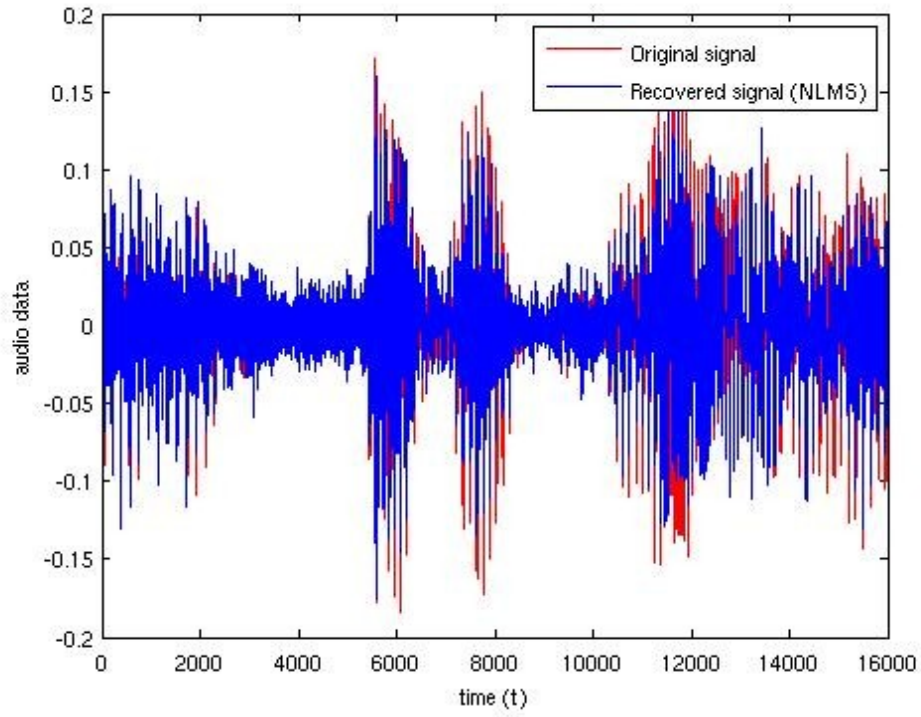


Figure1: one second of test sound Edgar Allan Poe - The Raven + Loud Quake III – 2.wav from 281 to 282 second.

From figure it shows that NLMS recovered original signal quite well. Figure2 shows the average squared error of 3 different sound 1,2 and 3 from left to right respectively. It is noticed 3 data set has different performance though data set 2 and 3 has same length of filter order(M=200). In Data set filter coefficients are changed from 280 second of input data . Due to environmental change average squared error is increase.

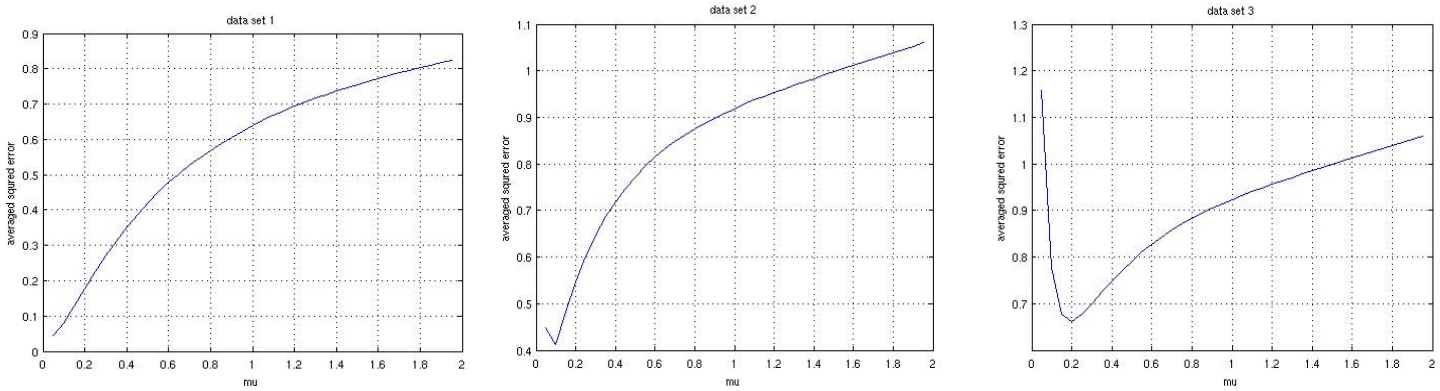


Figure2: one second of test sound Edgar Allan Poe – The Raven + Loud Quake III .wav from 280 to 281 second.

2. Least Squared(LS):

Here 10 seconds of input signal were used from 281 second to 291 second. In put signal was segmented in different parts (1,2,4,8,10) and calculated average squared error for each segmentation . The figure 3 shows average squared error as function of segmentation. When segmentation increases from 2 to 10 average squared error increases. Dataset 1 and 2 have almost same error performance due to constant environment. Dataset 3 has more error than others.

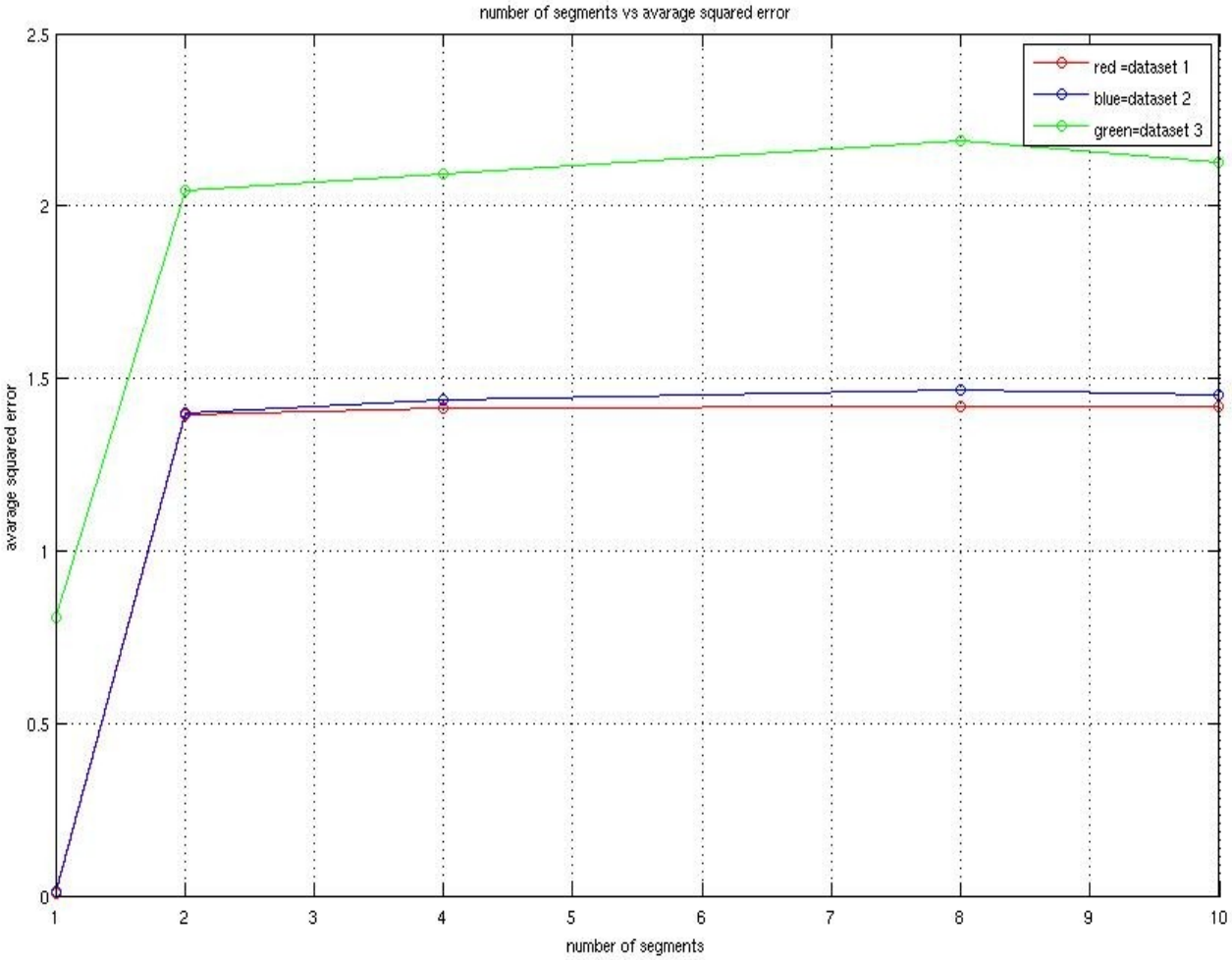
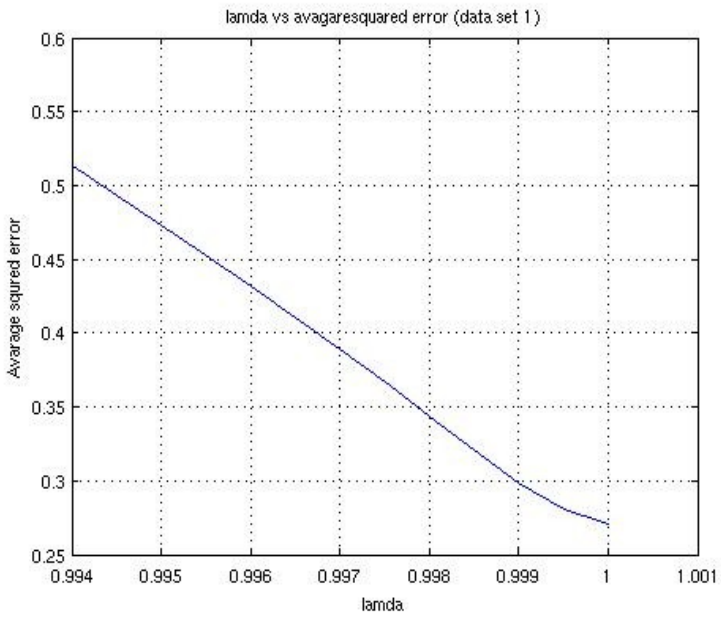


figure 3: average squared error as function of segments

3. Recursive Least Squared (RLS)

Here one second of input data was used from 281 to 282 second. Performance is evaluated in accordance with lamda (forgetting factor). Its observer from figure4 that average squared curve is monotonously decreasing while lamda increase in a constant environment(dataset 1 and 2). increasing filter order gives more average error. In dataset 3 from figure5 it is noticed that performance is similar curve but a little but more error shows that dataset 1 and 2. RLS perform better than NLMS while changing the environment. In figure6 the original signal quite nicely recovered by RLS algorithm.



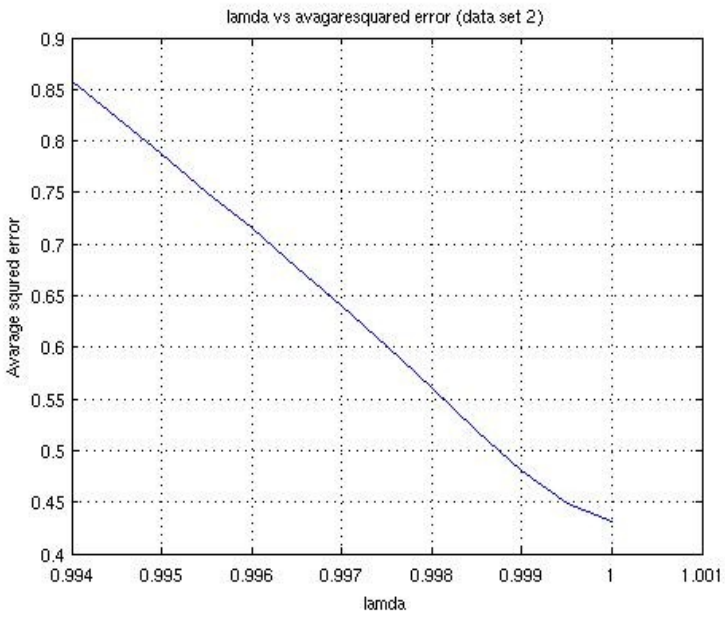


figure4 : average squared error as a function of lamda .

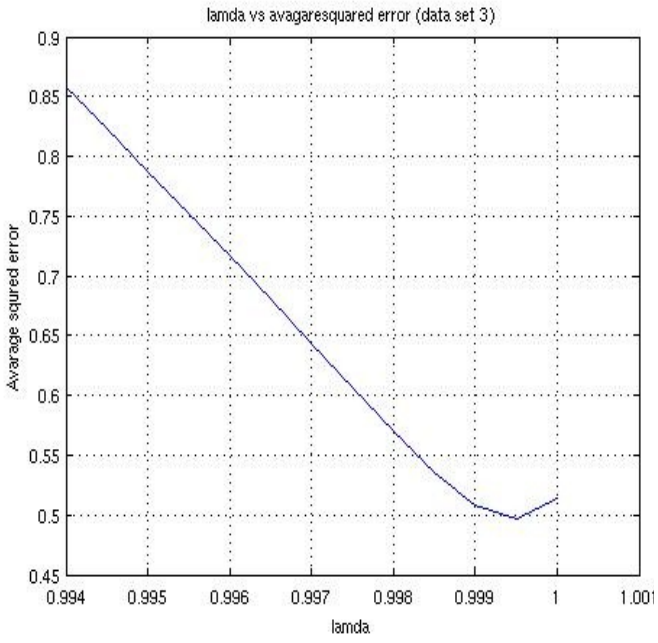


Figure5: avarege error as function of lamda dataset 3.

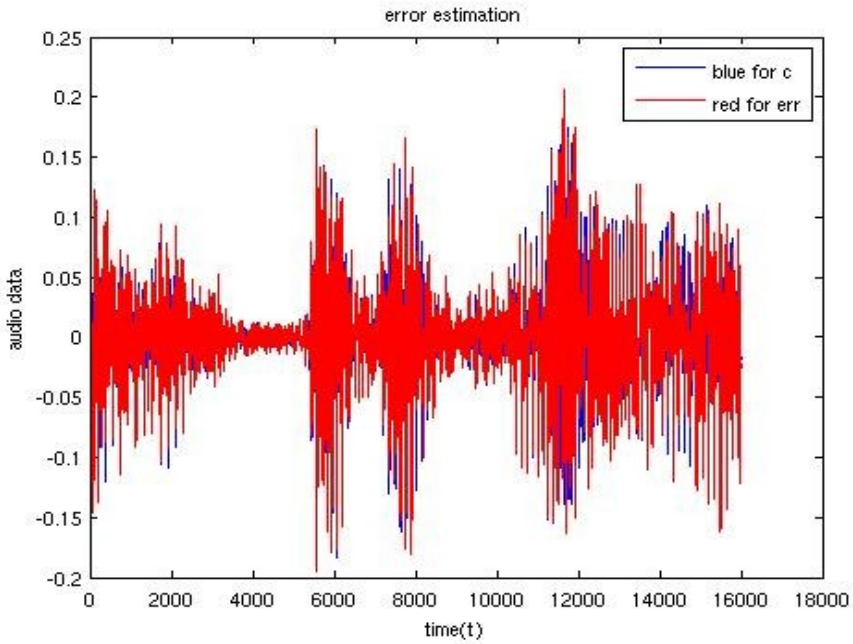


figure6: recovered and original signal of dataset 3