Institute of Information Technology (IIT)

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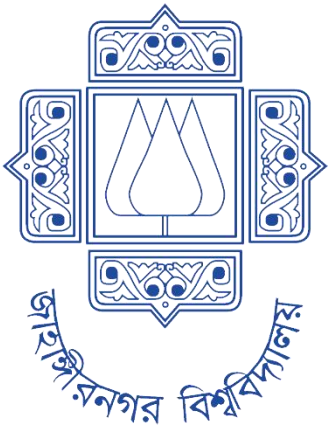

Lab Report: 08

Submitted by:

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EXPERIMENT NO : 08

NAME OF THE EXPERIMENT

Adaptive Filtering Using the Least Mean Squares (LMS) Algorithm

OBJECTIVE

1.Noise Reduction and Signal Recovery.
2.Performance Assessment through Mean Squared Error (MSE).

APPARATUS

1.MATLAB

THEORY

In signal processing, the goal is to clean up noisy signals. If a signal is distorted by unwanted noise, like static on a radio.

To remove this noise, we use a mathematical technique called the LMS (Least Mean Squares) algorithm. It listens to the noisy signal and continuously adjusts itself to reduce the noise while preserving the original signal.

The LMS algorithm is like an automatic cleaner for your audio. It's always working to make the signal clearer by getting rid of the unwanted interference. We can measure its success by checking how close the cleaned-up signal is to the original, noise-free audio. The goal is to make this difference as small as possible, ensuring that the algorithm effectively removes noise and restores the original signal's quality.

PROGRAM

```
clc;

clear all;

close all;

t = 0.001:0.001:1;

s = 2 * sin(2 * pi * 50 * t);

n = numel(s);

A = s + 0.9 * randn(1, n);

m = 25;

w = zeros(1, m);

wi = zeros(1, m);

e = zeros(1, n);

mu = 0.0005;

for i = m:n

e(i) = s(i) - sum(wi .* A(i:-1:i-m+1));

w = w + 2 * mu * e(i) * A(i:-1:i-m+1);

end

figure;

subplot(3,1,1);

plot(t, s);

title('Original Signal');

xlabel('Time (s)');

ylabel('Amplitude');

subplot(3,1,2);

plot(t, A);
```

```
title('Noisy Signal');

xlabel('Time (s)');

ylabel('Amplitude');

subplot(3,1,3);

plot(t, s - e);

title('Filtered Signal');

xlabel('Time (s)');

ylabel('Amplitude');

figure;

plot(t, e);

title('Error Signal');

xlabel('Time (s)');

ylabel('Amplitude');

mse = mean(e.^2);

disp(['Mean Squared Error (MSE): ', num2str(mse)]);
```

RESULT

```
Mean Squared Error (MSE): 1.952
>>
```

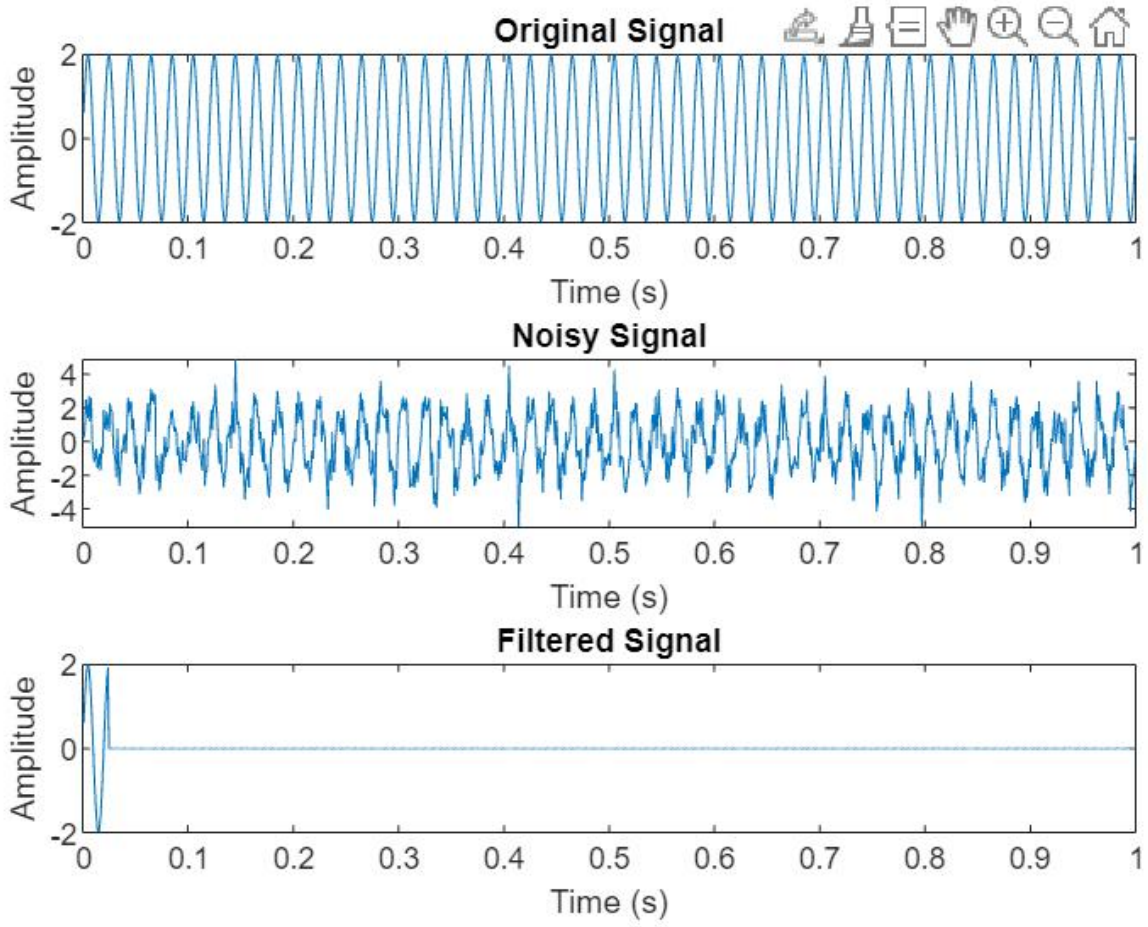

Fig:noisy signal and filtered signal

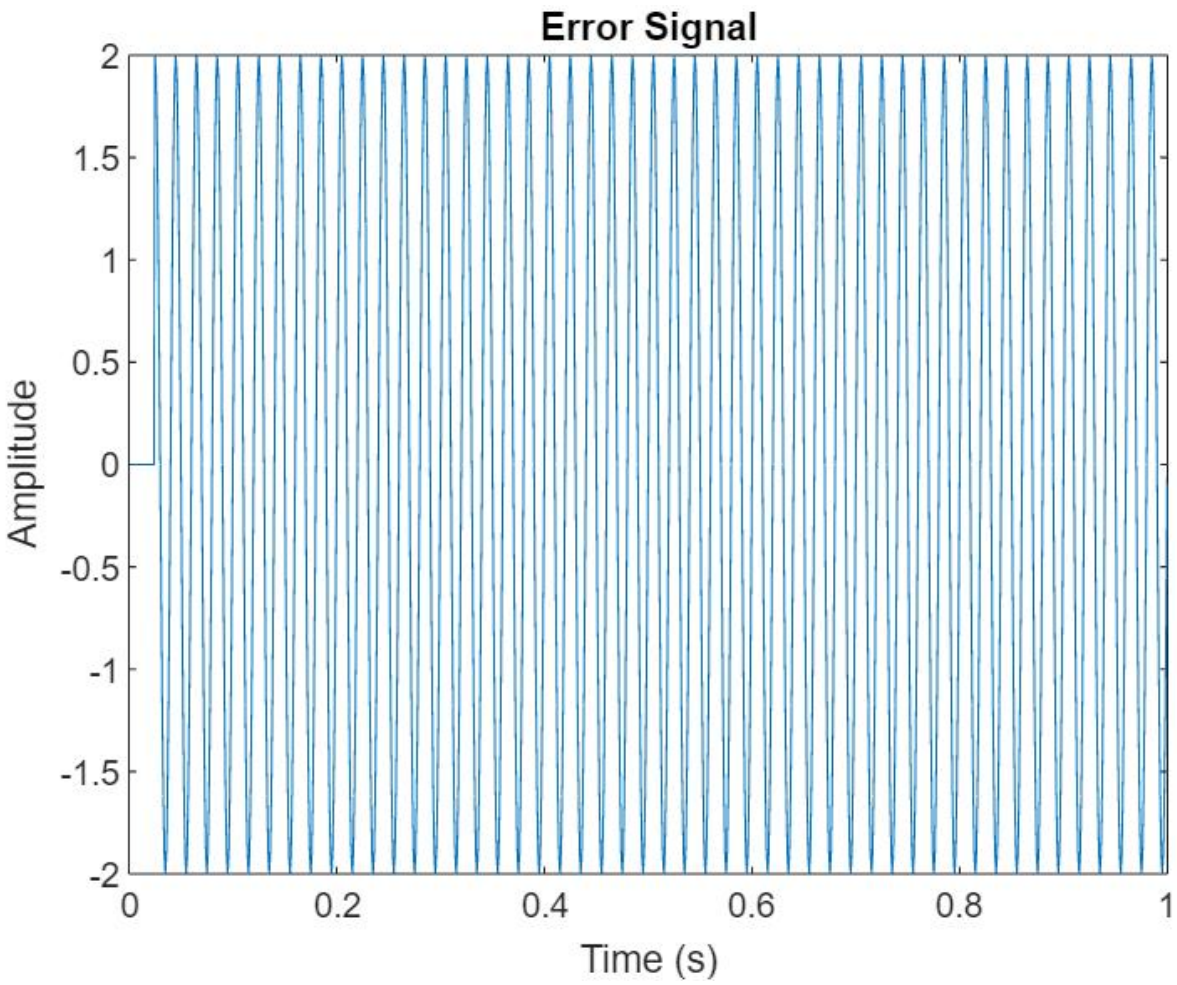

Fig: Error signal

DISCUSSION

In this experiment, we employed the LMS algorithm to enhance signal quality by reducing noise. The algorithm continuously adapted itself to the noisy input, progressively minimizing interference. Monitoring its performance through the Mean Squared Error (MSE) allowed us to gauge its effectiveness. Our discussion centers on the successful noise reduction achieved and the practical applications of adaptive filtering in improving signal quality, including its relevance in fields such as communications, audio processing, and data analysis.

CONCLUSION

In conclusion, our experiment demonstrated the practical application of the LMS algorithm for noise reduction. The algorithm effectively cleaned noisy signals, improving signal quality by minimizing interference. By utilizing the Mean Squared Error (MSE) as a performance metric, we verified the algorithm's success in noise reduction. This experiment highlights the significance of adaptive filtering techniques in various domains where signal quality enhancement is crucial, from audio processing to telecommunications.

REFERENCE

[1]Wikipedia Contributors, "Least mean squares filter," *Wikipedia*, Available:https://en.wikipedia.org/wiki/Least_mean_squares_filter [Accessed: Aug. 31, 2023]