GENETICALLY MODIFIED FIR LOW PASS FILTER FOR RICH SOUND ENVIRONMENT USING ADAPTIVE APPROACH

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Abstract:

In this paper an effort is made to design FIR filter using genetic algorithm in combination with adaptive algorithm which then applied for speech processing of hearing aid applications. The filter with these characteristics can remove noise present in the hearing aid very effectively than with traditional approach which improves the hearing capability of people with deaf. The results are simulated and compared with traditional approach using MATLAB.

1. INTRODUCTION

In signal processing usually filter is applied to remove noise. The signal which is contaminated with noise during its journey in the channel or in the processing circuit. In the case of people with hearing disability even then with usage of good hearing aid still they feel annoying because of variation characteristics of noise which needs a filter of variable characteristics so that noise with variation in characteristics can be eliminated effectively. So adaptive filtering [6] is best suited to use in hearing aid. First the filter is designed using genetic algorithm [7] which produces best coefficients for the filter to remove noise effectively.

2. PROPOSED SYSTEM BLOCK DIAGRAM:

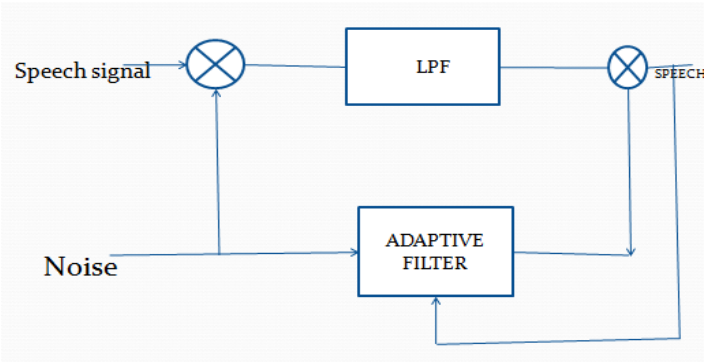

Figure-1 block diagram of proposed concept

Low pass filter is designed using genetic algorithm and adaptive LMS algorithm is applied to make the filter dynamic so that filter will respond to changes in noise characteristics. Here speech signal with noise (sine wave) is applied to the filter the response of the filter is then analyzed with variation in sine wave which is considered as dynamic noise

3. GENETIC ALGORITHM:

Genetic algorithms are theoretically and empirically proved to provide robust search in complex spaces. Its validity in *–Function* Optimization and Control Applications is well established. Genetic Algorithms (GA)[8] provide a general approach for searching for global minima or maxima within a bounded, quantized search space. Since GA only requires a way to evaluate the performance of its solution guesses without any apriority information, they can be applied generally to nearly any optimization problem. GA does not guarantee convergence nor that the optimal solution will be found, but do provide, on average, a “good” solution. GA is usually extensively modified to suit a particular application.

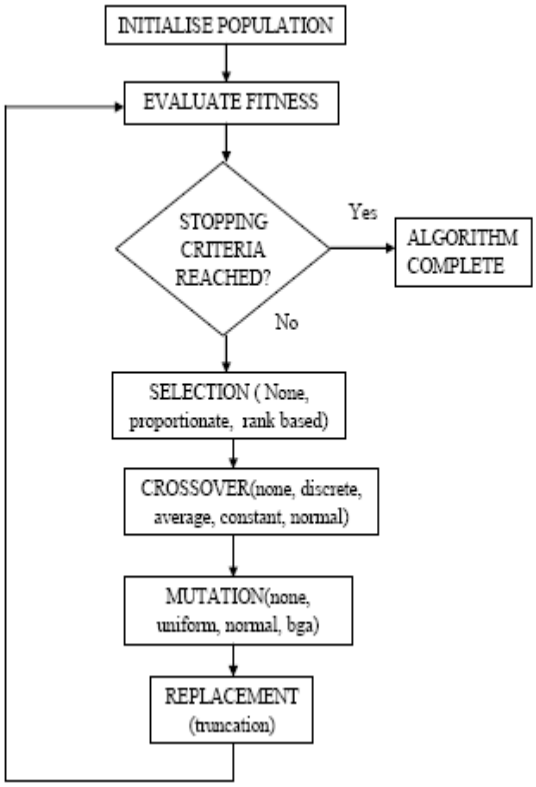

Figure-2 Flow chart of continuous GA

4. FITNESS FUNCTION:

The fitness function provides a way for the GA to analyze the performance of each chromosome in the population. Since the fitness function is the only relation between the GA and the application itself, the function must be chosen with care. The fitness function must reflect the application appropriately with respect to the way the parameters are to be minimized.

FITNESS FUNCTION IS:

@(n)[(0.6875)-((sin(0.6875*pi*n))/(pi*n))] …..1

5. FILTER COEFFICIENTS

Generation	f-count	f(x)	f(x)	Generations
31	800	2.638e-05	0.08157	2
32	825	2.638e-05	0.1359	3
33	850	1.64e-05	0.1067	0
34	875	1.64e-05	0.08082	1
35	900	1.64e-05	0.07122	2
36	925	1.64e-05	0.1163	3
37	950	1.64e-05	0.06085	4
38	975	1.64e-05	0.05703	5
39	1000	1.64e-05	0.03138	6
40	1025	1.64e-05	0.04814	7
41	1050	1.64e-05	0.096	8
42	1075	1.64e-05	0.06336	9
43	1100	1.64e-05	0.0975	10
44	1125	1.64e-05	0.02686	11
45	1150	1.64e-05	0.05129	12
46	1175	1.64e-05	0.03797	13
47	1200	4.265e-07	0.02886	0
48	1225	4.265e-07	0.07087	1
49	1250	4.265e-07	0.07603	2
50	1275	4.265e-07	0.08699	3
51	1300	4.265e-07	0.07626	4

TABLE-1: Filter coefficients

6. FITNESS FUNCTION OUTPUT:

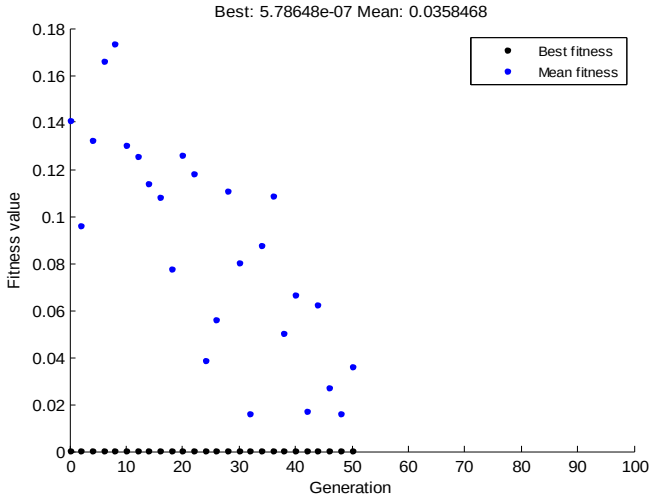

Figure-3 the output of fitness function

The figure-3 shows the output of fitness function which yields the best coefficients for filter design

7. RESULTS:

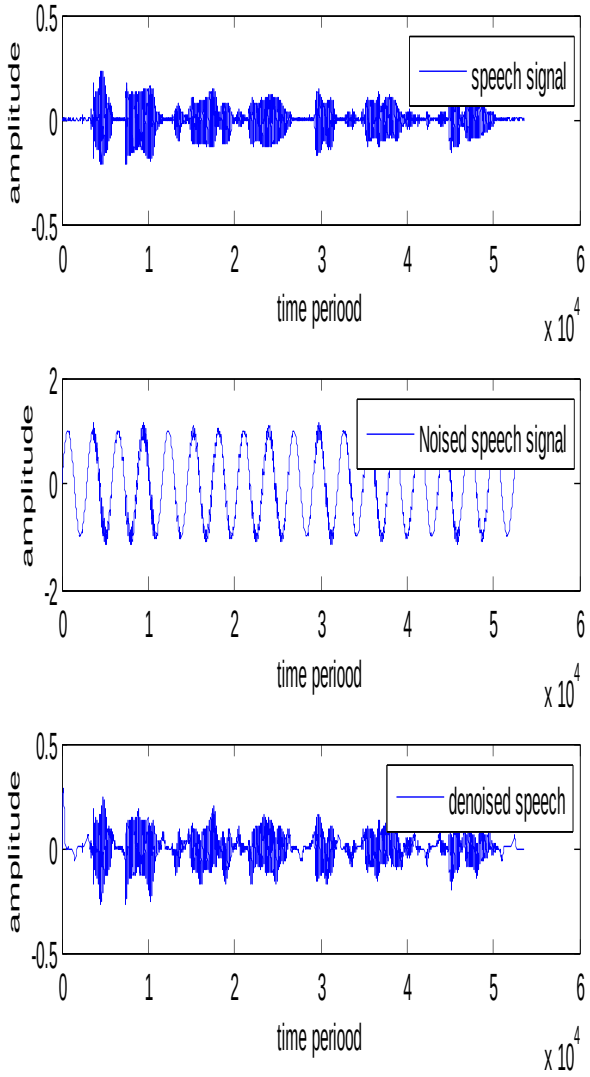

Figure -4 without GA

The figure-4 shows the response of designed filter without application of genetic algorithm with applied speech signal with noise

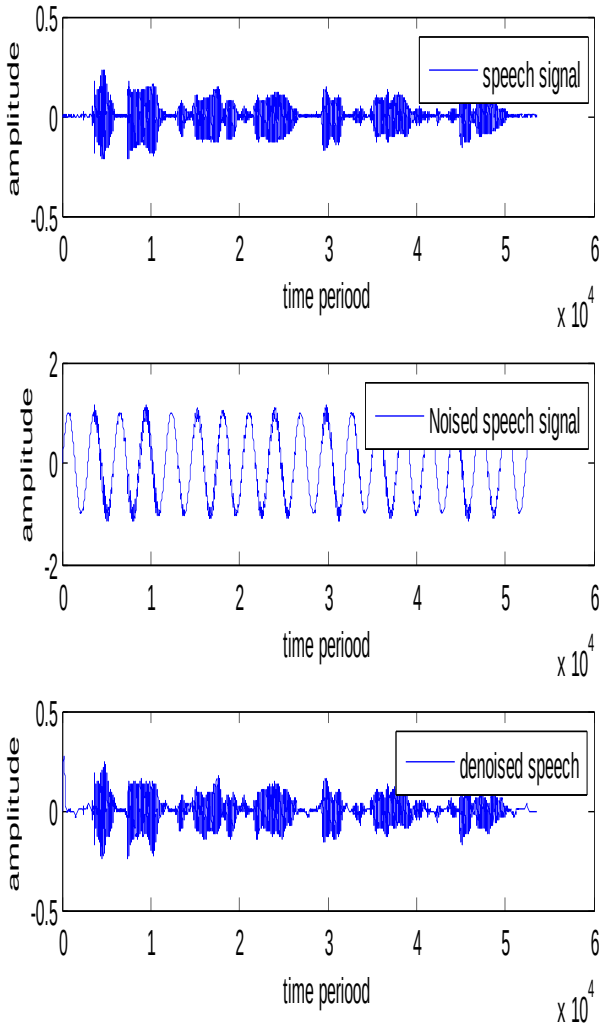

Figure -5 with GA

The figure-5 shows the response of designed filter with application of genetic algorithm in combination with adaptive LMS algorithm

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8.MEAN SQUARE ERROR ERFORMANCE OF FILTER:

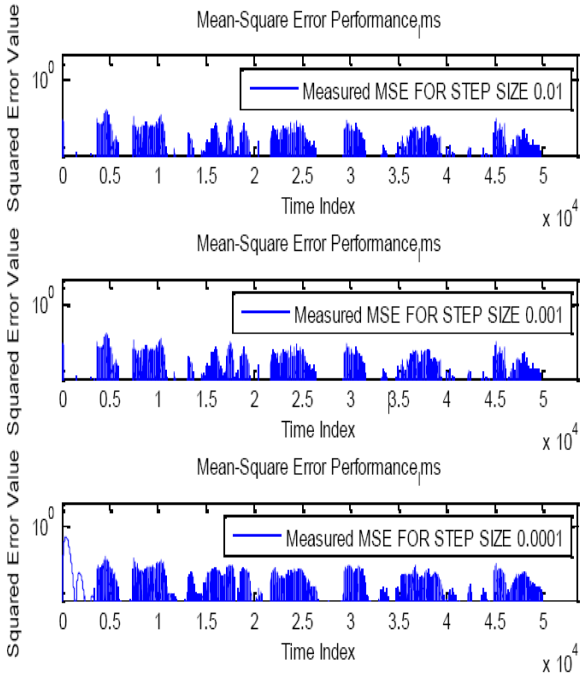

Figure -6 Mean square error performances with variation in step size

The above figure shows the MSE performance analysis for different step size and results are tabulated in table-2

9. RESULT ANALYSIS OF PROPOSED FILTER

Input SNR in dB	**0.0017**
Mean square Error for FIR Filter	**0.0027**
Output SNR in dB	**61.1973**
Mean suareError for GA FIR	**0.0010**

Table -2: Results of proposed filter

It is observed from the above table that performance of proposed filter is superior in terms of SNR than with traditional approach. The mean square error of proposed filter is also improved which can be observed from table with application of genetic algorithm.

CONCLUSION

The results as observed from table-2, obtained by simulation of the Function Approximation problem reveals the superiority of the Genetic Algorithm over the other methods of optimization in both unimodal and multimodal functions. There is a noticeable improvement in SNR of the speech signal which strengthens the hearing capability of duff person.

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