ABSTRACT

The purpose of communication system is to transmit and receive information truly and safely. There are two types of communication systems, namely wired and wireless. The information through the medium of transmission is likely to be distorted and corrupted due to noise. In order to suppress and eliminate that kind of noise, it is necessary to have several subsystems such as suppression system and filter system before the signal is processed by the receiver. The estimation of information signal from the distorted signal is done, using techniques like Generalized Side-lobe Canceller (GSC), Adaptive beam forming, Log spectral amplitude estimator and Adaptive Noise Cancellation (ANC). One of the most well-known techniques is ANC.

The advantage of the ANC technique is that no prior knowledge of signal or noise is required. The filter adapts the weights as the signal characteristics change, converging to the desired solution, though it suffers from slow convergence and stability. For suppression of noise, an intelligent volume controller is proposed. For elimination of noise, Genetic algorithm (GA) based noise cancellation method is proposed.

The background noise is one of the major factors, which adversely affects the perceived grade of service in audio communication systems. When the background noise level is high, the degradation of the signal is also very high. Hence it requires an increase in volume, in mobile phones. Also, when the background noise level is high, users tend to bring their mobiles very
close to their ears. Several techniques have been proposed to minimize the background noise in mobile environment. Signal to Noise Ratio is not adequate in these methods to cater to the specified requirements. The proposed noise suppression model, using Intelligent Volume Controller (IVC), minimizes the effects of background noise and thereby increases the Signal to Noise Ratio.

The audio quality is intelligently enhanced using IVC by suppressing the noise in mobile environment, for better reception. IVC adjusts the volume of the mobile phone according to the background noise type and noise level. The IVC is based on Fuzzy Logic Technique and it requires very less computations and memory. So, it is well-suited for the real time embedded applications. The proposed technique has been simulated using VHDL. This technique has also been implemented in Field Programmable Gate Array (FPGA) for various types of background noise.

Adaptive techniques are emerging very rapidly in the field of signal processing in communications. This is largely due to the development of sophisticated and robust adaptive processing methods and, in particular, due to the fact that the hardware devices used to implement modern communication systems are very ideally suited to realize the adaptive algorithms of such systems as well.

In any noise cancellation method, the parameters to be updated are calculated by optimizing an objective function. The methods used for the optimization of the objective function are based on gradient descent techniques. This process usually requires a large set of input/output data from
the system which is not always available. In addition, the parameter estimated is locally optimal. In the case of real time data, the weights are updated as the signal characteristics change, converging to the optimum solution. This is achieved using adaptive FIR filter, based on Statistical Least Mean Square (SLMS) algorithm. But it suffers from the rate of convergence and stability of the final solution.

Adaptive Neuro Fuzzy Inference System (ANFIS) based Noise cancellation system is used to identify an unknown nonlinear passage dynamics that transforms a noise source into an interference component in a observed signal. Minimizing the total error, $E[e^2]$ is equivalent to minimizing the difference between the information signal $x(k)$ and the estimated output $\hat{x}(k)$, such that ANFIS function is as close as possible to the passage dynamics in a least square sense. The difference of $x(k)$ and $\hat{x}(k)$ is more pronounced due to the unknown nonlinear passage dynamics. Hence improvement is required. This thesis proposes to discuss that kind of improvement.

GA approach for the background noise elimination is a probabilistically guided optimization process which simulates genetic evolution. In contrast to classical optimization algorithms, genetic algorithm is an optimization algorithm, based on the mechanics of evolution and natural selection. GA’s are able to focus their efforts on globally better areas of search space as a result of their ability to combine partial solutions, largely through the auspices of the crossover operator. By means of coding the variables, a population with stronger fitness is identified and maintained while a population with weaker fitness is removed. This process ensures better
offspring’s from parents. In GA, search process is stable and robust since it identifies global parameters for an adaptive Finite Impulse Response (FIR) system.