A NOVEL APPROACH TO ADAPTIVE NOISE CANCELLATION FOR SPEECH SIGNAL USING GRAZING ESTIMATION OF SIGNAL METHOD

1. INTRODUCTION TO RESEARCH WORK

Acoustic problems in the environment have gained attention due to the tremendous growth of technology that has led to noisy engines, heavy machinery, pumps, high speed wind buffeting and a myriad other noise sources. Exposure to high decibels of sound proves damaging to humans from both a physical and a psychological aspect. The problem of controlling the noise level in the environment has been the focus of a tremendous amount of research over the years.

The classical approach to noise cancellation is a passive acoustic approach. Passive silencing techniques such as sound absorption and isolation are inherently stable and effective over a broad range of frequencies. However, these tend to be expensive, bulky and generally ineffective for canceling noise at the lower frequencies. The performance of these systems is also limited to a fixed structure and proves impractical in a number of situations where space is at a premium and the added bulk can be a hindrance. The shortcomings of the passive noise reduction methods have given impetus to the research and applications of alternate methods of controlling noise in the environment.

Various signal processing techniques have been proposed over the years for noise reduction in the environment. The explosive growth of digital processing algorithms and technologies has given an impetus to the application of these techniques to the real world. Digital Signal Processors (DSPs) have shrunk tremendously in size while their processing capabilities have grown exponentially. At the same time the power consumption of these DSPs has steadily decreased following the path laid down by Gene’s law. This has enabled the use of DSPs in a variety of portable hearing enhancement devices such as hearing aids, headsets, hearing protectors, etc.
There are two different approaches for electrical noise reduction. The first approach is passive electrical noise reduction techniques, such as those applied in hearing aids, cochlear implants, etc. where the signal and ambient noise are recorded using a microphone, noise reduction techniques such as spectral subtraction, the LMS algorithm, etc are applied and the listener hears only the clean signal. One of the important assumptions of this technique is that the listener is acoustically isolated from the environment. This assumption is however not valid in a large particularly those number of situations where the ambient noise has very large amplitude. In such situations, the second approach of Active Noise Cancellation (ANC) is applicable. ANC refers to an electromechanical or electro-acoustic technique of canceling acoustic disturbance to yield a quieter environment. The basic principle of ANC is to introduce a canceling “antinoise” signal that has the same amplitude but the exact opposite phase, thus resulting in an attenuated residual noise signal. ANC has been used in a number of applications such as hearing protectors, headsets, etc.

The traditional wideband ANC algorithms work best in the lower frequency bands and their performance deteriorates rapidly as the bandwidth and the center frequency of the noise increases. Most noise sources tend to be broadband in nature and while a large portion of the energy is concentrated in the lower frequencies, they also tend to have significant high frequency components. Further, as the ANC system is combined with other communication and sound systems, it is necessary to have a frequency dependent noise cancellation system to avoid adversely affecting the desired signal.