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CLASSIFICATION OF HEARING PERCEPTION LEVEL USING AUDITORY EVOKED POTENTIALS

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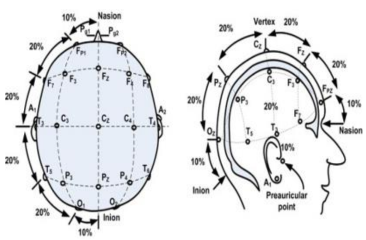
Graphical abstract



Abstract

An auditory loss is one of the most common disabilities present in newborns and infants in India. A conventional hearing screening test's applicability is limited as it requires a feedback response from the subject under test. To overcome such problems, the primary focus of this study is to develop an auditory loss assessment system using auditory evoked potential signals (AEP). The AEP responses of fourteen normal hearing subjects to auditory stimuli (20 dB, 30 dB, 40 dB, 50 dB and 60 dB) were derived from electroencephalogram (EEG) recordings. Box counting fractal method is applied to extract the fractal features from the recorded AEP signals. Feed forward and feedback neural networks are employed to distinguish the different hearing perception levels. The performance of the proposed auditory loss assessment system found to exceed 80% accuracy. This study indicates that AEP responses to the auditory stimuli to the normal hearing persons can clearly distinguish the higher order auditory stimuli followed by the lower order auditory stimuli and it can be used to estimate the level of hearing loss in the patient.

Keywords: EEG, auditory evoked potential, hearing perception level, feed forward network, feedback network

1.0 INTRODUCTION

Auditory evoked potential (AEP) can be observed as an electroencephalogram (EEG) signal elicited from the brain while an auditory stimulus is presented in a time-locked manner. AEP response reflects the neural processing of hearing ability level of an individual. AEP signal consist of reproducible positive or negative peaks, latency, amplitude and behavioural correlation [1]. Depending upon the latencies, AEP can be subsequently divided into short (0-12 milliseconds), middle (8-50 milliseconds) and long latency evoked potentials (50-300 millisecond) [2]. Most of the researchers mainly focused on the analysis of auditory brainstem response (ABR), the early portion (10-12 msec) of AEP signal. ABR signal comprised of seven peaks (I-VII), of which pre-dominant presence or absence of peak V essentially determines the hearing ability level [3, 4]. Early researchers have developed different techniques to detect the ABR peak V using spectral energy [5], matched filter [6], spectral analysis [7] and wavelet analysis [8].

The major difficulties encountered in identifying the ABR peak V are 1) At least 1000 to 2000 trials are necessary in order to realize the structure of a waveform with defined peaks, hence the task of averaging the ABR waveform becomes difficult and consumes more time; 2) it is quite complex to segregate the associated ABR peak IV and peak V; 3) it is also very difficult to search and identify the individual peaks of the ABR for abnormal hearing subjects, because of pathology of the auditory nerve. Further, it has also been reported that is finding the ABR peak V is difficult when the stimulation intensity level is below 30 dB, the defined five peaks are no longer visible [9]. Consequently, the identification of peak V appears to be quite difficult, and the level of