# DIABETIC RETINOPATHY ANALYSIS

R.Sivakumar*, Dr.G.Ravindran*, Dr.M.Muthayya**, Dr.S.Lakshminarayanan**, Dr.C.U. Velmurughendran**

*Centre For Medical Electronics, College of Engineering, Guindy, Anna University, Chennai- 600 025, India. E-mails: *sivarkumar@mailcity.com, raviguru@lycos.com*

** Sri Ramachandra Medical College and Research Institute (SRMC & RI), Porur, Chennai – 600 116, India.

**Abstract.** Diabetic retinopathy is one of the common complications of diabetes. Unfortunately, in many cases the patient is not aware any symptom until it is too late for effective treatment. Through analysis of evoked potential response of the optical nerve and optical brain centre will pave a way for early diagnosis of diabetic retinopathy and prognosis during the treatment process. In this paper, we present a method to classify diabetic retinopathy subjects from changes in visual evoked potential spectral components.

## Introduction

Diabetic retinopathy is a potentially blinding complication of diabetes that damages the eye's retina [1, 3]. At first, you may notice no changes in your vision. But don't let diabetic retinopathy fool you. It could get worse over the years and threaten your good vision. Visual Evoked Potential (VEP) is one of the reliable tools in analysing the neural activities [5, 6]. So far not much of the work have been take-up to identify the effect of retinopathy in optical response and variation in the functioning of optic nerve [2, 4]. Through analysis of evoked potential response of the optical nerve and optical brain centre will pave a way for early diagnosis of diabetic retinopathy and prognosis during the treatment process.

In general, the clinical use of VEP is based on the peak amplitude and the latencies of the N75, P100, and N145. The amplitude and the latencies of these peaks are measured directly from the signal. This requires precise definition of the starting and the end points. Latency measure depends on the point at which the latency is calculated and usually irregular peaks occur due to background EEG, so that averaging and interpolation are required. Therefore the diagnosis based on amplitude and latency in time domain is not alone sufficient. Hence other component should also be taken in to consideration.

Computer simulation is well established as a powerful and effective way of modeling health care systems [9]. In our analysis, first we present a method to classify diabetic retinopathy subjects from changes in visual evoked potential spectral components [10, 11]. Secondly we present an anatomically realistic computer model of a human eye under normal and retinopathy condition in a virtual environment using 3D max studio and Widows Movie maker.

## Method and results

The volunteers were divided into 4 groups namely first group is control (normal), other 3 groups with diabetic retinopathy. Second group Background diabetic retinopathy, third group Preproliferative diabetic retinopathy and fourth group proliferative diabetic retinopathy. All the recordings were done in a darkened, sound attenuated room and a patient were placed

in front of a black and white checkerboard pattern displayed on a video monitor. The checks alternate black/white to white/black at a rate of approximately twice per second. Every time the pattern alternates, the patient's visual system generates an electrical response that was detected and were recorded using electrode located at Oz and FPz position with sweep speed 50ms/div and sensitivity 2μv/div using Nicolet Viking IV NT machine. The ground electrode was attached to the ear lobe.

The recorded data was converted as X-Y components and by resample to make 256 samples data block. The spectral components of the recorded data were identified using MATLAB signal processing toolbox functions with 95% confidence level and plotted (*Fig.1 &2*). The spectral response shows that the peak response occurs at specific frequencies like 2,3,4,5 and 6Hz.

The important finding of this result is that there are distinct differences at the peak frequencies for normal and diabetic retinopathy patients. For normal patients peak frequency was at 2Hz, Background diabetic retinopathy patients the peak frequency was at 3Hz/ 4Hz and for Preproliferative diabetic retinopathy and proliferative diabetic retinopathy patients the peak frequency was at 5Hz/6Hz(*Fig.3&4)*. Correlation between the resulting spectral components with stages of diabetic retinopathy was identified (*table 1*).

We animated the diabetic retinopathy condition using 3D max studio and Widows Movie maker and correlated with the VEP spectral components. We added voice information along with the picture information, which correlates the VEP wave with stages of diabetic retinopathy and treatment method. Using this animation the patient can identify the change in VEP and change in retinal condition. Users were able to explore the eye components to discover retinopathy characteristics. This animation and simulation model will eventually be used to educate patients and medical students on various aspects of the diabetic retinopathy (*Fig.5*).

| No | Patient info. | Spectral components (peak frequency) Hz |
|---|---|---|
| 1. | Normal Patient | 2 |
| 2. | Background Diabetic retinopathy patient | 3 |
| 3. | Preproliferative diabetic retinopathy patient | 5 |
| 4. | Proliferative diabetic retinopathy patient | 6 |

*Table 1: Patient Disease condition with spectral component values*

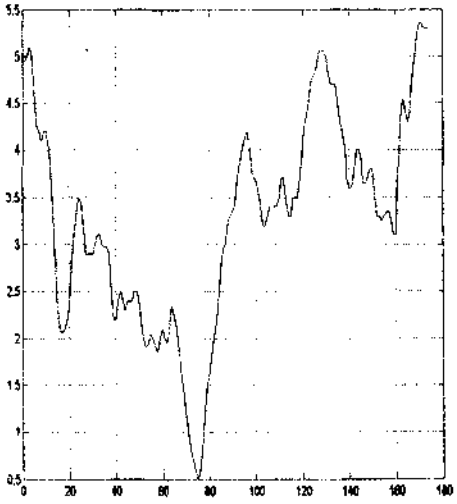

*Fig.1 Normal VEP*

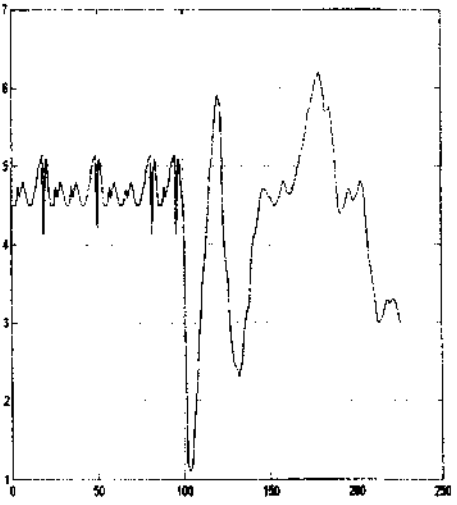

*Fig.2 Proliferative diabetic retinopathy VEP*

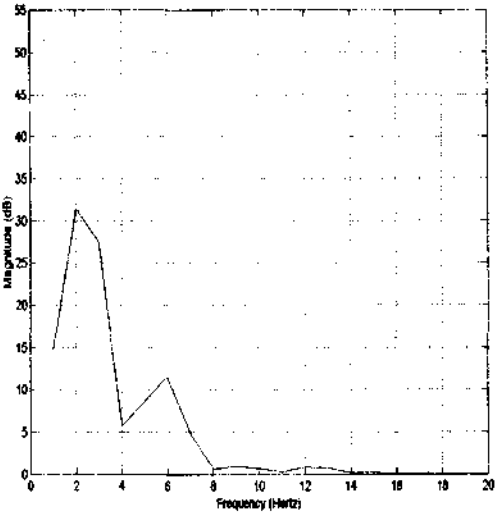


*Fig.3 Normal VEP Spectrum*

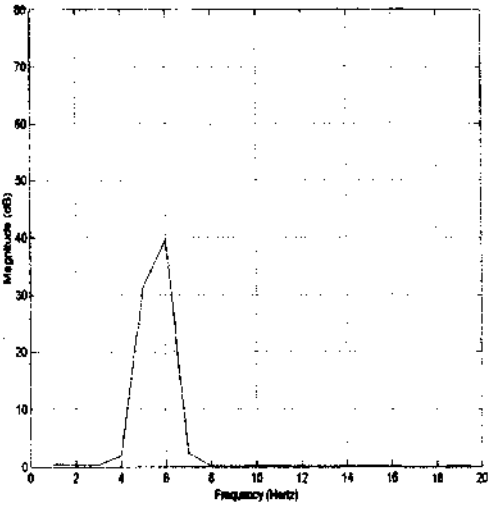


*Fig.4 Proliferative diabetic retinopathy spectrum*

*Fig.5 Animated retinal blood vessel leakage due to diabetic retinopathy picture*

## Discussion

A system for classification of diabetic retinopathy using VEP spectral components has been developed and tested on prerecorded data from a set of patients. This paper describes a specific application, which can be extended to further applications in medicine. Presently we are testing the system on a large patient off line database and in future it can be implemented for routine clinical use. This method of classification of diabetic retinopathy condition using frequency spectrum and peak frequency components almost coincides with expected retinopathy condition. These results will have significant usage in analysing the diabetic retinopathy condition. Further works are going on developing Artificial Neural Network using these data to indicate the diabetic retinopathy stages using spectral analysis [7, 8].

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