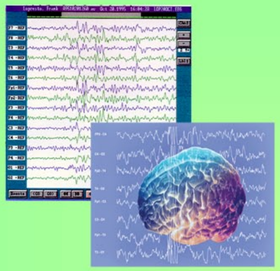
Advanced Brain-Wave Analysis For Early Diagnosis of Alzheimer's Disease (AD)



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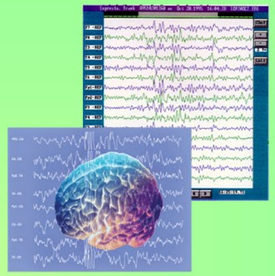

http://www.ccs.ornl.gov/Internships/rams_08/j_murphy

Abstract

The goal of this study is improvement in distinguishing various disease states: normal aging, mild cognitive impairment, early Alzheimer's disease (AD), and Diffuse Lewy Body disease (DLB). With the help of Dr. Robert Sneddon (University of California, Irvine), a Java program has been designed to model the Sneddon and Shankle qEEG methodology. The program analyzed data received from another collaborator, Dr. Yang Jiang (University of Kentucky School of Medicine), and calculated the ratio of variance of anterior cortical activity to the variance of posterior cortical activity. This measure will be used to identify the optimal cutoff value to discriminate normal from impaired subjects, and thus improve the accuracy for discriminating among disease states.

Background

- AD is a neurodegenerative disease of the nervous system that is:
  - non-treatable
  - affects the cognitive abilities of a person
  - renders them functionally useless in society
- Federal government estimates approximately 4 million people in the U.S. have AD
- Number of people with AD will increase in future as number of older persons increases
- Advances have been made in understanding AD, but no effective treatment exists
- Effectiveness of treatments depend on implementing them at earliest stage of disease as possible

Research Objectives

- Implement the qEEG methodology in Java
- Analyze UK EEG data to determine whether Shankle and Sneddon's results can be confirmed
- Demonstrate early detection of DLB for the first time via qEEG

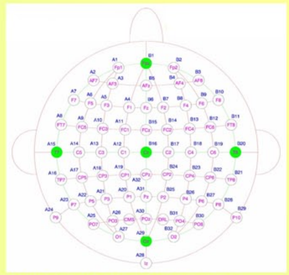

Figure 1. Placement diagram of electrodes on the head

Figure 2. Person wearing an electro cap that holds the electrodes in place

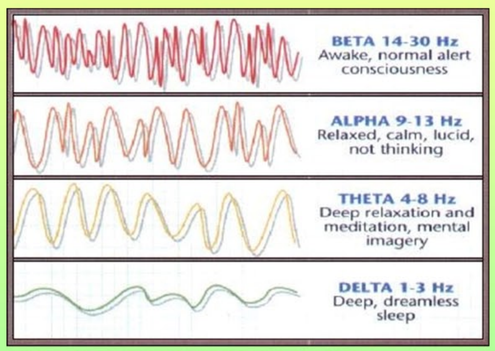

Figure 3. Diagram of the four brain wave categories

Method

- Computational analysis of electroencephalography (EEG) data using the nonlinear Tsallis entropy, implemented in Java on desktop system
- Analyzed EEG data collected at UK during administration of a delayed visual recall task

Results

- Java code to calculate variance ratio
- Sample numerical results
- Comparison across 40 data sets

Future Applications

- Anticipating a clinical device in the next several years that could be used by a physician to provide early diagnosis of AD in 5 to 10 years before AD onset
- Ability to provide early diagnosis of neurological diseases such as:
  - Parkinson's disease
  - Diffuse Lewy Body disease
  - Clinical depression
  - Bi-Polar disorder

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