THE EEG ANALYSIS AND THE BRAINMAPPING

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ABSTRACT

The work deals with program equipment for analysis of the EEG data in therapeutic procedure. The EEG data included information about brain waves. This information predicated the state of mind. One-dimensional analysis is performed to finding the frequency components in each channel of the EEG data separately. Two-dimensional analysis (performed in all EEG channels simultaneously) is used for mapping of brain activity.

1. INTRODUCTION

Electroencephalographic (EEG) measurement gives information about brain activity. EEG methods are very perspective and evolving. Electroencephalography at present is used for therapy, known as neurotherapy and brain wave therapy. Some types of brain waves can be monitored and presented to the therapist and patient.

The frequency spectral analysis is used for EEG processing. The EEG signal is filtered and then transformed to the frequency domain by Fast Fourier Transformation (FFT). The output of frequency spectral analysis gives information about multiple sorts of brain waves, called delta, theta, alpha and beta. The brain waves keep changing in reaction to patient physical or mental activity. Graphical presentation of EEG changes is designed and used in software applications for EEG analysis and brain mapping.

2. ANALYSIS

EEG system by manufacturer Alien was used for measurement of EEG signals. During the recording, the sensors were placed on designated sites on the scalp according to standard electrode system „10 – 20“. Signals were recorded continuously with sampling frequency 1024 Hz. EEG signal in each channel was filtered by the Finite Impulse Response system – FIR. Afterwards, filtered signal was transformed by FFT with window size of 1024 samples. The filtered and transformed data were used for 1D and 2D analysis.

2.1. PROGRAM APLICATIONS

Two software applications were designed for EEG data processing. EEG_xhroze00 deals with 1D analysis and brain_mapping uses 2D analysis of EEG data. These software applications were created with a Graphic User Interface (GUI), the accessory of the Matlab program.

2.2. SOFTWARE APPLICATION EEG_XHROZE00

Software application EEG_xhroze00 is used to filter input data and also to perform frequency spectral analysis of loaded data. The interface of running software application EEG_xhroze00 is shown in Figure 1.

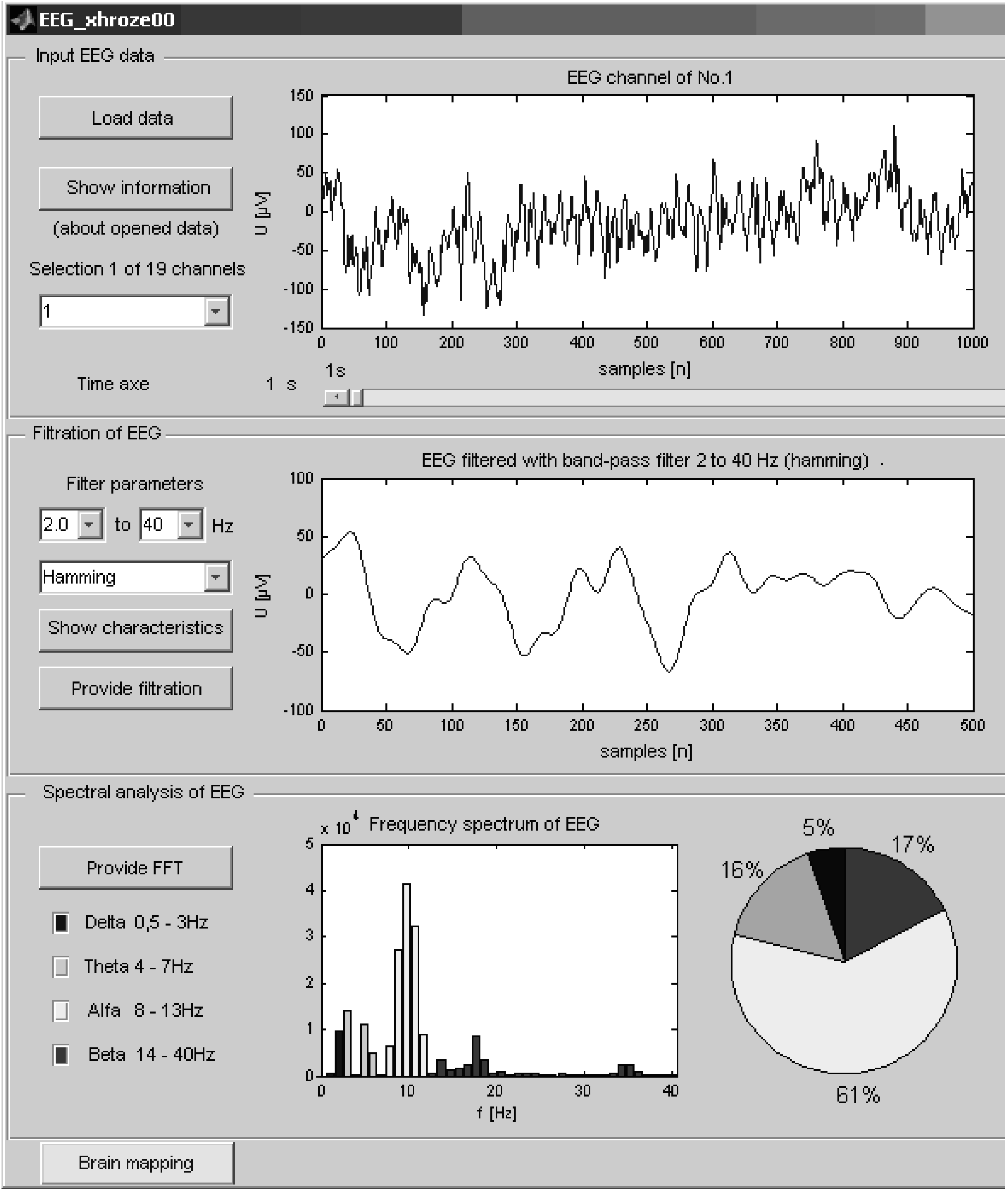

Figure 1: The interface of software application EEG_xhroze00

Application contains three sections. "Input EEG data" includes loading of data, generating of patient personal data and displaying of selected EEG signal. The EEG signal is displayed on the right part of the application. The "Filtration of EEG" section contains definition of FIR filter properties, such as frequency range and filter window. Window filter can be selected from the following types: Hamming, Chebwin, Blackman, Flattopwin, Gausswin, Hann, Kaiser, Tukey. On the right side of interface there is filtered signal consisting of the last 500 samples from the end. In the last section named "Spectral analysis of EEG" the button "provide FFT" provides algorithm of fast Fourier transform with the window length n = 1024 samples and draws the spectrograms with amplitudes of frequency components and the doughnut charts with percentage share of brain waves.

2.3. SOFTWARE APPLICATION BRAIN_MAPPING

Software application brain_mapping provides the brain mapping activity. Running application is shown in Figure 2.

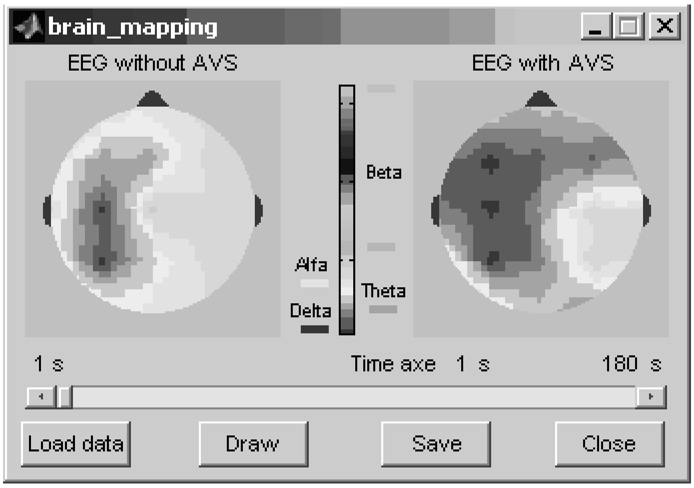

Figure 2: Software application brain_mapping

After loading of data the first second of brain activity is displayed. Different part of signal can be displayed by adjusting the slider. The EEG data are filtered with band pass filter (from 2 Hz to 40 Hz) and then transformed by FFT algorithm. In each of 19 channels the main frequency (the frequency component with the highest amplitude) of the EEG signal is selected. The maximum values of amplitudes corresponding to all channels are saved in vector of maximums. All 19 electrodes are laid out accordingly to the system "10-20". The brain activity map is realized by image matrix of dimension 64x64 pixels depicted in Figure 3. The algorithm of matrix approximation is shown bellow.

- The values from vectors of maximums are placed in the matrix of brain mapping pixels marked black.
- The pixels marked dark gray are computed by the arithmetic mean of the nearest pixels marked black.
- The pixels marked dark gray with cross are computed by the arithmetic mean of the nearest pixels marked black and dark gray.
- The pixels marked dark gray with dot are computed by the arithmetic mean of the nearest pixels marked black, dark gray and dark gray with cross.
- The pixels marked light gray are computed by the arithmetic mean of the nearest pixels marked black, dark gray, dark gray with cross and dark gray with dot.
- The pixels marked white are computed by the arithmetic mean of the nearest pixels marked black, dark gray, dark gray with cross, dark gray with dot and light gray.

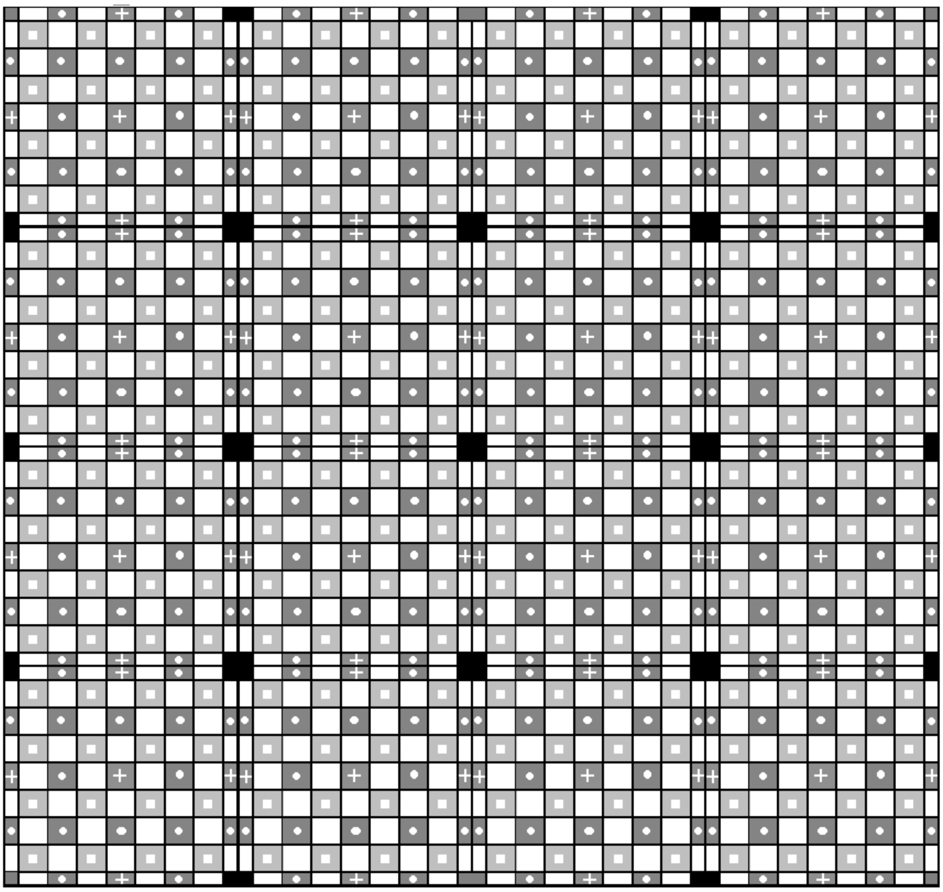

Figure 3: Matrix of brain mapping

3. CONSLUSION

The software applications EEG_xhroze00 and brain_mapping show results of electrical brain activity measuring. Software application EEG_xhroze00 provides one-dimensional analysis in each channel of the EEG data separately. The brain_mapping provides two-dimensional analysis from all 19 channels, so it performs the mapping of whole brain activity simultaneously. Both applications were realized in GUI. Therefore these applications are suitable for therapists and for patients too.

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