EEG MATLAB ANALYSES PRESENTATION

L.Šenfeld [1], F.Lehr [1], P. Ježdík [1], A. Jahodová 2
[1] Faculty of Electrical Engineering, CTU in Prague,
[2] 2nd Medical School, Charles University in Prague

Abstract

Analysis of intracranial electroencephalograms (iEEG) is one of the applicable techniques of epileptogenic zone localization for patients with pharmacoresistant epilepsy. Our research group closely cooperates with the neurology department of the university hospital in Prague. Problems with cross presentation of iEEG data between medical and technical researchers often appear due to the use of different viewers and presentation software. Our aim is to develop user-friendly software suitable for both the medical and technical branch of the research group. We present here the idea of the project and a structure of preliminary implementation.

1 Introduction

At present, communication and signal analyses presentation between the technical and medical community inside the Intracranial Signal Analysis Research Group in Prague (ISARG) is not truly efficient. Medical researchers cannot easily deal with presentations such as Matlab figures, not only because of frequently lacking a Matlab environment, but also the necessity of at least basic understanding the scripting language in case of a demand for unexpected interaction. On the other hand, the commercial environment used by medical research is not accessible for technicians and the free options of the viewers do not retain the necessary functionality.

Our research demands interaction between the technical analyses and subjective evaluation of recordings by the neurologists. The methodology specifies two crucial steps for new algorithms in their development and tuning. First, the technician designs an algorithm, implements it and presents the results across the recordings. Second, the neurologist checks out the results and confirms or rejects them. The evaluated results are then returned as feedback to the technicians.

Problems appear not only in the different data formats used by both branches, but also in the form of the viewing. For instance, the technician shows spectrograms of the recordings and marks an event. The neurologist, by contrast, needs more strongly to see highlighted EEG curves in his viewer instead of just the time stamp of the event. Also, in the other way, when the neurologist marks a significant part of the curves, the technician should see it more clearly, directly in his analysis. We suggest a solution based on module programming, in which the end user has two options to access the records, as a technician and/or as a neurologist. The both views are tie by absolute time of each sample in the records. See the structure in Figure 1.

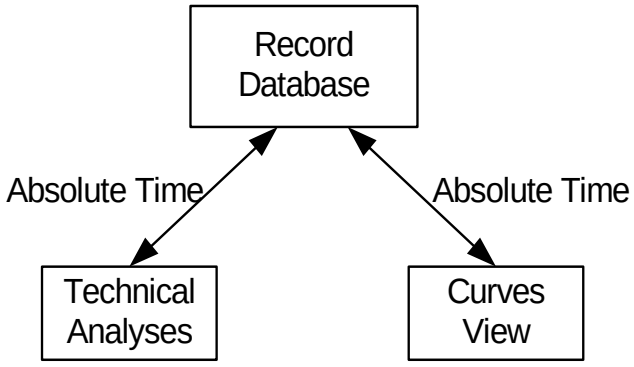

Figure 1.Basic block scheme of the application

Another point of view is also the demand for high stability and performance of the presentation, even while involving large data amounts but also using standard personal computers. The typical recordings of EEG data for analyses occupy around 1-1.5GB. Together with results of analyses that are necessary to be presented at the same time, the memory demands is typically doubled i.e. 3GB. The proposition of a universal Graphical User Interface (GUI) based on the Matlab platform that would be sufficient for the research seems to be odd. As a result, we decided to develop the presentation software based on C#.NET.

2 Demands Summary

The doctoral viewer has to maintain all capabilities of the commercial viewers. Operators have to easily find all their bookmarks, tools, views etc in the same structure as it comes from habits. The viewer has to be capable mark events in the signal, as well as add notes for technicians. Standard set of filters for biological signals such as notch filters for mains cancelling and neurologic bands band passes or stops.

The technical views should able to present different kinds of analyses. The best option seems to be a modular system where each module equals to an analysis. Each module needs to have sets of its parameters if necessary.

Both views have to be connected by a root module (core). The data presentation is tie by absolute time of each sample. The core has to be also capable deal with standard data formats such as the biological standards EDF, EDF+, GDF, EEG, etc. and also –MAT binary data with sufficient data exchange structure. The modular structure is shown in Figure 2.

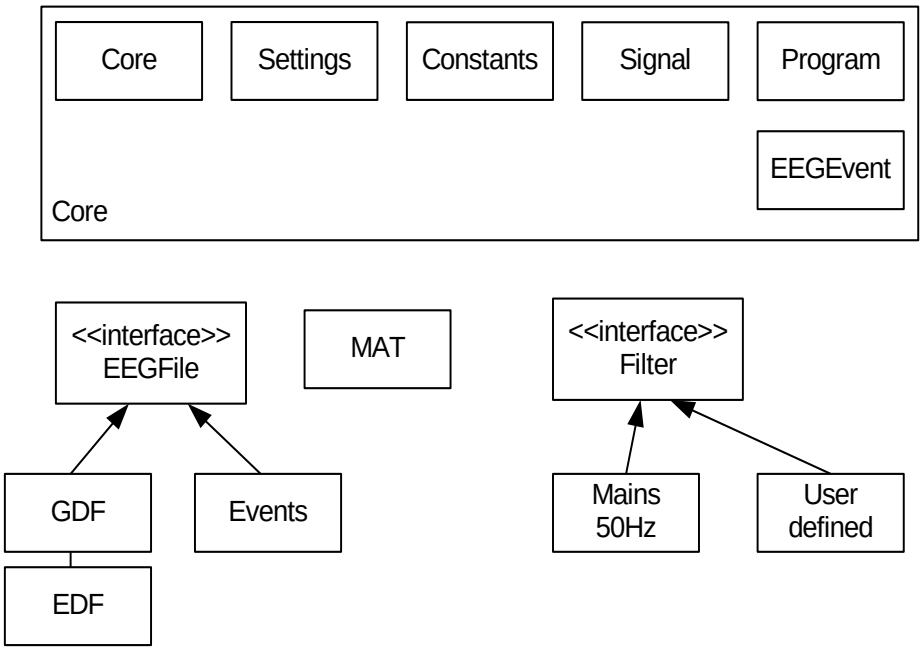

Figure 2.The modular structure of the application

3 Implementation

Since beginning of the programming the demands of modularity and ability of extension is the priority. There is chosen following design. The application has unchangeable core. It is the computing and

analytical basement for other modules. Using the core is possible to import or export records of standard formats, to synchronize the views and to apply filters. The other part of the applications is the interface for modules. These modules contain methods for imaging results and their user interface. The basic version includes a few modules for different kinds of results imaging. The module for medical view presents the data in standard form. The interface is user friendly and keeps the common structure and habits.

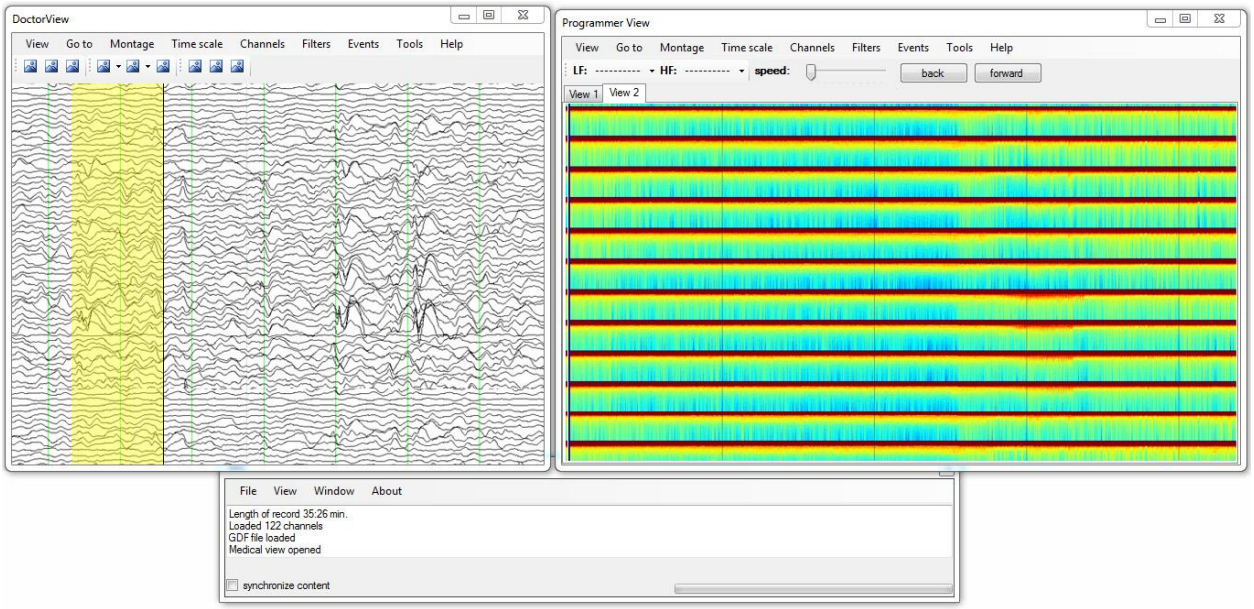

Figure 3. The User modular user interface. Doctor view on the left, one of the technical views on the right, core interface is on bottom.

3 Summary

A few gamma versions of the software have been already released. The highest one already allows the medical view with the basic capabilities. Also the most important feature coming from nowadays demands of the research, the events marking, is implemented. The modular system seems to be satisfactory for the needs of the ISARG.

4 Acknowledgement

This work has been supported by the grants IGA NT11460-4/2010 Intracranial EEG signal processing; epileptogenic zone identification in non-lesional refractory epilepsy patients, SGS 10/272/OHK4/3T/13 Analysis of intracranial EEG recording, and resesearch program MSM6840770012 Transdisciplinary Research in Biomedical Engineering.

Ing. Petr Ježdík, Ph.D.
e-mail: jezdip1@fel.cvut.cz
Lukáš Šenfeld
e-mail: senfeluk@feld.cvut.cz
František Lehr
e-mail: lehrfran@feld.cvut.cz
MUDr. Alena Jahodová
e-mail: a.jagoda@email.cz