IN THE FOCUS

Brain Products devices are supported in the OpenViBE program for BCI research

by Yann Renard, lead software engineer for the OpenViBE program

Brain-computer interfaces (BCIs) represent a new way of interacting with computers and/or devices "by thought". BCIs enable commands to be transmitted through brain activity alone. Interest in BCI research is increasing very rapidly, with many laboratories and companies being active in this field. BCIs are promising interfaces for many applications that range from rehabilitation [1] to video games [2][3]. It is a complex research field that requires multi-disciplinary expertise in fields including neurophysiology, brain behavior, signal processing, computer science, machine learning, human/computer interaction etc. Newcomers in this field will greatly benefit from a program that supports the basic functionalities needed for BCI research. OpenViBE fulfills this need.

OpenViBE is a free and open-source software platform released and supported by INRIA [4] (the French national institute for research in computer science and control). OpenViBE is dedicated to the design, testing and use of BCIs [5]. In general terms, it is a program intended for use with real-time neurosciences (i.e. those involving the real-time processing of brain signals). It can be used to acquire, filter, process, classify and visualize brain signals in real time. The entire program has been written in C++ and consists of a set of modules that can be integrated easily and efficiently for designing BCIs for such applications as Virtual Reality (VR) interaction

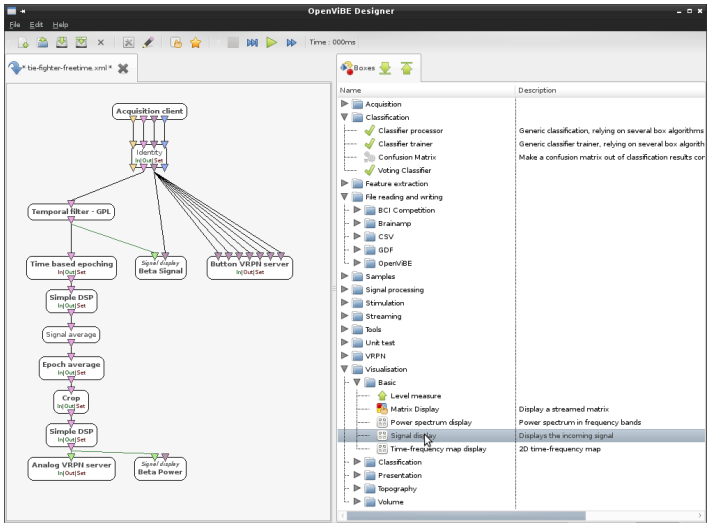
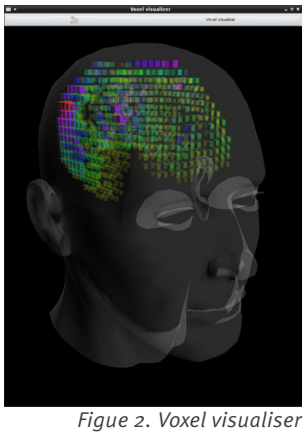


Figure 1. OpenViBE Designer

The graphical user interface of OpenViBE (see Figure 1) is simple to access and is very easy to use for creating BCI scenarios and saving them for later use. The platform's main advantages are modularity, portability and the availability of different tools for different types of user, including programmers and non-programmers, as well as superior code performance and compatibility with virtual reality technologies. The program also offers many 2D and 3D visualization tools for representing brain activity in real time (see Figure 2). However, the first thing that needs to be done when constructing a BCI is to acquire the actual brain signals.



Figue 2. Voxel visualiser

There are numerous methods for acquiring brain signals for BCI applications. Among them are MagnetoEncephaloGraphy (MEG), functional Magnetic Resonance Imaging (fMRI) and ElectroCorticoGraphy (ECoG). However, ElectroEncephaloGraphy (EEG) is still the most widely used acquisition technique for BCI research. EEG has numerous advantages over the other techniques: it is much less expensive, it is non-invasive, and it provides excellent temporal resolution. Brain Products excels in brain signal acquisition using EEG. The Brain Products devices cover a wide range of applications and are an excellent choice for BCI. It seemed obvious that these devices should be supported by OpenViBE. This required some integration development work to be undertaken. Work on supporting the integration of the Brain Products devices into OpenViBE started in the second half of 2009, a few weeks after the first official release of OpenViBE. Brain Products and INRIA set up a cooperation venture to provide integration for the V-Amp / FirstAmp devices. This driver, which was first released in January 2010, allows the acquisition of up to 16 channels sampled at 2kHz. It is now included in the official releases of OpenViBE and is being used on a daily basis in multiple laboratories.

After this first success, I personally proposed a new cooperation venture so that the BrainAmp series devices could also be supported in OpenViBE. This second driver provides compatibility for the BrainAmp Standard, BrainAmp DC, BrainAmp MR and BrainAmp MR plus. It allows the acquisition of up to 32 channels sampled at 5kHz. It was first released in September 2010, and is already included in the official OpenViBE release. It is based on dedicated low-level SDK, meaning that it directly connects to and communicates with the device. This makes intermediate acquisition software such as BrainVision Recorder unnecessary, and guarantees the lowest latency and the best performance by eliminating overhead.

Naturally, most of the device's hardware functionality can be configured at runtime. For instance, you can select and rename the channels you wish to acquire.

Or you can choose which of the 250Hz or 1000Hz hardware low pass filters to apply to each channel. You can also choose the sampling resolution and DC coupling or check the impedances of each channel etc. Incidentally, the current version does not handle multi-amplifier set-ups yet. This function will be available soon, and will most probably be approved for the official January 2011 release of OpenViBE. From that time you will be able to acquire up to 128 channels cascading 4 amplifiers of 32 channels each.

The direct connections to the BrainAmp Series and the V-Amp / FirstAmp amplifiers make OpenViBE the best-connected BCI framework for the BrainProducts amplifiers! So if you own a Brain Products amplifier and have not tried OpenViBE yet, you are just a few clicks away from starting your BCI research.

Further information can be found on the OpenViBE website [6]. You can download and use the software free of charge. The software comes with numerous predefined BCI scenarios. For instance, one scenario enables Event-Related Synchronization (ERS) and Event-Related Desynchronization (ERD) detection. This scenario can be used for motor imagery BCI. Another scenario enables Event-Related Potential (ERP) detection, and can be used for P300 Speller applications. Steady State Visual Evoked Potentials (SSVEP) detection will soon be included as well.

The first official release of OpenViBE was announced in May 2009. It was the result of a three-year ANR-funded research project that involved INRIA, INSERM, GIPSA-Lab, CEA, Orange Labs and AFM. The OpenViBE community is expanding daily and is very actively involved in novel developments, as the OpenViBE platform has been selected by numerous new research projects including CoAdapt [7] and RoBIK (Robust BCI Keyboard) [8]. You can contact the OpenViBE project leader Anatole Lecuyer (anatole.lecuyer@inria.fr [9]) with any scientific questions.

You can also contact me (yann.renard@inria.fr) for technical questions. Interested readers can follow me and my OpenViBE-related work on my weblog [10] as well. ●

References

1.Wolpaw, J., Birbaumer, N., McFarland, D., Pfurtscheller, G., & Vaughan, T. (2002). "Brain-computer interfaces for communication and control". Clinical Neurophysiology, 113(6), 767-791.

2.A. Lécuyer, F. Lotte, R. Reilly, R. Leeb, M. Hirose, M. Slater, "Brain-Computer Interfaces, Virtual Reality, and Videogames", IEEE Computer, Vol 41, Num 10, pp. 66-72, 2008

3.OpenViBE2 research project: http://www.irisa.fr/bunraku/openvibe2

4. INRIA: http://www.inria.fr

5.Y. Renard, F. Lotte, G. Gibert, M. Congedo, E. Maby, V. Delannoy, O. Bertrand, A. Lécuyer, "OpenViBE: An Open-Source Software Platform to Design, Test and Use Brain-Computer Interfaces in Real and Virtual Environments", Presence : teleoperators and virtual environments, vol. 19, no 1, 2010

6.OpenViBE software: http://openvibe.inria.fr

7. CoAdapat reserach project: https://twiki-sop.inria.fr/twiki/bin/view/Projets/Athena/CoAdapt/WebHome

8.ROBIK research project: https://sites.google.com/site/robustbcikeyboard/

9. Anatole Lecuyer's page: http://www.irisa.fr/bunraku/GENS/alecuyer

10.Yann Renard's blog: http://stickyvibe.tuxfamily.org

ANR: French national research funding agency

INRIA: Research institute for computer science and automation

INSERM: Research institute for medical research

INPG: Grenoble institute of technology

CEA: French alternative energy and atomic energy commission

Orange Labs: French telecom company

AFM: French association for combating myopathies