OpenViBE: history, concept and applications

3rd OpenViBE workshop@SMC’18

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An open source software platform
for Brain-Computer Interfaces
and real-time neurosciences

http://openvibe.inria.fr

Enjoyed by research labs, clinicians, teachers,
game developers and hobbyists worldwide
Main funded project using OpenViBE

- **2005-2009**: ANR OpenViBE (RNTL, BCI and disabled people, partners: Inria-Rennes, INSERM, CEA, Orange, AFM, GIPSA-LAB)
  - May 2009: First public release
  - 2009-2011: ADT LOIC (Rennes-Nancy, OpenViBE support and dev)
  - 2009-2012: ANR OpenViBE2 (Rennes, BCI and videogames)
  - 2009-2012: ANR Co-Adapt (Sophia, dynamic BCI)
  - 2009-2011: ADT Immersive BCI (Sophia, BCI and immersive display)
  - 2009-2012: ANR RoBIK (CEA/GIPSA, speller for disabled people)
  - 2010: First OpenViBE int. tutorial (BCI Meeting, Monterey, US)
  - 2011: Google Science Fair (student project congratulated by Obama)
  - 2012-2013: LIRA (Rennes-Bordeaux-Nancy, Stress and Relaxation)
  - 2012-2015: ADT OpenViBE-NT (Rennes-Bordeaux-Nancy-Sophia)
- **Nov 2012**: Creation of Mensia Technologies
- 2013-2016: Labex CominLabs HEMISFER (Rennes, Neurofeedback)
- 2014-2017: Labex CominLabs SABRE (Rennes, fast computation EEG)
- 2014: First OpenViBE int. workshop (BCI Conference, Graz, Austria)
- **2014**: First contributions from Mensia to open-source project
- 2014-2016: ADT OpenViBE-X (Sophia)
- **2015**: Release of OpenViBE v1.0 (= the 19th release)
- **2015-2016**: Ilab CertiViBE (Hybrid-MENSIA)
- 2016: 2nd OpenViBE workshop (BCI Meeting, US)
- **2017**: ATT CONSORViBE
- 2018: Medical Certification and first products from Mensia

2005 - 2016:
- OV creation
- 1st wave: Consolidation
- Mensia
- 2nd wave: transfer, dissemination
- 3rd wave: stabilizing, certification

OpenViBE workshop (SMC'18) - 4
Concept: General Software Architecture
## Concept: Plugins

<table>
<thead>
<tr>
<th>GDF file writer/reader</th>
<th>Temporal filtering</th>
<th>Spectral analysis</th>
<th>Signal and spectral visualisation</th>
<th>Matlab scripting</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDF file writer</td>
<td>Spatial filtering xDAWN, CSP</td>
<td>Classification LDA/SVM</td>
<td>2D and 3D topography map</td>
<td>Python scripting</td>
</tr>
<tr>
<td>CSV file writer/reader</td>
<td>Universal DSP</td>
<td>Auto-Regressive coefficients</td>
<td>Voxel display</td>
<td>Lua scripting</td>
</tr>
<tr>
<td>Generic network acquisition</td>
<td>Signal epoching</td>
<td>Windowing</td>
<td>Time/frequency mapping</td>
<td>VRPN input/output</td>
</tr>
</tbody>
</table>

+ many more such as LSL, multiclass classifiers…
Concepts: modularity and reusability

- quickly and efficiently arrangement of small processing components into a high level / complex composition
Functionalities: An acquisition device abstraction

- Allows any device to be integrated, through the development of a C++ driver
- Already supported:
  - All Brain Products devices (VAmP, Brainamp series, Quickamp)
  - Brainmaster (Atlantis, Discovery)
  - EGI (Netamps 300)
  - Emotiv (EPOC)
  - g.Tec (g.USBam, g.Mobilab+)
  - All Micromed devices (through SystemPlus Evolution s/w)
  - OpenEEG (modularEEG, monolithEEG)
  - Neurosky (Mindset, MindWave)
  - Most TMSi devices (including Porti, Refa, and derived Mindmedia NeXus, ANT Neuro ASALAB...)
  + many others (check the full list on http://openvibe.inria.fr/supported-hardware)
Functionalities: Paradigms

P300

SSVEP

Motor Imagery

Neurofeedback
### Functionalities: stimuli

**Visual Stimulus:**
- Included in the release
- Done by users

**Audio Stimulus:**
- Sound Player box

**Keyboard Stimulus**
Functionalities: Various real-time displays
VRPN plug-in
- OpenViBE can be considered as an external peripheral
- Immediate compatibility with most VR software / tools

Matlab plug-in
- OpenViBE can call Matlab code

Lua plug-in
- Experiment protocol can be implemented with Lua scripts

Python plug-in
- OpenViBE can call Python code for signal processing as well as implementing experiment protocols

File reader / writer plug-in
- The signals can be imported / exported with different formats (gdf, edf, csv, ...)

External configuration files
- Each box configuration can be defined in a file

For example, write your own spatial filter in Matlab and use it in OpenViBE
**Author’s view**

Make your own DSP chains

**Operator’s view**

Interactive Application

**Subject’s view**

Neurofeedback

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No programming skills required

- A scenario designer
- Graphical User Interface
- WYSIWYG (What You See Is What You Get)
Functionalities: predefined applications

- Several predefined and ready to use scenarios:
  1. Neurofeedback with the *Tie Fighter* VR game
  2. BCI based on motor activity (Graz-BCI, handball)
  3. BCI based on P300 (*Speller, Magic Card*)
  4. BCI based on SSVEP (*Spaceship Shooter*)

- Lots of *box tutorials* scenarios to showcase specific features (read EEG from a file, compute a topographic map, filter signal, etc.)
What is Free Software?

- Free software supposes 4 basic rules:
  - You are free to use the software for any purpose
  - You are free to study the source code and modify it for your own needs (that is the software must be open-source)
  - You are free to re-distribute copies of the software
  - You are free to distribute modified versions of the software but you have to keep them free as in freedom!

- Usually there is a community and an ecosystem around the free software that can
  - Provide Support
  - Share experience and ideas
  - Help in solving scientific or technical challenges
  - Give continuous guidelines
Oct 2018: Come check the OpenViBE workshop at IEEE SMC 2018, Japan
**Latest News (see all)**

**The 3rd International OpenViBE workshop (2018)**

Location: Miyazaki, Japan  Date: October 7, 2018 Workshop of the IEEE International Conference on Systems, Man and Cybernetics (IEEE SMC 2018)  Time 09:00 – 12:00  SuAM-R06-W02 : Third International OpenViBE Workshop Room: 4F R06 (4F Crystal)  Session Chairs: Fabien Lotte, ... Continue reading →

**Expected releases**

OpenViBE v2.2.0 December 2018
OpenViBE source code is hosted on the inria gitlab in a Git repository \url{https://gitlab.inria.fr/openvibe}

Since v1.18.0 Gitlab replaces Gforge.

- Getting the **latest** (unstable) version
- Visualize if the codebase was in a compilable state last night from the \textit{build status} page.
- **Push updates. Only for developers with account on gitlab.inria.fr**
- **Previous** Gforge (v0.17.0 – v1.3.0) and SVN (v0.1.0 – v0.16.0) repositories