History, concept, functionalities and community

OpenViBE Tutorial
@NeuroErgonomics22

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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
Brain-Computer Interfaces

Brain imaging → Signal denoising → Feature extraction → Command recognition → Execution

Feedback

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Main funded project using OpenViBE

  - 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)
  - 2015-2016 : Ilab CertiViBE (Hybrid-MENSIA)
  - 2016 : 2nd OpenViBE workshop (BCI conference, Austria)
  - 2016 : ANR REBEL
  - 2017 : ATT CONSORVIBE
  - 2018 : Medical Certification and first products from Mensia
  - 2018 : Third OpenViBE int. tutorial (SMC, Japan)
  - 2019 : ERC BrainConquest (user training)
  - 2020 : ANR Grasp-IT (Feedbacks for Stroke patients)
  - 2021 : ANR ABCDIS (BCI acceptability by stroke patients)
  - 2021 : ANR BETAPARK (Parkinson)
  - 2022 : CHISTERA BITSCOPE (Passive BCI for Art)
  - ...

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OpenViBE Concept
Concept: General Software Architecture

OpenViBE application

OpenViBE kernel

OpenViBE API

OpenViBE API

OpenViBE plugins

OpenViBE plugins

OpenViBE plugins

OpenViBE plugins

TCP/IP

UDP

LSL

VRPN

Network Communication

Outside World Application
## Concept: Plugins

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<th>GDF file writer/reader</th>
<th>Temporal filtering</th>
<th>Spectral analysis</th>
<th>Signal and spectral visualisation</th>
<th>Matlab scripting</th>
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<td>EDF file writer</td>
<td>Spatial filtering</td>
<td>Classification</td>
<td>2D and 3D topography map</td>
<td>Python scripting</td>
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<td>xDAWN, CSP</td>
<td>LDA/SVM</td>
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<td>Auto-Regressive coefficients</td>
<td>Voxel display</td>
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<td>Generic network</td>
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<td>Time/frequency mapping</td>
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Concepts: modularity and reusability

- quickly and efficiently arrangement of small processing components into a high level / complex composition
Concepts: different users

Author’s view

Make your own DSP chains

Operator’s view

Subject’s view

No programming skills required
• A scenario designer
• Graphical User Interface
OpenViBE Functionalities
Functionalities: An acquisition device abstraction

- Allows any device to be integrated, through the development of a C++ driver or a LSL connection
- Already supported:
  - All Brain Products devices (VAmpp, Brainamp series, Quickamp)
  - Brainmaster (Atlantis, Discovery)
  - Cognionics (all?)
  - EGI (Netamps 300)
  - Emotiv (EPOC)
  - g.Tec (g.USBam, g.Mobilab+, gNautilus)
  - All Micromed devices (through SystemPlus Evolution s/w)
  - OpenBCI (cyton+daisy)
  - 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

Neurofeedback

Motor Imagery

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Functionalities: stimuli

• **Visual Stimulus:**
  - Included in the release
  - P300
  - done by users

• **Audio Stimulus:**
  - Sound Player box

• **Keyboard Stimulus**

• **Vibration stimulus**
Functionalities: Various real-time displays
Functionalities: Interaction with other software

- **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
OpenViBE Key Features
Key figures

- Releases: #32: OV 3.1.0: Avril 2021
- Website: ~110,000 Unique visitors / ~300,000 visits in 2020
- Downloads: ~5500 downloads in 2020 (~3000 downloads per release)
- Forum members: ~1200 users total
- Forum posts: ~6700 posts total
- Citations: ~709 citations (OpenViBE paper 2010, google scholar)
- ~170k lines (C++)
For further information

**Brain–Computer Interfaces 1**
*Foundations and Methods*
Edited by Maureen Clerc
Laurent Bougrain and Fabien Lotte

**Brain–Computer Interfaces 2**
*Technology and Applications*
Edited by Maureen Clerc
Laurent Bougrain and Fabien Lotte

**Les interfaces cerveau-ordinateur 1**
*fondements et méthodes*
sous la direction de
Maureen Clerc, Laurent Bougrain et Fabien Lotte

**Les interfaces cerveau-ordinateur 2**
*technologie et applications*
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