



## *History, concept, functionalities and community*

**OpenViBE Tutorial  
@NeuroErgonomics22**

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University of Lorraine (France)

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

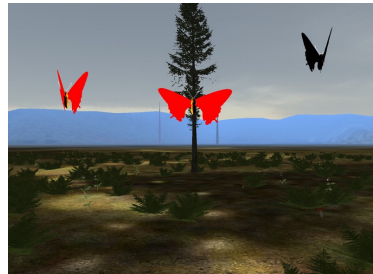
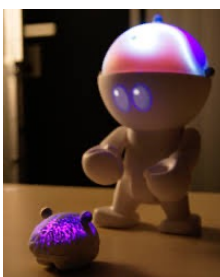
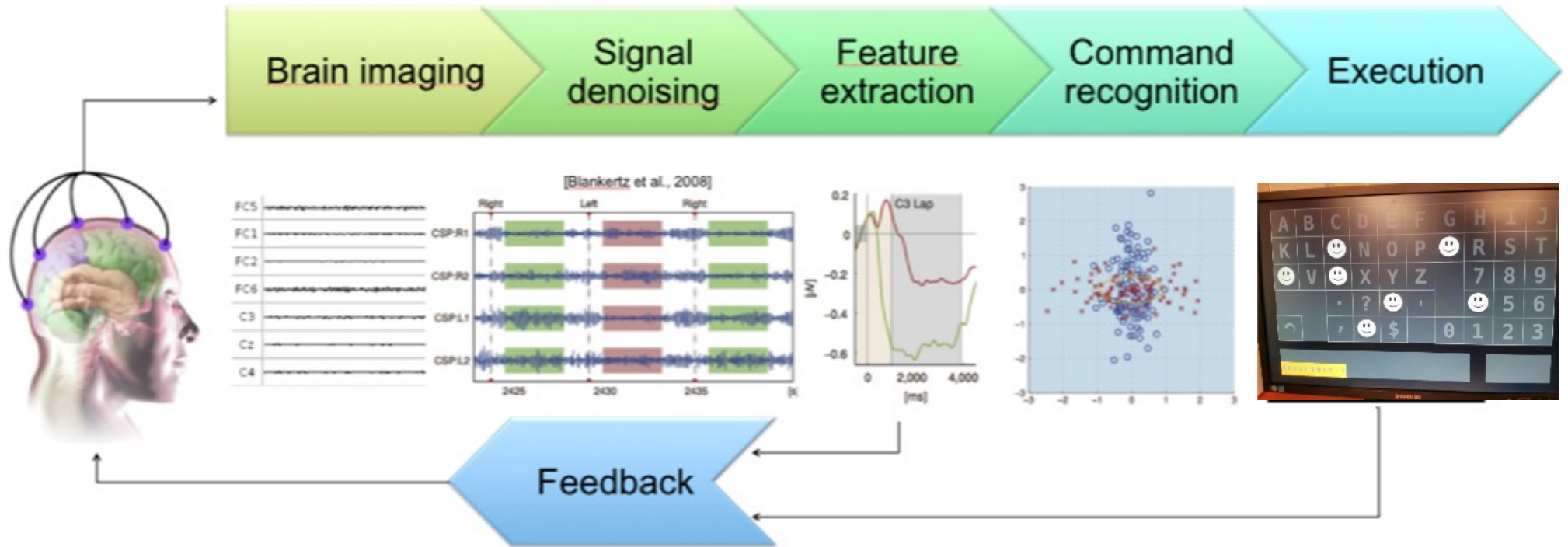


<http://openvibe.inria.fr>

Enjoyed by research labs, clinicians, teachers,  
game developers and hobbyists worldwide



# Brain-Computer Interfaces



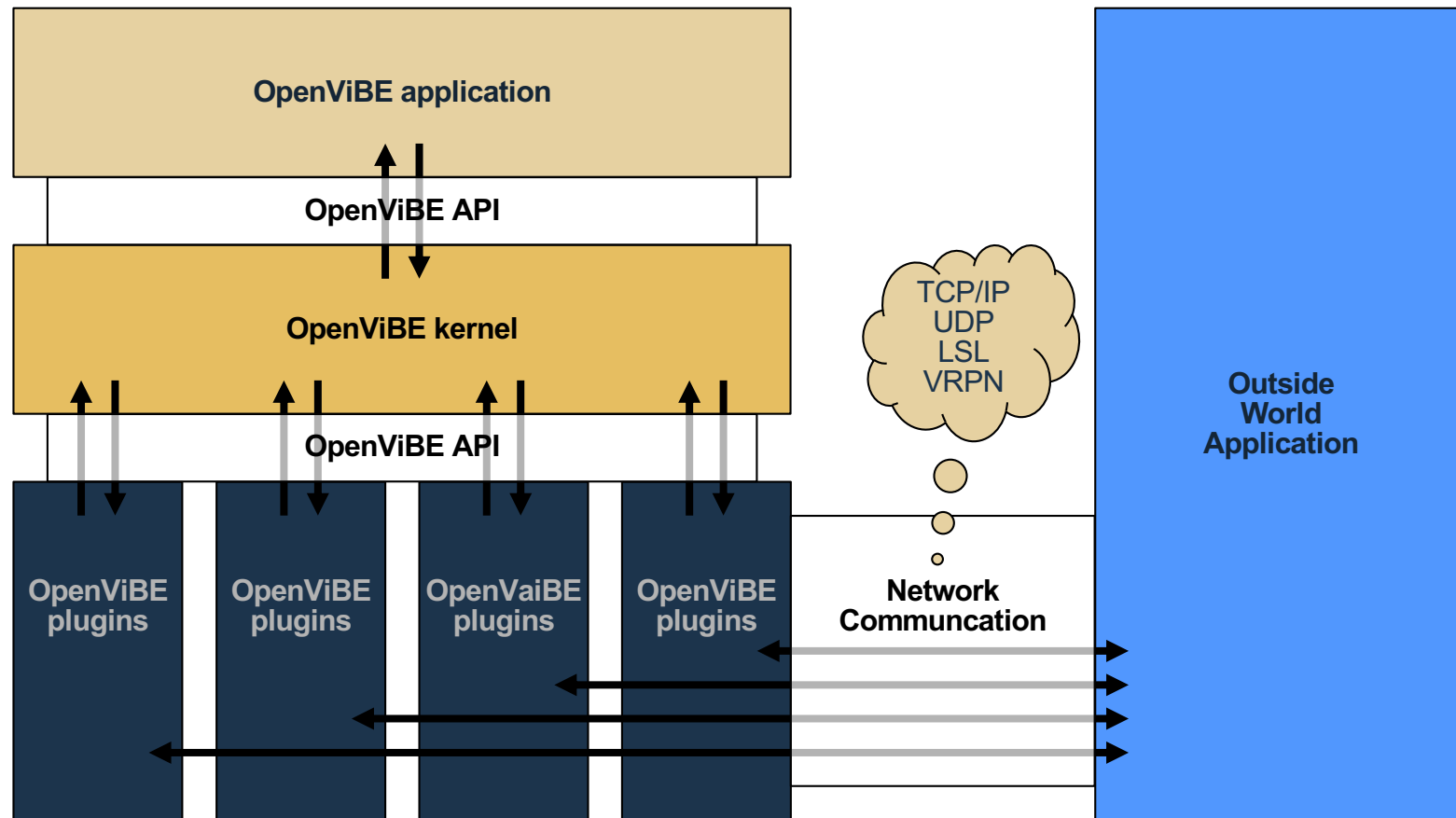
# Main funded project using OpenViBE

- **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)
- 2015-2019 : *IPL BCI-LIFT (Sophia-Rennes-Nancy-Bordeaux)*
- 2015-2016 : Ilab CertiViBE (Hybrid-MENSIA)
- 2016 : 2<sup>nd</sup> 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 ABCIS (BCI acceptability by stroke patients)
- 2021 : ANR BETAPARK (Parkinson)
- 2022: CHISTERA BITSCOPE (Passive BCI for Art)
- ...



# OpenViBE Concept

# Concept: General Software Architecture



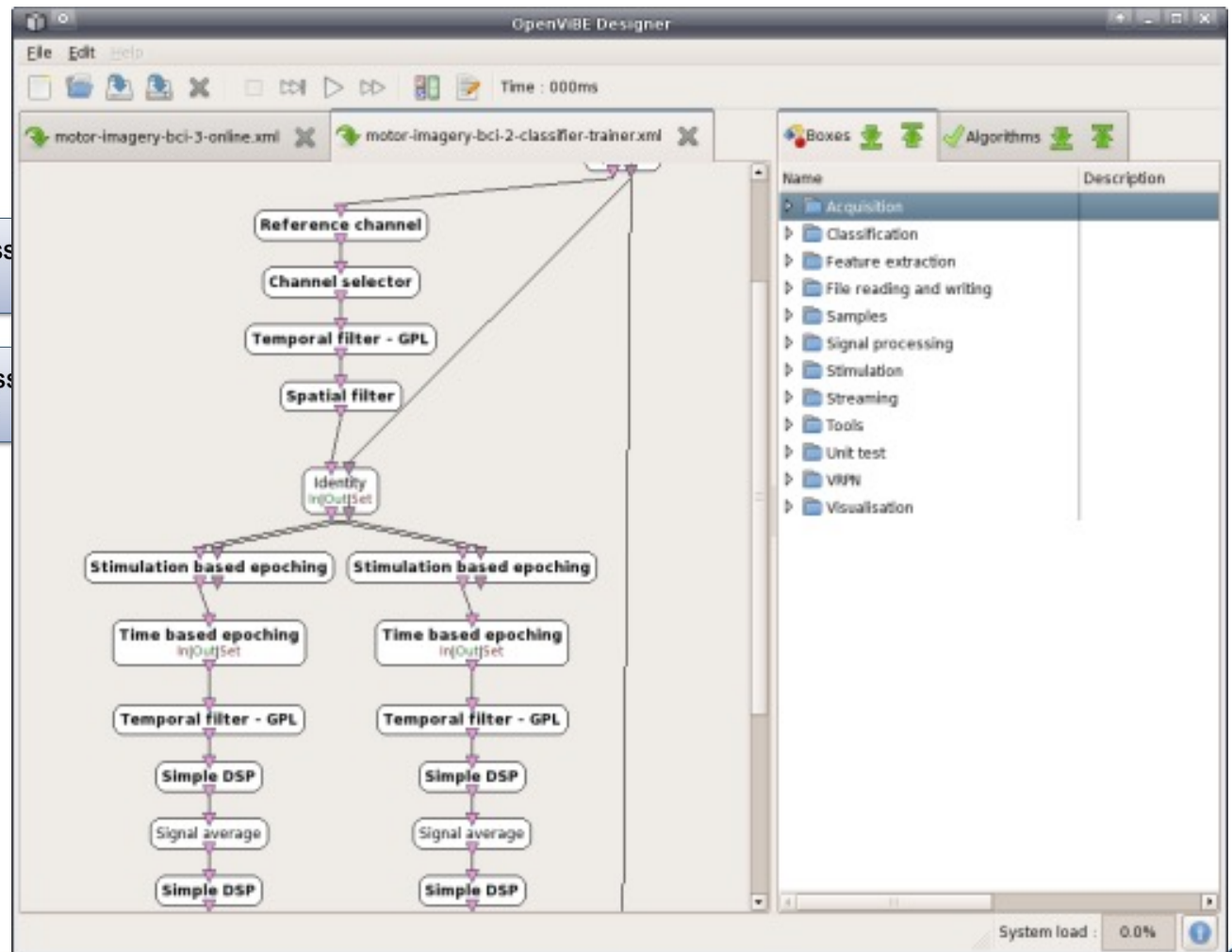
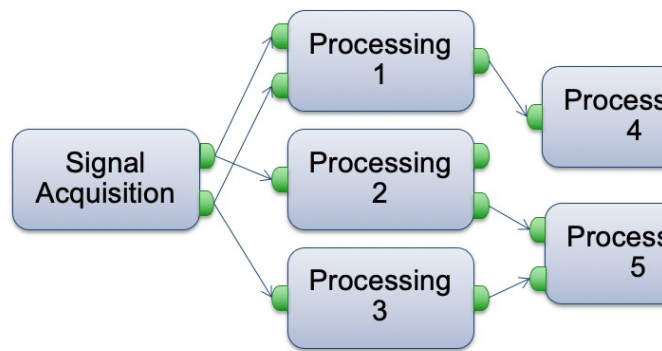
# Concept: Plugins

GDF file writer/reader	Temporal filtering	Spectral analysis	Signal and spectral visualisation	Matlab scripting
EDF file writer	Spatial filtering xDAWN, CSP	Classification LDA/SVM	2D and 3D topography map	Python scripting
CSV file writer/reader	Universal DSP	Auto-Regressive coefficients	Voxel display	Lua scripting
Generic network acquisition	Signal epoching	Windowing	Time/frequency mapping	VRPN input/output
	<b>Connectivity measure</b>	<b>Multiclass classifiers</b>		<b>LSL Input/output</b>
	<b>Artefact detection</b>	<b>Riemmanian geometry</b>		



# Concepts: modularity and reusability

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

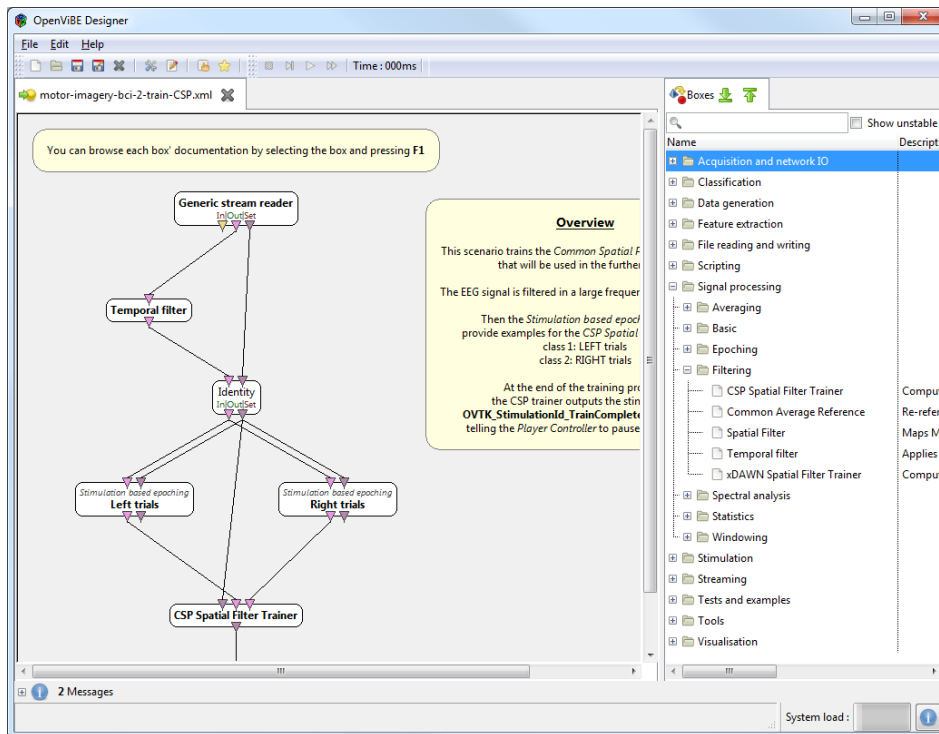




# Concepts: different users

## Author's view

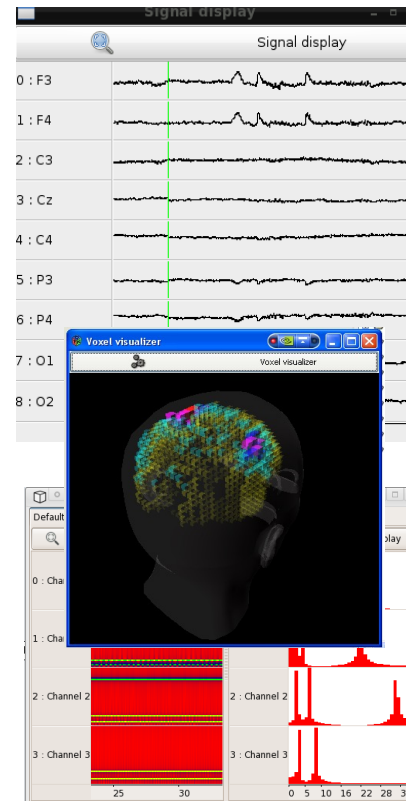
Make your own DSP chains



No programming skills required

- A scenario designer
- Graphical User Interface

## Operator's view

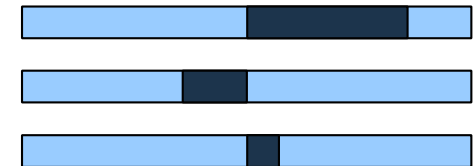


## Subject's view

### Interactive Application



### Neurofeedback



# OpenViBE Functionalities

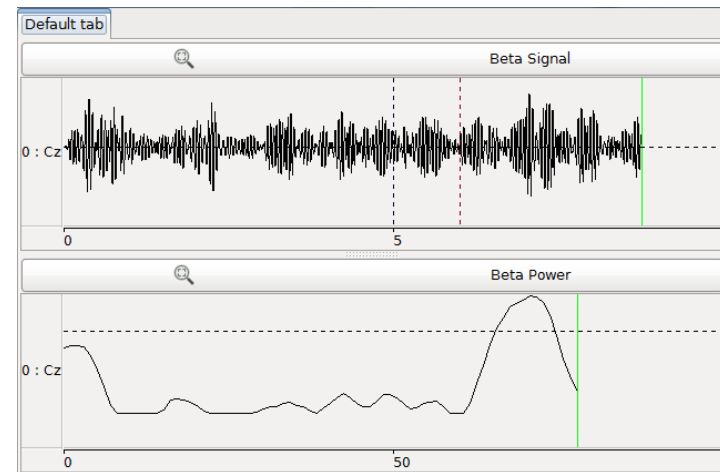
# Functionalities: An acquisition device abstraction

- Allows any device to be integrated, through the development of a C++ driver or a LSL connection
  - Already supported :
    - All Brain Products devices (VAmP, Brainamp series, Quickamp)
    - Brainmaster (Atlantis, Discovery)
    - Cognionics (all?)
    - EGI (Netamps 300)
    - Emotiv (EPOC)
    - g.Tec (g.USBam, g.Mobilab+, g.Nautilus)
    - 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/> )

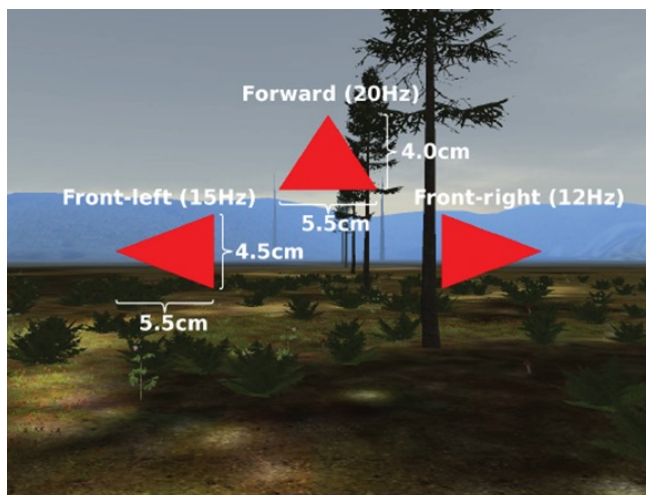
# Functionalities: Paradigms



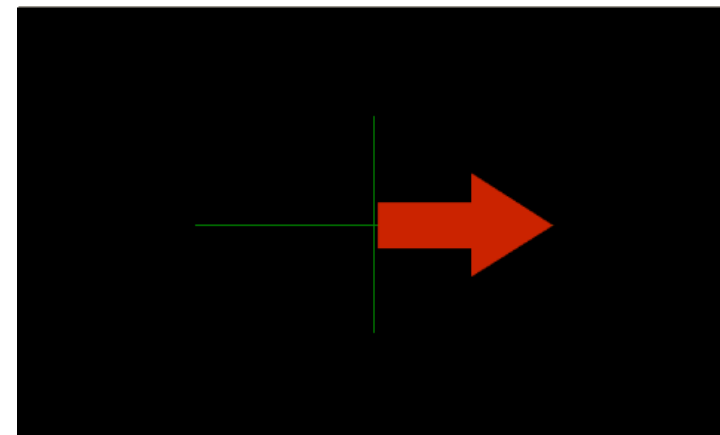
P300



Neurofeedback



SSVEP

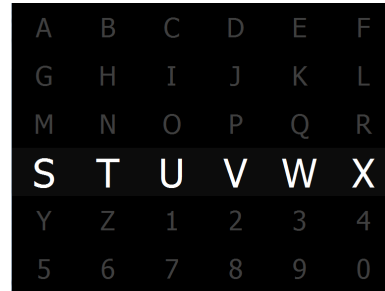


Motor Imagery

# Functionalities: stimuli

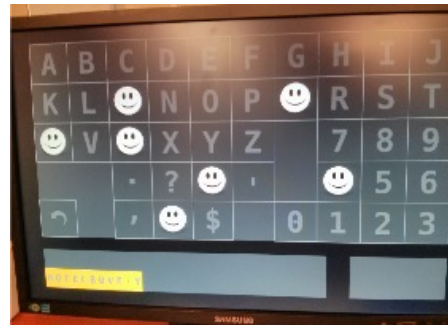
- Visual Stimulus:

Included in the release P300

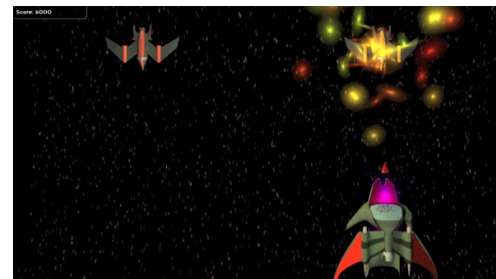


done by users

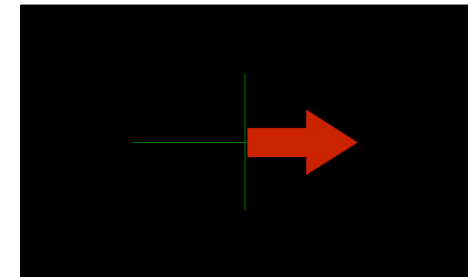
P300



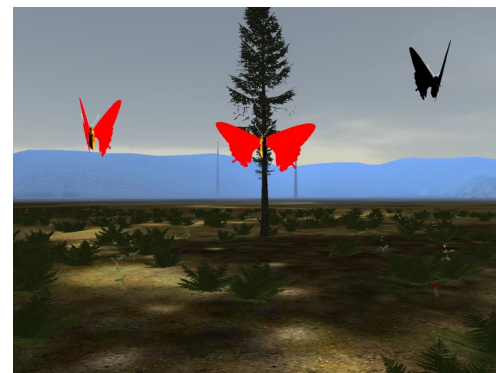
SSVEP



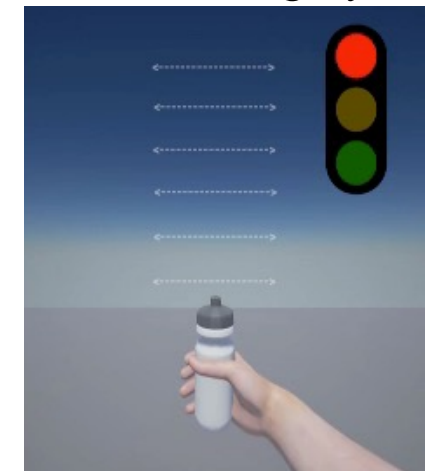
Motor Imagery



SSVEP



Motor Imagery



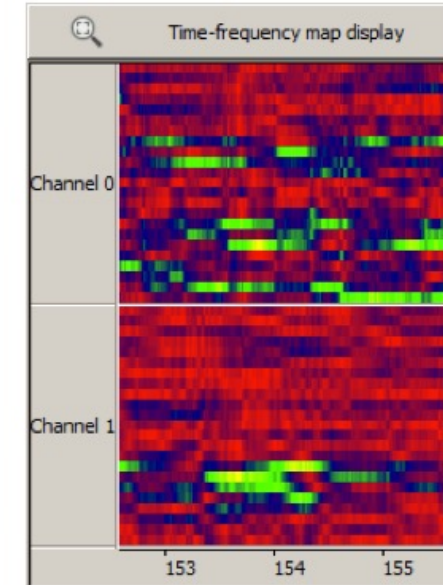
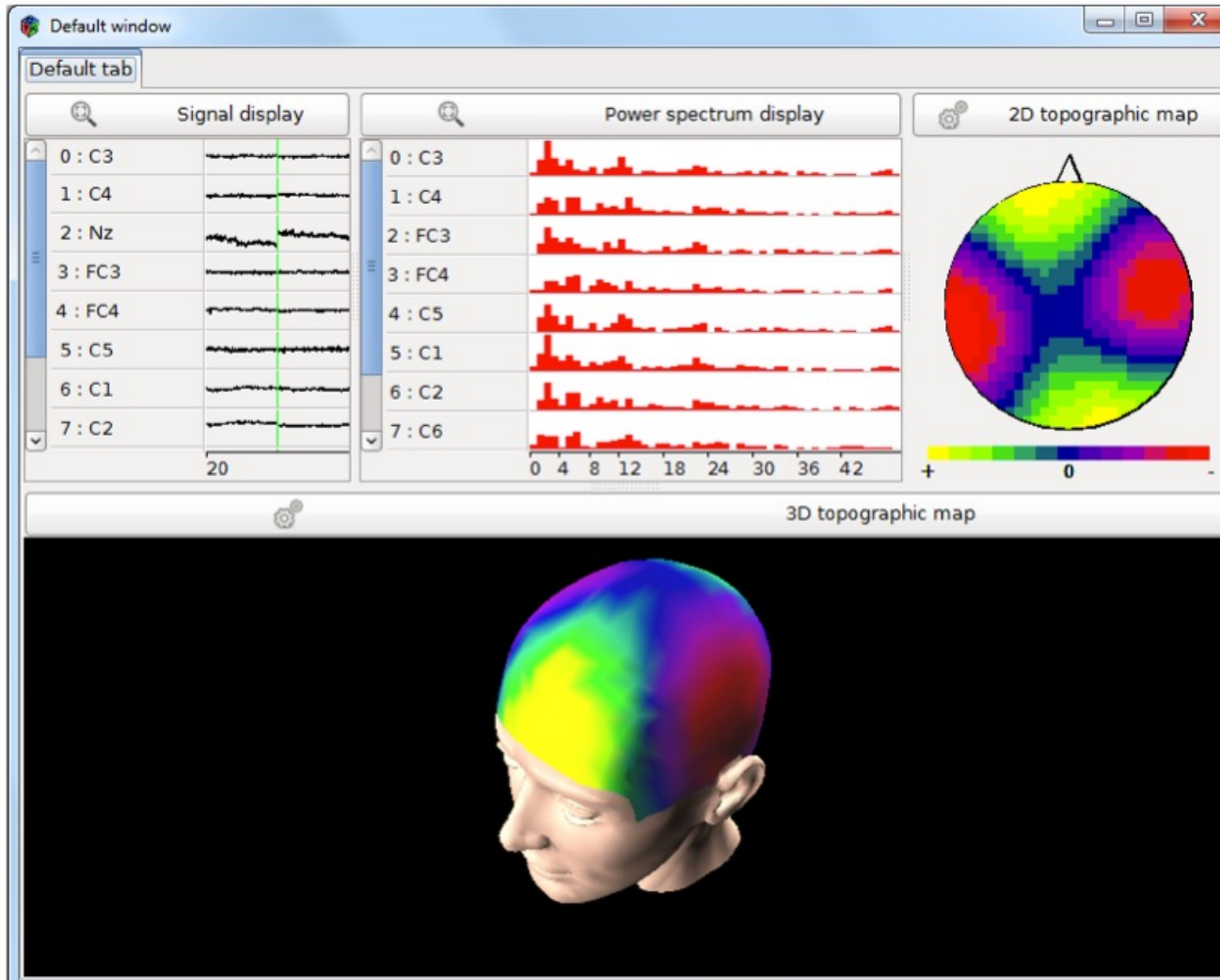
- Audio Stimulus:

- Sound Player box 

- Keyboard Stimulus

- Vibration stimulus

# Functionalities: Various real-time displays

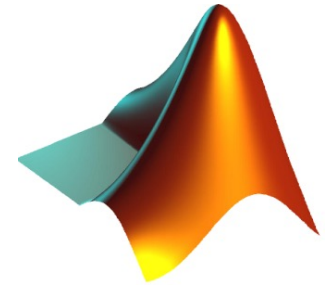




# Functionalities: Interaction with other software

- 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

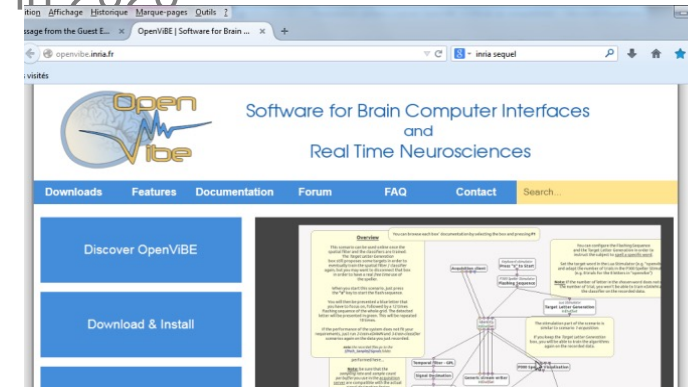
For example, write your own spatial filter in Matlab and use it in OpenViBE



# 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++)



Forum		Topics	Posts	Last post
<b>General</b>				
	<b>OpenViBE News</b> OpenViBE software releases, jobs and events	56	110	Tue Sep 25, 2018 1:54 pm jtindgren ➔
	<b>Discussion about OpenViBE</b> Come here to discuss about OpenViBE in general!	277	1188	Tue Jul 31, 2018 7:31 am jtindgren ➔
	<b>Discussion about BCI and related topics</b> About Brain Computer Interfaces, EEG, neurofeedback, related event announcements, jobs, etc.	82	238	Wed Aug 29, 2018 3:00 pm andrew_dimitrijevic ➔
	<b>Feature Requests</b> Ask for a new OpenViBE feature.	16	70	Fri Jan 20, 2017 2:12 pm oyenil ➔
<b>Using OpenViBE components</b>				
	<b>Acquisition server and drivers</b> Obtaining data from various hardware devices	154	790	Fri Sep 21, 2018 8:58 am jtindgren ➔
	<b>Designer</b> About the GUI application to design signal processing pipelines	159	722	Thu Sep 20, 2018 2:17 pm jtindgren ➔
	<b>Boxes</b> Concerning processing components: filters, file load/save, visualizations, communication ...	156	645	Tue Oct 02, 2018 7:33 am kyunghowon ➔
<b>OpenViBE scenarios</b>				
	<b>Scenarios and BCI design</b> Working with OpenViBE signal processing scenarios and doing scenario/BCI design	214	801	Thu Oct 04, 2018 12:40 pm Yael ➔
	<b>Tutorial scenarios</b> About BCI and box tutorial/demo scenarios bundled with OpenViBE.	27	79	Wed Jun 27, 2018 8:42 am deeann ➔
<b>OpenViBE-related development</b>				
				Thu Jun 21, 2018 12:01 pm



# For further information

