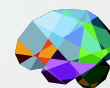


NODE #7 WORKSHOP

AUGUST 7-8, 2018 | MONTREAL, CANADA

Architecture of TVB

Paula Popa and Mihai Andrei, CODEMART



THEVIRTUALBRAIN.

Architecture of TVB

The main site

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Simulate a human brain, right on your PC!
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**Delivering practical results.
For novel clinical applications.**


**Coming up:
TVB Node#7**


**Profound science.
Professional software.**

For over 20 years, bright minds and ambitious projects have attempted to emulate the human brain across various scales of organization. Despite impressive efforts to bring in the latest and greatest computing power of massively parallel hardware, success hasn't yielded practical applications yet.

To get practicality sooner, The Virtual Brain takes a network approach on the largest scale: By manipulating network parameters, in particular the brain's connectivity, The Virtual Brain simulates its behavior as it is commonly observed in clinical scanners (e.g. EEG, MEG, fMRI).

Though The Virtual Brain incorporates the complex world of neuro-chemistry only to a small degree, it gains a lot by not becoming as complex as the brain itself.

Instead, The Virtual Brain embraces and extends novel concepts from computational, cognitive and clinical neuroscience in order to drastically reduce the model's complexity while still keeping it sufficiently realistic – and delivering the same output as clinical brain-scanners.

Upcoming events

**AUG 7**

TVB Node#7
Montréal, QC, Canada : 2 DAY WORKSHOP :: AUGUST 7-8, 2018 Get up to speed about the fundamental principles of full brain network modeling using the open-source neuroinformatics

Past events

**FEB 26**

Workshop: TVB:Node#6
Berlin, Germany : Get up to speed about the fundamental principles of full brain network modeling using the open-source neuroinformatics platform The Virtual Brain (TVB). TVB enables

**NOV 15**

TVB Poster Series @ SfN 2017
Washington DC, USA : TVB Poster Series @ SfN 2017 Don't miss the TVB poster series at SfN where you can find out about the latest research using TVB. This year, in addition to The

**NOV 11**

See TVB live at SfN 2017!
Washington DC, USA : The Virtual Brain team will exhibit at the Annual Meeting of the Society for Neuroscience in Washington DC, USA. This is your chance to see demonstrations of the latest

**MAY 15**

Workshop: TVB:Node#5
Marseille, France : Get up to speed about the

Latest publications

Neurological Biomarkers and Neuroinformatics: The Role of The Virtual Brain
Molecular-Genetic and Statistical Techniques for Behavioral and Neural Research; Elsevier

Predicting the spatiotemporal diversity of seizure propagation and termination in human focal epilepsy
Nature Communications

Differentiation of Alzheimer's disease based on local and global parameters in personalized Virtual Brain models
Neuroimage Clinical

New developments

**TVB at FENS 2018**
June 29: TVB will be taking part in this year's FENS Forum in Berlin! There will be several opportunities to hear and see

**TVB at Long Night of Sciences in Berlin**
June 6: Experience The Virtual Brain this Saturday, June 9th from 5pm to midnight at

**TVB @ International Conference on Learning & Memory**
April 20: Joelle Zimmermann

[**www.thevirtualbrain.org**](http://www.thevirtualbrain.org)



NEUROSCIENCE



BRAINSIMULATOR



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THEVIRTUALBRAIN.

Scalable Brain Simulation

Clinical Application

Collaborations

Publications

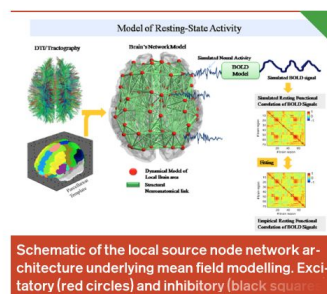
Understanding what counts: The key to make brain simulation feasible.

What makes The Virtual Brain unique is a rather new way of addressing the inherent difficulties of simulating a large-scale network like the human brain:

- Understanding the brain's behavior as a network's performance at all seems obvious but isn't so much in hindsight: The Virtual Brain builds upon the discovery of the **critical network parameters of the human brain**, their influence to functional processes and their proper tweaking to rectify a malfunctioning or damaged network.
- Rather than making simplifying assumptions about topology, density and range of large-scale connectivity (anatomical realism), The Virtual Brain invokes the **Connectome**, simultaneously integrating multiple modes of network activity.
- The Virtual Brain includes an array of new and useful measures for the brain's organization thanks to **extensive use of graph theory**: segregation, integration, efficiency and influence of subnetworks, nodes and their edges.
- For the first time, The Virtual Brain provides the same qualities and quantifications of **common neuro-imaging methods (EEG, MEG, fMRI)** like for a real brain, making it ideal for **experimental validation and customization**.

Realizing that network nodes in actual human beings are far from homogeneous, The Virtual Brain captures the functioning of the sub-networks of the human brain through the novel concept of the space-time structure of the network couplings featuring means for quantifiable coupling matrices within and across regions.

Upcoming versions will constantly process these experimental results



Schematic of the local source node network architecture underlying mean field modelling. Excitatory (red circles) and inhibitory (black squares)

Bibliography

Amari S. (1977). Dynamics of pattern formation in lateral-inhibition type neural fields. *Biological Cybernetics*, 27:77-87.

Assisi, C. G., Jirsa, V. K., and Kelso, J. A. S. (2005). Synchrony and clustering in heterogeneous networks with global coupling and parameter dispersion. *Physical Review Letters*, 94(1):018106.


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Breakspear, M. and Jirsa, V. (2007). Neuronal Dynamics and Brain Connectivity - *Handbook of Brain Connectivity (Understanding Complex Systems)*, Springer Berlin / Heidelberg, 3-64.

Brunel, N. and Wang, X.-J. (2003). What determines

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Software Downloads

System Requirements


Import & Export data

Getting Help & Support

Screenshots




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v1.5.4
Updated 291 days ago

656 MB
↓

455 MB
↓

654 MB
↓

What you are getting

We offer ready-made packages which were tested for all major, **64-bit desktop platforms**. If you wish to install a 32-bit version of TVB, you can still do so from the → [source code on GitHub](#).

These packages work equally well for **new installations** or for **updating existing installations**. After unpacking, it's a good idea to look into the included **README** and **Tutorial files**, as well as our extensive → [documentation web-site](#). Besides that, we provide ample → [help and support](#) for the software.

Our brain simulator software requires modern hardware, operating systems and web browsers. Please see our → [technical requirements](#) for details. While the TVB software itself is **open source** with a → [GPLv3 license](#), we include some → [3rd party packages](#) with different licenses.

Download & register as a TVB scientist!

Join our growing global community of **over 2,000 registered TVB scientists** and be among the first to learn about educational events in your area, receive news about research conducted with TVB and the latest plans for software updates and new features!

Release notes

OCT 16 2017

Version 1.5.4 (build 8430)
58 changes

Improvements in Visualizers

MAY 12 2017

Version 1.5.3 (build 8253)
1 changes

Fixing bugs

MAY 11

Version 1.5.2 (build 8247)
2 changes

First name

Last name

Email address

☐ Yes, I agree to the → [TVB Privacy Policy](#)

Organization

Area of work

Other Fields

How did you hear about The Virtual Brain?

www.thevirtualbrain.org


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Extensive support.
For scientists & developers.

Read the documentation

Discuss with peers

View the source code



Context-sensitive help & user guides

The software packages for The Virtual Brain contain **user guides** as PDF files (for users, developers and contributors). These can be found in the "docs" folder of the installation.

In the GUI, you can also use illustrated, **context-sensitive help** for entire sections or particular elements (e.g. variables for modeling parameters). The availability of context-sensitive help in the GUI is marked with a round "?" button.

Standard packages also contain a small set of **demo data** to play with.



Online documentation & tutorials

We offer a dedicated documentation website under → docs.thevirtualbrain.org. It covers almost every imaginable topic, from installation to step-by-step tutorials to developer guides for modifying and contributing code.

The documentation website also offers downloads for **bulky demo data sets** which are used in the online tutorials. These are a great start for new users to work with actual data.



Discussion forum and mailing list

If you have specific questions, also about how to use TVB for your current research activity, you can use our → [public discussion forum](#), which doubles as a mailing list if you prefer this channel.

In this forum, you can meet and discuss with other TVB users, as well as experts from our own support team. It's a perfect place to ask things like **"Does anyone else see that both the EEG and the BOLD have similar shape in terms of the 1/f type of drop off towards the higher frequency range?"**.



Source code

Talk with experts

We're happy to help you when your struggle with the TVB software. Please understand that we can't give programming lessons or scientific consulting.

For anything else like **errors** you encounter, **suggested improvements** or **feature requests**, we're eager to hear from you!

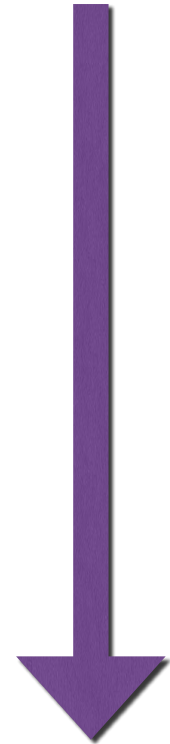


General TVB support

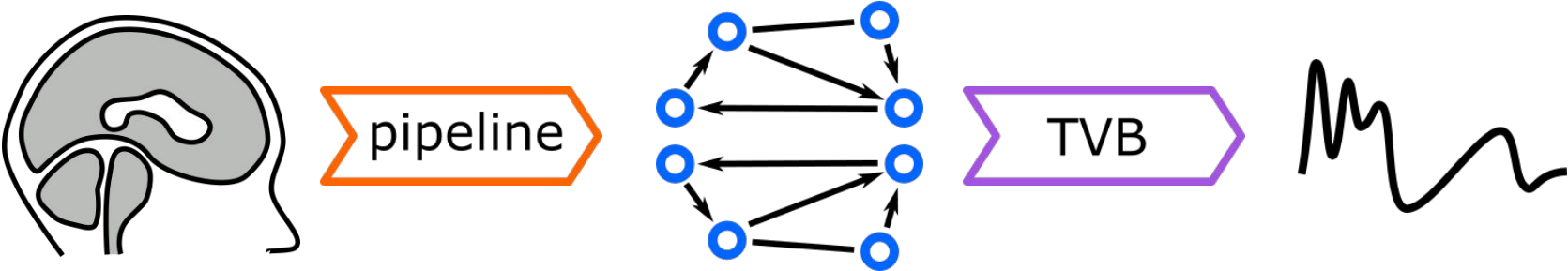
For general issues

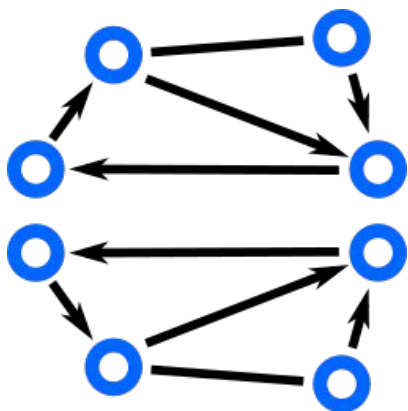


Start Framework Dev. – Dec 2010
First public teaser – Mar 2012
Release 1.0 – Oct 2012
Epileptor Model – 2014
First GSOC collaboration – Jun 2014
Link with Allen DB – Sep 2016
Installed in HBP Collab – Dec 2016
Release 1.5.4 – October 2017

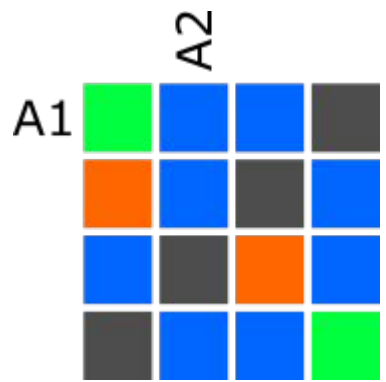
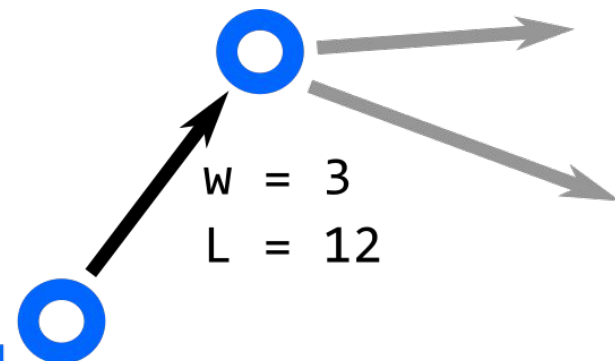


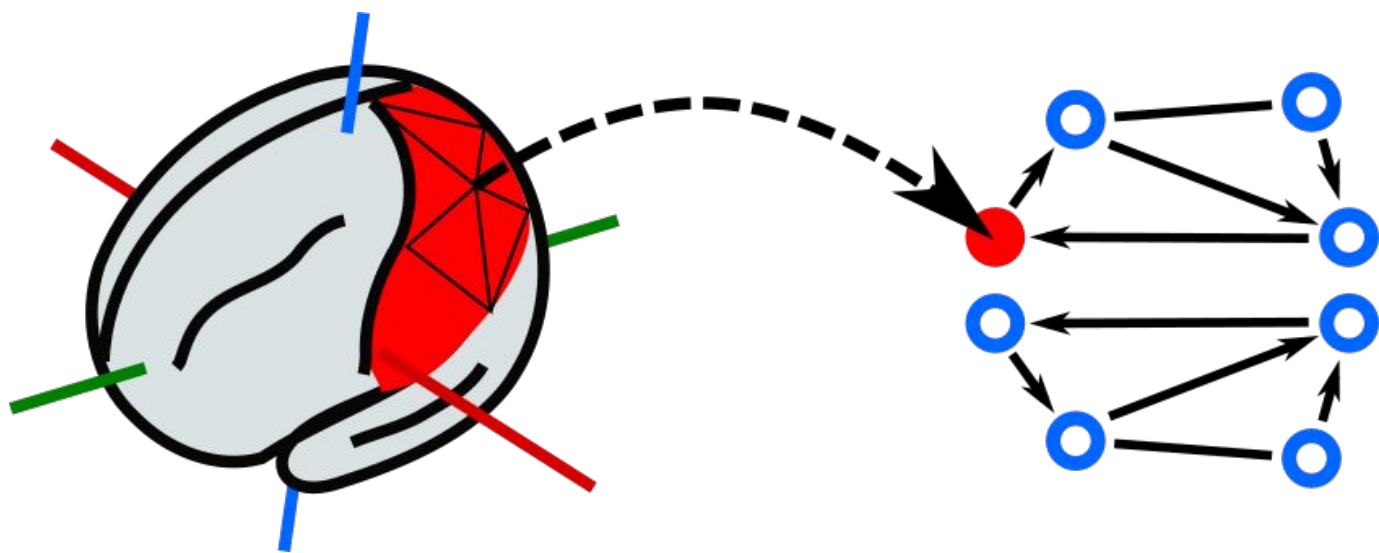
Architecture of TVB
High level data flow

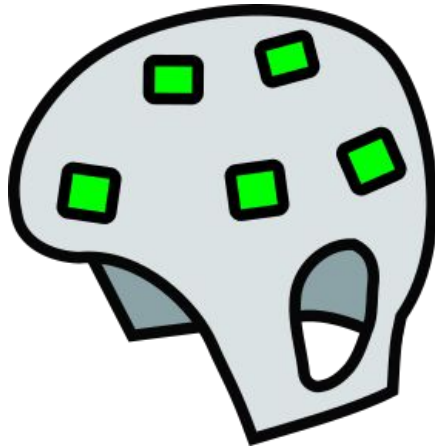




name = rA1
pos = [x, y, z]



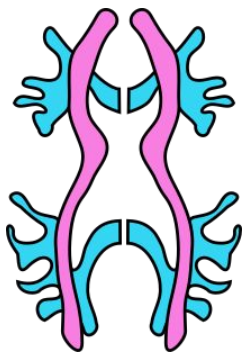
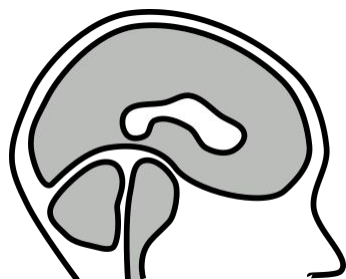




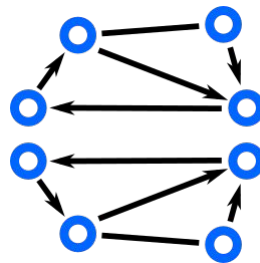
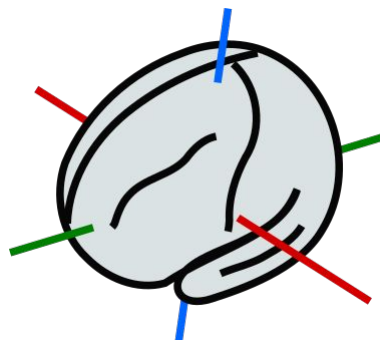
```
name = A'1
```

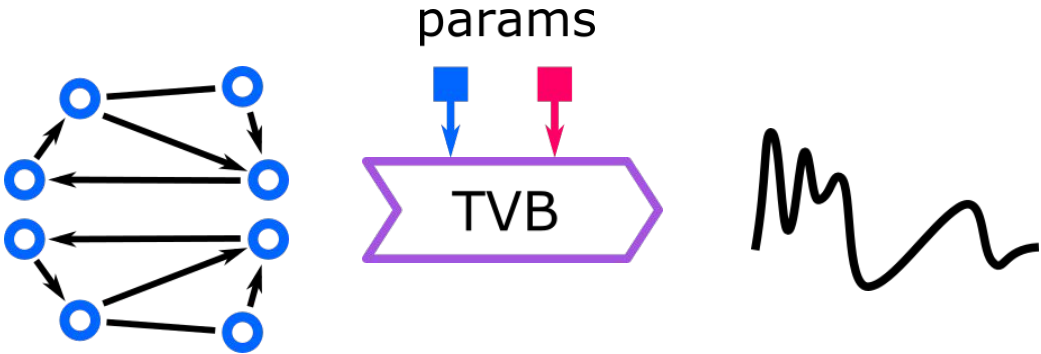
```
pos = [x, y, z]
```

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Pipeline

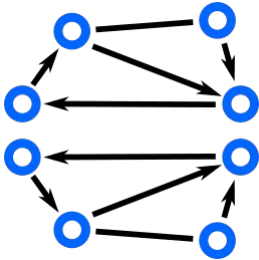


pipeline

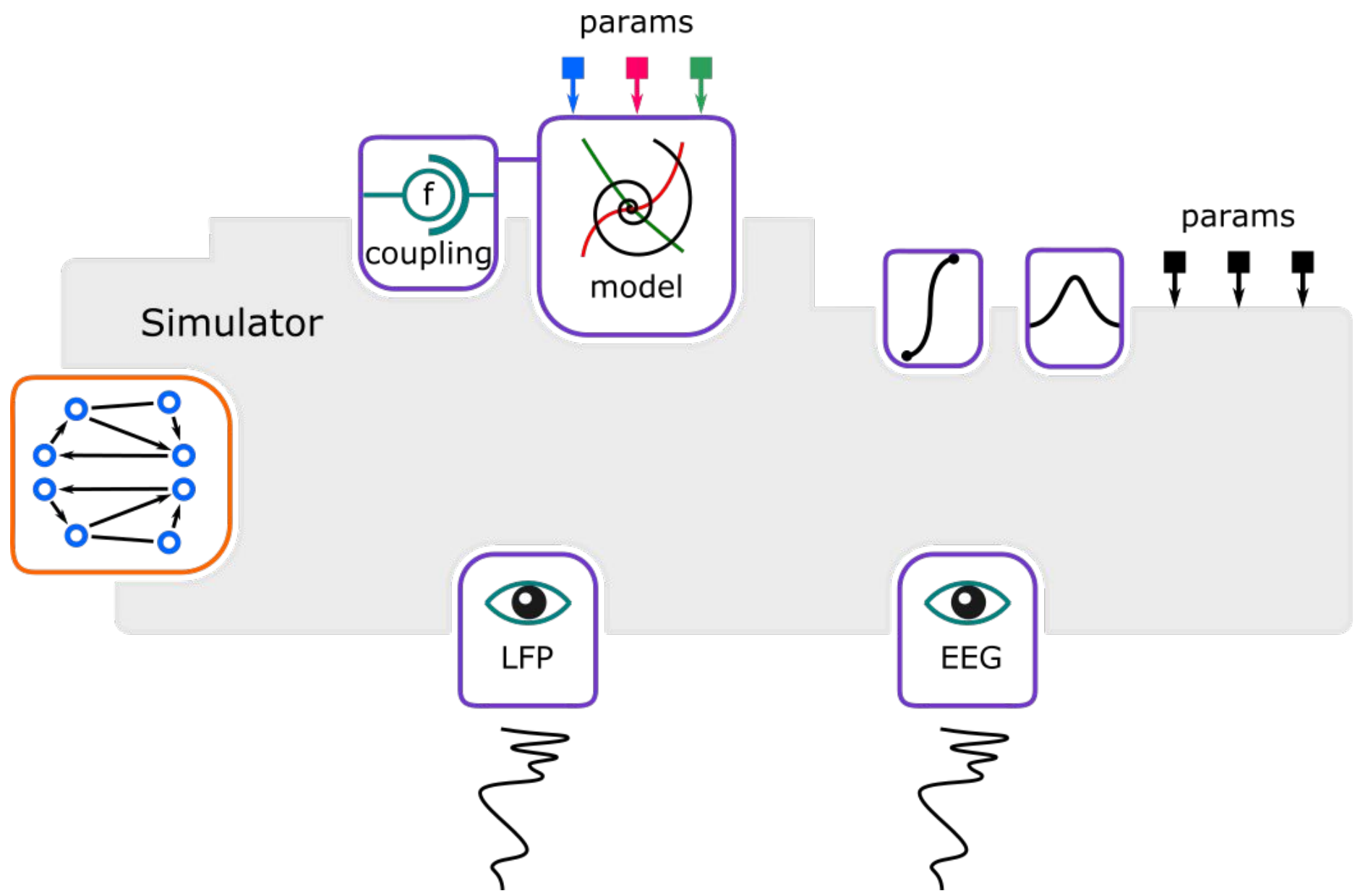


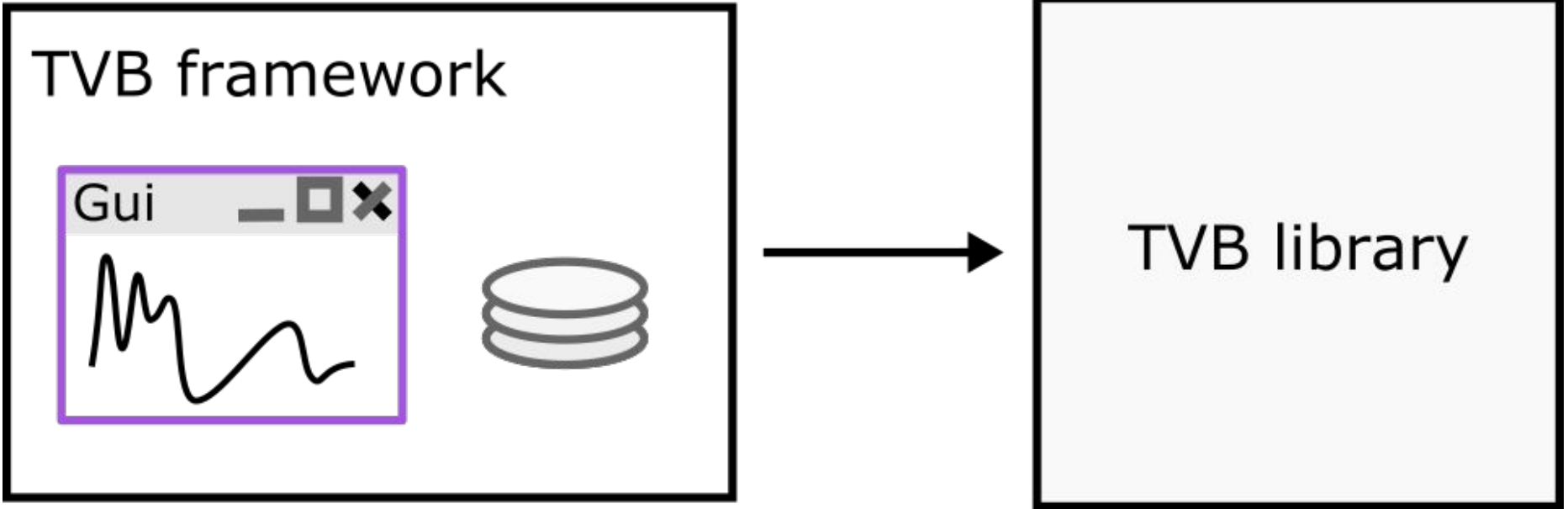


params



Architecture of TVB
Simulator details





TVB library

simulator

models
monitors
...

datatypes

analysers



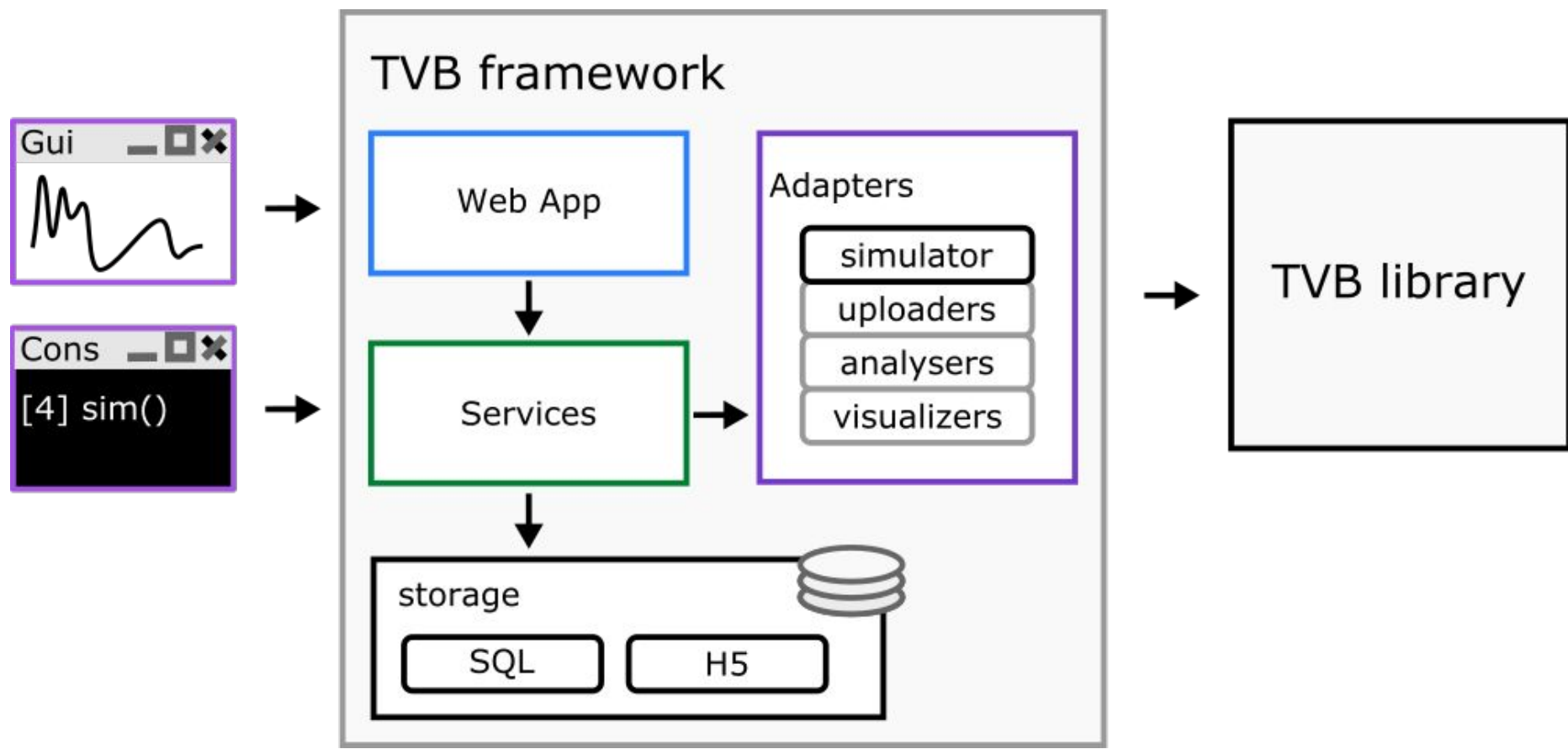
Cons



```
[4] sim()
```

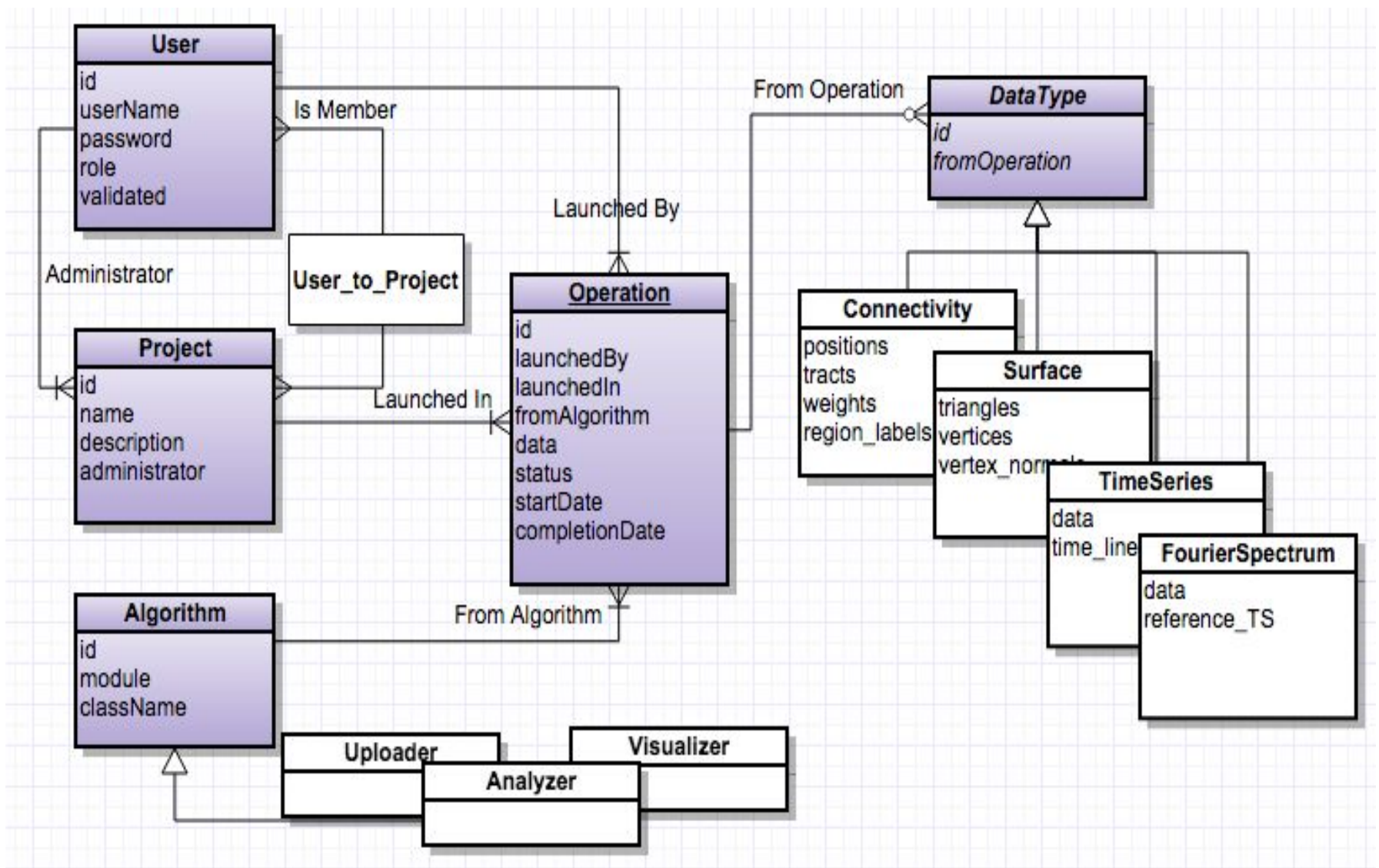
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Framework details

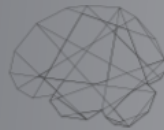


Architecture of TVB

Metadata schema



- Python
- Numpy numba
- Scipy jupyter
- BCT
- networkx
- Javascript
- jquery mathjax
- D3 webgl
- Cherrypy genshi
- Sqlalchemy sqlite postgres
- Hdf5
- nibabel



THANK YOU