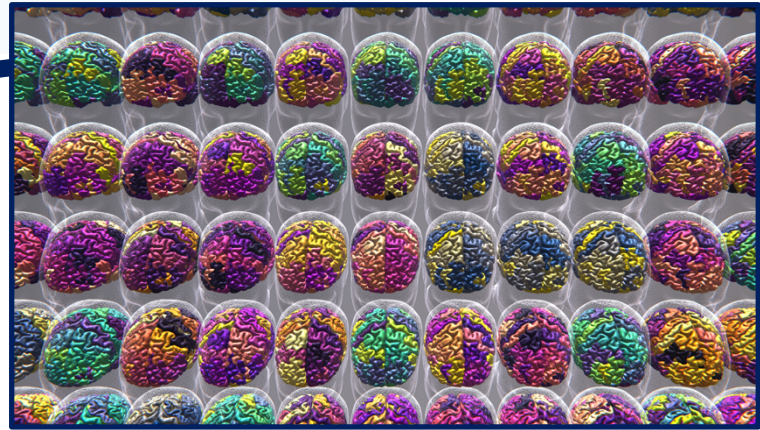




VirtualBrainCloud

Personalized Recommendations for Neurodegenerative Disease



www.VirtualBrainCloud-2020.eu

Public deliverable report

D5.5: Webinar with demonstration of personalized simulation (“case studies”) using the integrated model in TVB

Date	January 2023
Authors	CHARITÉ (Petra Ritter) © VirtualBrainCloud consortium
Dissemination level	public
Website	www.VirtualBrainCloud-2020.eu



This project has received funding from the European Union's Horizon 2020 research and innovation programme under **grant agreement No 826421**



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1. Introduction

The Virtual Brain Cloud (TVB-Cloud) has developed EU General Data Protection Regulation (GDPR) compliant cloud infrastructure that enables researchers for integrating sensitive multimodal multi-level health data in computational multi-scale brain models to run personalized simulations of human digital twins.

Several novel technological developments have been made. In this deliverable we demonstrate examples of our public outreach work. We provide links to various webinars that are available online demonstrating human personalized digital twin simulation case studies and the underlying technology.

2. Description of work performed

We chose various formats to demonstrate personalized simulation (case studies) using the integrated model in The Virtual Brain (TVB, thevirtualbrain.org, Ritter et al. 2013, Sanz-Leon et al. 2013, Schirner et al. 2022).

All Webinars have been announced on our project website (<https://virtualbraincloud-2020.eu>) and distributed via the project's twitter channel (https://twitter.com/tvb_cloud?lang=en) as well as via other social media channels.

Several of the webinars were organized jointly with EBRAINS (ebrains.eu) and the Human Brain Project (HBP) of which TVB-Cloud is a partnering project¹.

3. Results

Within the TVB-Cloud project, we have achieved the following major results concerning personalized human digital twin simulations:

- Provision of personalized brain simulation as a GDPR compliant cloud service² (Schirner et al. 2022) accessible by users via EBRAINS Research Infrastructure (RI)
- Extension of existing TVB software for multi-scale brain simulation (Schirner et al. 2022; Maier et al. 2022) accessible by users via EBRAINS Research Infrastructure (RI)
- Inclusion of Positron Emission Tomography (PET) results to constrain personalized brain network models (Stefanovski et al. 2019)
- Provision of proof of principle for simulation augmented classification of dementia (Triebkorn et al. 2022)

¹ <https://www.humanbrainproject.eu/en/collaborate-hbp/partnering-projects/>

² <https://ebrains.eu/service/the-virtual-brain/>



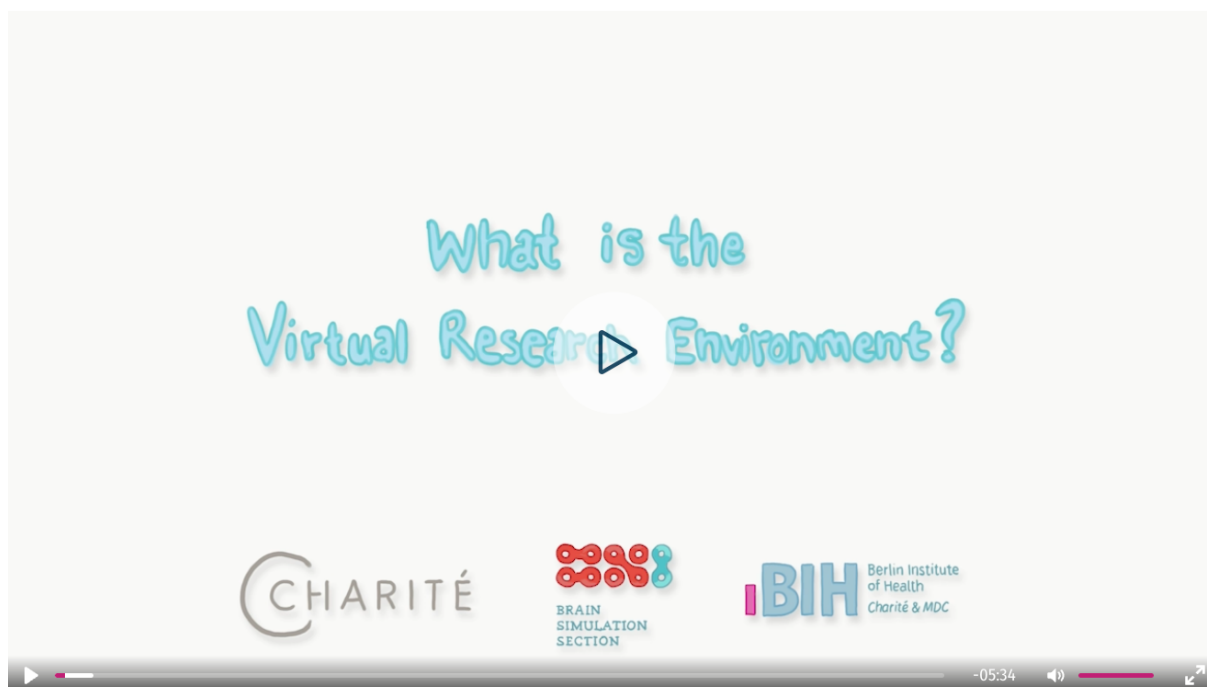
- Provision of secure Virtual Research Environment³ for GDPR compliant management and processing of sensitive health data listed in the registry of research data repositories⁴ (re3data)

These and additional results (see references) were presented as webinars for different target audiences.

Technology Webinars

Explainer Video What is The Virtual Research Environment

<https://www.bihealth.org/en/translation/network/digital-medicine/bihcharite-virtual-research-environment>



Find many more related webinars on our BrainModes YouTube channel:

<https://www.youtube.com/@brainmodes3231/videos>

18th Fenix Infrastructure Webinar Nov 2nd 2022

“How to implement a secure processing pipeline for human data”

<https://www.brainsimulation.org/bsw/zwei/events/single/11026-18th-fenix-infrastructure-webinar>

³ <https://www.bihealth.org/en/translation/network/digital-medicine/bihcharite-virtual-research-environment>

⁴ <https://www.re3data.org/repository/r3d100014127>



18TH FENIX INFRASTRUCTURE WEBINAR "HOW TO IMPLEMENT A SECURE PROCESSING PIPELINE FOR HUMAN DATA"

02 NOV 2022

Place: Online

FENIX
RESEARCH INFRASTRUCTURE

Webinar:
How to implement a secure processing pipeline for human data
Speaker: Petra Ritter (Charité)

Wednesday 2 November 2022 | 15:00-16:00 CET

Fenix has received funding from the European Union's Horizon 2020 research and innovation programme through the ICEI project under the grant agreement No. 800858.

The **18th Fenix Infrastructure Webinar "How to implement a secure processing pipeline for human data"** takes place on **Wednesday 2 November 2022 at 15:00 CET**.

Date and Time: Wednesday 2 November 2022, 15:00-16:00 CET

Cost: Free of charge

Speakers: Petra Ritter (Berlin Institute of Health at Charité - BIH)

Description:

This webinar will present existing solutions that enable secure and privacy-protecting processing of human health data in the cloud and on HPC. We will present secure research software solutions accessible via web interfaces with HPC backends and full-fledged Virtual Research Environments with data protection by design and default.

The presented solutions have been developed as part of HBP, [EOSC project Virtual Brain Cloud](#), and [EBRAINS Health Data Cloud](#) and are further developed in the EC Infrastructure project [EBRAIN-Health](#). Reference: [Brain simulation as a cloud service: The Virtual Brain on EBRAINS](#).

Who should attend?

- Neuroscientists
- HPC infrastructure users
- EBRAINS service developers
- Other platform service developers

Main takeaways

- How scientific tool developers can make their services available using ICEI/Fenix Research Infrastructure
- How to provide GDPR-compliant compute and software services

Agenda

- Presentation
- Q&A

The webinar has been recorded and the full recording is available on the Fenix [Webinars page](#).



The Webinar “How to implement a secure processing pipeline for human data” is available online:

<https://fenix-ri.eu/media/webinars>

<https://www.youtube.com/watch?v=G79vPahGkIc>

Scientific Webinar Series

Summer School 2022: The Virtual Brain in Clinical Research June 28 - Sept 13, 2022

<https://www.brainsimulation.org/bsw/zwei/events/single/9651-summer-school-2022-the-virtual-brain-in-clinical-research>

10 Webinars are available online:

<https://www.youtube.com/playlist?list=PLVtblERyzDeLNHXIPxPVosUxaz8fuFqHE>

Principles of traveling waves
Experiment Simulation

Summer School 2022

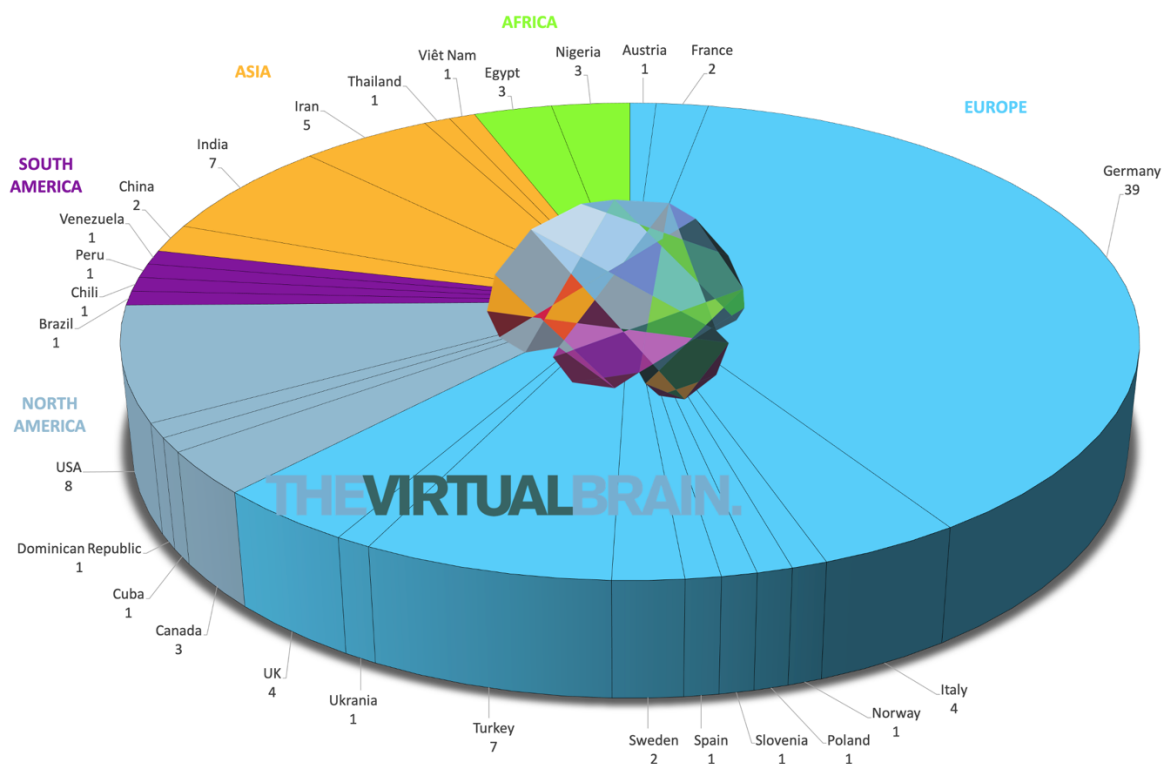
BrainModes
13 videos 867 views Last updated on Nov 9, 2022

Play all Shuffle

- The Virtual Brain in Clinical Research: An Introduction - Prof. Petra Ritter**
BrainModes • 541 views • 6 months ago
1:48:38
- Inferring Mechanisms through brain network modeling - Dr. Michael Schirner**
BrainModes • 376 views • 5 months ago
1:51:57
- Modeling Neurodegeneration - Dr. Med. Leon Stefanovski, MD**
BrainModes • 247 views • 5 months ago
1:30:36
- Integrating biological knowledge in brain network models - Leon Martin**
BrainModes • 182 views • 5 months ago
1:56:16
- Basics of Machine Learning - Kiret Dhindsa PhD**
BrainModes • 130 views • 5 months ago
1:35:49
- TVB-multiscale - D. Perdakis, M. Schirner, L. Domide, J. Mersmann, P. Ritter**
BrainModes • 137 views • 4 months ago
1:56:31
- In silico optimization of deep brain stimulation - Dr. Jil Meier**
BrainModes • 153 views • 4 months ago
1:55:07
- Workflows on GDPR compliant platforms: VRE and EBRAINS - Dr. Michael Schirner**
BrainModes • 149 views • 4 months ago
1:47:23
- Processing of Stroke Patients for the Virtual Brain - Patrik Bey**
BrainModes • 123 views • 4 months ago
1:31:27
- Understanding Principles of Cortical Travelling Waves - Dominik Koller MSc.**
BrainModes • 75 views • 1 month ago
1:27:06



SUMMER SCHOOL 2022 - 106 PARTICIPANTS FROM 27 COUNTRIES



Fall School 2021: The Virtual Brain in Clinical Research: An Introduction

Oct 5, 2021-Feb 1, 2022

<https://www.brainsimulation.org/bsw/zwei/events/single/7420-the-virtual-brain-in-clinical-research-an-introduction>

All 15 Webinars are available online:

<https://www.youtube.com/playlist?list=PLVtbIEryzDeKQHHciFUB7paIZ-MHTcn3w>












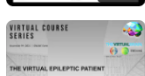


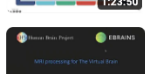


The Virtual Brain in Clinical Research: An Introduction

Virtual Fall School 2021

BrainModes
17 videos 1,480 views Last updated on Jun 18, 2022

⋮ ↻ ⋮

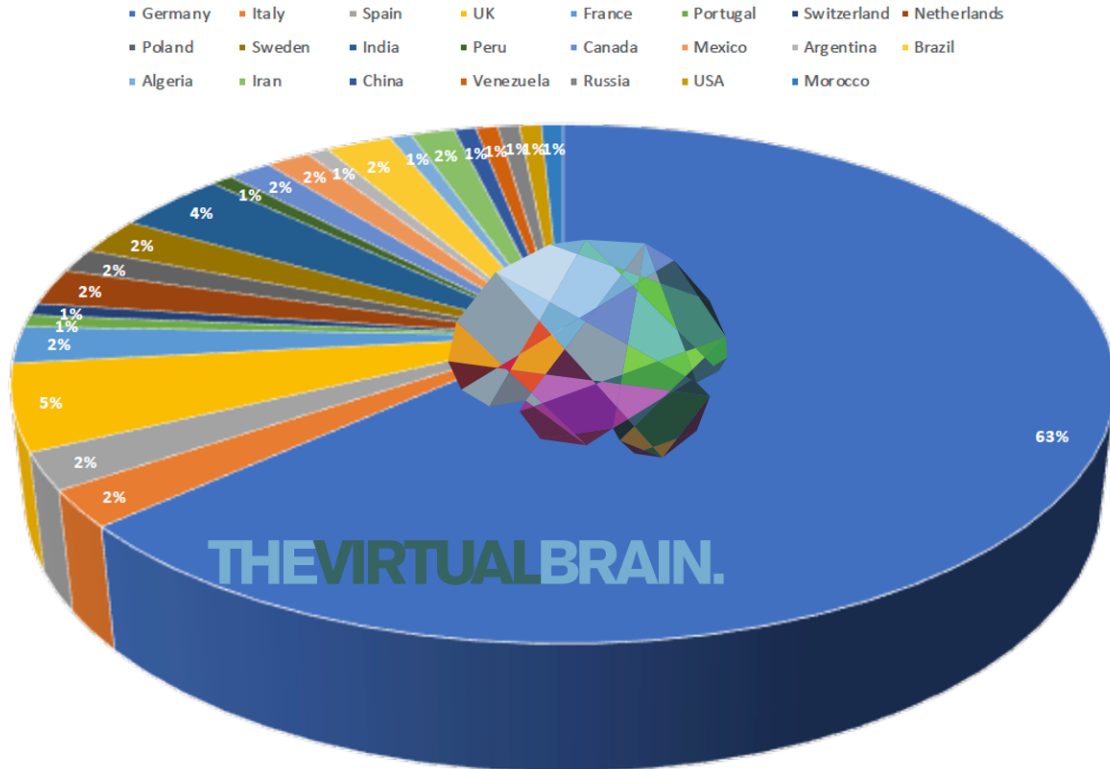
▶ Play all 🔀 Shuffle

- 1  **The Virtual Brain in Clinical Research: An Introduction - Prof. Petra Ritter**
BrainModes • 465 views • 1 year ago
- 2  **Ontologies and their importance for brain modeling - Dr. Konstantin Bülau**
BrainModes • 308 views • 1 year ago
- 3  **Dementias in the context of brain simulation - Dr. Leon Stefanovski**
BrainModes • 246 views • 1 year ago
- 4  **Psychosis - Linking clinical practise and theory - Leon Martin**
BrainModes • 291 views • 1 year ago
- 5  **Fundamentals of the Virtual Brain - Dr. Dionysios Perdikis**
BrainModes • 506 views • 1 year ago
- 6  **Basic TVB Programming: GUI, iPython, MATLAB - Dr. med. Leon Stefanovski**
BrainModes • 213 views • 1 year ago
- 7  **Basics of Machine Learning - Dr. Kiret Dhindsa**
BrainModes • 166 views • 1 year ago
- 8  **Graph Theory - Dr. Jil Meier**
BrainModes • 1.7K views • 1 year ago
- 9  **MR Processing Basics - Leon Martin**
BrainModes • 122 views • 1 year ago
- 10  **The Virtual Epileptic Patient - Dr. Julie Courtiol**
BrainModes • 150 views • 11 months ago
- 11  **GDPR Compliant Research Infrastructure - Patrik Bey & Paul Pawletta**
BrainModes • 99 views • 11 months ago
- 12  **Functional MRI (fMRI) - Leon Martin**
BrainModes • 178 views • 11 months ago
- 13  **MRI Processing for the Virtual Brain - Dr. Michael Schirner**
BrainModes • 214 views • 11 months ago
- 14  **Fundamentals Of Neuroanatomy - Dr. Konstantin Bülau, Leon Martin, Dr. Leon Stefanovski**
BrainModes • 187 views • 11 months ago
- 15  **APIS - Interfacing tools and services - Dr. Konstatin Bülau, Lion Deger**
BrainModes • 85 views • 11 months ago

The Fall School 2021 had 86 participants from 23 countries:



Course Participants from 23 Countries



Scientific Webinars

HBP Brain Matters #10 Webinar

Topic: Special Episode on Alzheimer's Disease - How the Human Brain Project enables clinical research for dementia

<https://www.brainsimulation.org/bsw/zwei/events/single/10052-hbp-brain-matters-10-webinar>

The Webinar can be watched here:

<https://www.youtube.com/watch?v=hbpVX6VUy14>



TODAY'S EPISODE

Brain Matters #10 - Special episode on Alzheimer's

"How the Human Brain Project enables clinical research for dementia"

16h30 – 16h40: Introduction by moderator Petra Ritter

16h40 – 16h50: Presentation by Leon Stefanovski

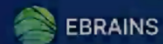
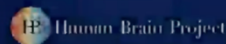
16h50 – 17h00: Presentation by Jil Mona Meier

17h00 – 17h10: Presentation by Michael Schirner

17h10 – 17h25: Q&A session

17h25 – 17h30: Conclusion

#BrainMatters



Codejams (online)

EBRAINS/HBP CodeJam #13 22-24 November 2022 **TVB-EBRAINS integrated workflows and Health Data Cloud**

Target audience: Developers

<https://www.brainsimulation.org/bsw/zwei/events/single/11217-ebrains-hbp-codejam-workshop-13>

<https://flagship.kip.uni-heidelberg.de/jss/HBPm?ml=243&m=showAgenda>

Thursday, 24 November 2022		
CET: 10:00 UTC: 09:00	Morning session, day III (dial in)	
CET: 10:00-10:45 UTC: 09:00-09:45 (45 min)	Talk / demonstration: TVB-EBRAINS integrated workflows (TVB-Cloud with Unicore, CWL, control via collab and multiscale simulation)	Petra Ritter (Charite - Universitaetsmedizin Berlin)
CET: 10:45-12:15 UTC: 09:45-11:15 (90 min)	Coding in parallel break-out rooms <ul style="list-style-type: none"> One of the parallel sessions: TVB-Cloud Coding TVB-Multiscale (Jil Meier, Dionysios Perdikis, Valery Bragin) 	
CET: 12:15-13:45 UTC: 11:15-12:45 (90 min)	(Lunch)	
CET: 13:45 UTC: 12:45	Afternoon session, day II (dial in)	
CET: 13:45-14:30 UTC: 12:45-13:30 (45 min)	Talk / demonstration: Health Data Cloud (HDC): Knowledge Graph (KG) and IAM integration	Michael Schirner (Charite - Universitaetsmedizin Berlin)
CET: 14:30-16:00 UTC: 13:30-15:00 (90 min)	Coding in parallel break-out rooms <ul style="list-style-type: none"> one of the parallel sessions: HDC / Health Data Cloud workflows (Patrik Bey, Marc Sacks) 	
CET: 18:00 UTC: 17:00	End of the CodeJam	

Contact: bjoern.kindler@kip.uni-heidelberg.de



Training Events (online)

EBRAINS Infrastructure Training Event – Simulate with EBRAINS 7-10. Nov 2022 The Virtual Brain & Health Data Cloud: Processing with data protection by design and by default

<https://www.brainsimulation.org/bsw/zwei/events/single/9750-ebraains-training-event-simulate-with-ebraains>

<https://flagship.kip.uni-heidelberg.de/jss/HBPm?m=showAgenda&meetingID=242>

CET: 10:25 UTC: 09:25	Introduction: whole brain level simulation	
CET: 10:25-10:30 UTC: 09:25-09:30 (5+1 min)	TVB (The Virtual Brain)	.ics Petra Ritter
CET: 11:42-11:47 UTC: 10:42-10:47 (5+1 min)	Health Data Cloud: processing with data protection by design and by default	.ics Petra Ritter

Session 2: The Virtual Brain (TVB)
TVB Multiscale Dionysios Perdikis (Charite - Universitaetsmedizin Berlin) Jil Meier (Charite - Universitaetsmedizin Berlin) show talk video
Multiscale brain circuit modeling using NetPyNE and NEURON Valery Bragin show talk video
TVB-NRP Dionysios Perdikis (Charite - Universitaetsmedizin Berlin) Krzysztof Lebioda (Technische Universitaet Muenchen)
TVB in EBRAINS Lia Domide (Codemart SRL) Paula Popa (Codemart SRL) show talk video

The Webinars have been recorded and are available online via the respective links below.

TVB-multiscale:

<https://flagship.kip.uni-heidelberg.de/jss/HBPm?ml=242&publicVideoID=9263>



EBRAINS INFRASTRUCTURE TRAINING EVENTS
SIMULATE WITH EBRAINS

TVB-multiscale:

Deep Brain Stimulation use case demonstration

D. Perdikis, J. Meier, P. Ritter
Brain Simulation Section, Brain Institute of Health, Department of Neurology, Charité—Universitätsmedizin Berlin

November 9th, 2022

CHARITÉ **iBIH** Berlin Institute of Health @Charité **BRAIN SIMULATION SECTION** **EBRAINS** **THE VIRTUAL BRAIN** Co-funded by the European Union

WORK IN PROGRESS

Simulate with EBRAINS
Dionysios Perdikis and Jil Meier (Charité)
TVB multiscale
7-10 November 2022, online

Multiscale brain circuit modeling using NetPyNE and NEURON

<https://flagship.kip.uni-heidelberg.de/jss/HBPm?mi=242&publicVideoID=9268>

Human Brain Project

Multiscale brain circuit modeling using NetPyNE and NEURON

NetPyNE **NEURON**

Connections strength matrix

V_{axona} (Cell 1 Proj 1)

V_{axona} (Cell 1 Proj 2)

Valery Bragin (SUNY)
TVB Multiscale brain circuit modeling
7-10 November 2022, online



TVB in EBRAINS

<https://flagship.kip.uni-heidelberg.de/jss/HBPm?ml=242&publicVideoID=9265>

The slide features several logos at the top: 'SOFTWARE FOR MASTERPIECES CODEMART', 'Institut de Neurosciences des Systèmes', and 'CHARITÉ UNIVERSITÄTSMEDIZIN BERLIN'. In the center, it says 'TVB THE VIRTUAL BRAIN.' with a colorful brain icon. Below that, it says 'in EBRAINS' with the EBRAINS logo. On the right, it lists the date '9 Noi 2022' and speakers 'Lia DOMIDE' and 'Paula PRODAN'. At the bottom left, there is a 'Simulate with EBRAINS' banner with logos for HDC, FETUX, EBRAINS, and carbor, dated '7-10 November 2022, online'. A video player interface shows '0:02 / 47:09' and the title 'Simulate with EBRAINS, 9 Nov 2022, https://ebrains.eu/events/simulate-with-ebrains'. On the right, a video feed shows a woman speaking.

Session 2: TVB (continued)
Converting comp. modeling data into BIDS using EBRAINS
Jil Meier (Charite - Universitaetsmedizin Berlin)
show talk video
TVBase and TVB Ontology
Leon Stefanovski ()
Leon Martin (Charite - Universitaetsmedizin Berlin)

Converting computational models into BIDS data standard

<https://flagship.kip.uni-heidelberg.de/jss/HBPm?ml=242&publicVideoID=9266>



EBRAINS INFRASTRUCTURE TRAINING EVENTS
SIMULATE WITH EBRAINS

Converting computational modeling data into BIDS using EBRAINS

Dr. Jil Meier
(PI: Prof. Petra Ritter)
9th of November 2022

Session 2
TVB: demonstrating the TVB-EBRAINS integrated end-to-end personalized brain simulation workflows in the Cloud

Simulate with EBRAINS
7-10 November 2022, online

Jil Meier (Charité)
Converting comp. modeling data into BIDS using EBRAINS

0:03 / 23:11
Simulate with EBRAINS, 9 Nov 2022, <https://ebrains.eu/events/simulate-with-ebrains>

Panel Discussions

World Health Summit in Berlin (broadcasted online) Oct 16-18, 2022

How to achieve a global health data space

Audience: Policy makers

<https://www.worldhealthsummit.org/>



OCTOBER 15-17, 2023
BERLIN, GERMANY & DIGITAL
SCIENCE · INNOVATION · POLICIES

REGIONAL MEETING
WASHINGTON DC, USA
APRIL 13, 2023 & DIGITAL

ABOUT PARTNERS INITIATIVES M8 ALLIANCE NEWSROOM LOOK BACK: WHS 2022

REGIONAL MEETINGS

WORLD HEALTH SUMMIT

3 DAYS - 100+ NATIONS - 300+ SPEAKERS - 4,000+ PARTICIPANTS ON-SITE - 50,000+ PARTICIPANTS ONLINE



PD 11 - How to Achieve a Global Health Data Space

Oct. 18, 2022, CEST: 09:00 AM - 10:30 AM / UTC: 07:00 AM - 08:30 AM

Digital Session: <https://youtu.be/z3CiGouR0jM>

Panel Discussion (PD 11) - Europe

Breaking the data silos is essential to reshape the future of healthcare and crisis preparedness. With the growing opportunities of digital health and Artificial Intelligence (AI), we are, more than ever before, in the pole position for a Global Health Data Space that could help to treat and govern data for health as a global public good. However, across and within countries there is a stark divide in the capacity to effectively work with data. The 2021 I-DAIR Global Research Map reveals, the divide between data use leaders based in a small number of countries and the rest of the world is growing. Additionally, biases in data relating to gender, race, and age limit the universal benefit and the trust in data use.

Only when used equitably and ethically, the work with data can offer an unprecedented possibility to improve global health and well-being and achieve Universal Health Coverage (UHC) 2030. Impact at the global level will thereby only be possible with shapers and decision makers from different disciplines including from countries of relatively lower income and/or with smaller populations. With this session we wish to spark stakeholder engagement for a transparent data system that protects citizens' data and facilitates their use for healthcare and research.

Chairs:

[Prof. Dr. Petra Ritter](#)

Charité - Universitätsmedizin Berlin | Berlin Institute of Health (BIH) | Professor for Brain Simulation | Germany

Speakers:

[Dr. Marlies Dorlöchter](#)

DLR Project Management Agency | International Health Research | Head of Division | Germany

[Dr. Ruxandra Draghia Akli](#)

Johnson & Johnson | Global Head of Global Public Health R&D | United States of America

[Dr. Steve MacFeely](#)

World Health Organization (WHO) | Data Analytics | Director

[Dr. Mehdi Snène](#)

International Digital Health and Artificial Intelligence Research Collaborative (I-DAIR) | CEO ad interim | Switzerland

[Paweł Świeboda](#)

Human Brain Project | Director-General | Belgium

EBRAINS Research Infrastructure | CEO



European Parliament Lunch Debate on Sept 27, 2022 in Brussels Topic: The role of AI and big data in dementia research

<https://www.brainsimulation.org/bsw/zwei/events/single/10182-european-parliament-lunch-debate>

The video recording can be watched here:

<https://www.alzheimer-europe.org/news/alzheimer-europe-hosts-lunch-debate>



4. Conclusion, next steps

The TVB-Cloud project has delivered multiple webinars on the personalized simulation technologies and case studies.

In addition to the webinars also additional materials have been provided for selected case studies. These packages contain scripting tutorials, code and data to reproduce published case studies

1. In silico optimization of deep brain stimulation

<https://search.kg.ebrains.eu/instances/4efb127d-8393-4c97-b955-90f2c492b526>



MODEL 📄 ✉

Multiscale model of a spiking basal ganglia network and a whole-brain mean-field model with The Virtual Brain (mex2022.1)

Meier, J. M.; Perdikis, D.; Blickensdörfer, A.; Stefanovski, L.; Liu, Q.; Maith, O.; Dinkelbach, H. U.; Batadron, J.; Hamker, F. H.; Ritter, P.

- Overview
- How to cite
- Get model
- Publications

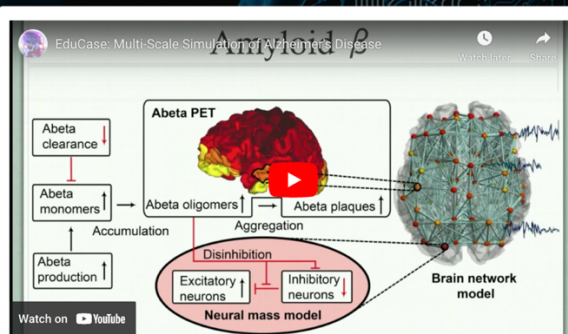
DOI: [10.25493/7HG2-PX2](https://doi.org/10.25493/7HG2-PX2)
 License: GNU General Public License v3.0 or later
 Homepage: https://github.com/the-virtual-brain/tvb-multiscale/tree/Meier_et_al_ExpNeur2021

Custodians: [Ritter, P.](#)
 Study targets:
 • Parkinson's disease
 • Homo sapiens
 • deep brain stimulation
 Brain structure:
 • collection of basal ganglia
 • brain
 Model scope: network: brain region
 Abstraction level:
 spiking neurons: point neuron

Deep brain stimulation (DBS) has been successfully applied in various neurodegenerative diseases as an effective symptomatic treatment. However, its mechanisms of action within the brain network are still poorly understood. For an accurate prediction of the effects of DBS, we implement a detailed spiking model of the basal ganglia, which we combine with The Virtual Brain via our previously developed co-simulation environment. This multiscale co-simulation approach builds on the extensive previous literature of spiking models of the basal ganglia while simultaneously offering a whole-brain perspective on widespread effects of the stimulation going beyond the motor circuit. In the first demonstration of our model, we show that virtual DBS can move the firing rates of a Parkinson's disease patient's thalamus - basal ganglia network towards the healthy regime while, at the same time, altering the activity in distributed cortical regions with a pronounced effect in frontal regions. The developed modeling approach has the potential to optimize DBS lead placement and configuration and forecast the success of DBS treatment for individual patients.

Version specification:
 All of the information necessary to re-run the analysis in the analysis of Meier et al. (2022) is provided in [this manual](#)

2. Linking molecular pathways and large-scale computational modelling to assess candidate disease mechanisms and pharmacodynamics in Alzheimer's disease <https://training.incf.org/lesson/linking-molecular-pathways-and-large-scale-computational-modeling-assess-candidate-disease>



Linking molecular pathways and large-scale computational modeling to assess candidate disease mechanisms and pharmacodynamics in Alzheimer's disease

By The Virtual Brain	Difficulty level Beginner	
Type Jupyter Notebook Tutorial Video	Duration 29:08	Topic Computational neuroscience

Tutorial on how to perform multi-scale simulation of Alzheimer's disease on The Virtual Brain Simulation Platform. Authors: L. Stefanovski, P. Triebkorn, M.A. Diaz-Cortes, A. Solodkin, V. Jirsa, A.R. McIntosh, P. Ritter

External Links

- » [Link to The Virtual Brain](#)
- » [Link to publication](#)
- » [Link to Scripting Tutorial](#)
- » [Link to GitHub repository](#)

Technology requirement

Download [The Virtual Brain Simulation Platform](#)



5. References

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Ritter, P., M. Schirner, A. R. McIntosh and V. K. Jirsa (2013). "The virtual brain integrates computational modeling and multimodal neuroimaging." Brain Connectivity 3(2): 121-145.

Sanz Leon, P., S. A. Knock, M. M. Woodman, L. Domide, J. Mersmann, A. R. McIntosh and V. Jirsa (2013). "The Virtual Brain: a simulator of primate brain network dynamics." Frontiers in Neuroinformatics 7(10).

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