

29th Annual Computational Neuroscience Meeting CNS*2020, Online

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The Human Brain Project (HBP) Brain Simulation Platform (BSP)

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Human Brain Project



Co-funded by
the European Union



The HBP BSP

Registration link for the HBP Collaboratory V2:

<https://services.humanbrainproject.eu/oidc/account/request>

After getting an account, you will be able to access the BSP through the following dedicated link:

<https://bsp.humanbrainproject.eu>

or via the HBP website at the Brain Simulation link:

<https://www.humanbrainproject.eu/>

The BSP and the HBP Collaboratory

The screenshot shows the homepage of the Brain Simulation Platform (BSP) within the Human Brain Project (HBP) Collaboratory. The top navigation bar includes links for HOME, COLLABS, PLATFORMS, HELP, FEEDBACK, and FORUM, along with user profile and notification icons. The main content area features a large blue background image of brain tissue. On the left, a sidebar titled 'Navigation' lists various sections: Overview (which is selected and highlighted in yellow), Guidebook, Brain Simulation Platform Monitor, HPC Status Monitor, Platform News, Online Use Cases, Models, Open Source Tools, Live Papers, Activities, Settings, Storage, Contacts, and About Us. The central workspace displays the title 'Brain Simulation Platform' and a welcome message: 'Welcome to the Brain Simulation Platform. The Brain Simulation Platform enables the reconstruction and simulation of scaffold models of brain and brain tissue in a data-driven approach. This is version 2 of the Platform, which was released at the beginning of June 2017, following feedback from a recent review process by external reviewers and the European Commission.' To the right, an 'Overview' section highlights that 'For version 2, the Platform has been re-organised to be more user-centric and user-friendly, so that users, with different neuroscientific and/or technical backgrounds and expertise levels, can benefit and use the Platform's capabilities for their scientific goals and curiosity.' A prominent orange 'START' button is located in the bottom right corner of the workspace area.

The BSP - Guidebook

Brain Simulation Platform Public Member

Navigation	ADD	Workspace	Guidebook
<p>Overview</p> <p>Guidebook</p> <p>Brain Simulation Platform Monitor</p> <p>HPC Status Monitor</p> <p>Platform News</p> <p>» Online Use Cases</p> <p>» Models</p> <p>» Open Source Tools</p> <p>Live Papers</p> <p>» Activities</p> <p>Settings</p> <p>Storage</p> <p>Contacts</p> <p>» About Us</p>		<p>HBP Brain Simulation Platform Guidebook</p> <p>next: Getting started</p> <h2>The Human Brain Project Brain Simulation Platform</h2> <p>The Brain Simulation Platform is part of the Human Brain Project (HBP) Platform ecosystem. It aims at providing scientists with powerful tools to reconstruct and simulate scaffold models of brain and brain tissue in a data-driven fashion. Its development is embedded in Subproject 6 of the HBP, where a tight co-design loop between science and engineering ensures the required substantial technical and scientific innovations.</p> <p>As a result, the unique functionality of the Platform allows novel questions to be addressed, which could previously not be researched.</p> <ul style="list-style-type: none">• Getting started<ul style="list-style-type: none">◦ Working with Collabs◦ Use Case Organization<ul style="list-style-type: none">▪ User experience▪ Use Case maturity▪ HPC access▪ Video Tutorials▪ Service Account▪ Neuroscience Gateway (NSG)◦ Service Accessibility• HPC Status Monitor<ul style="list-style-type: none">◦ HPC System status	<p>Next topic</p> <p>Getting started</p> <p>This Page</p> <p>Show Source</p> <p>Quick search</p> <input type="text"/> <p>Go</p> <p>Collaboration </p>

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The BSP – BSP Monitor

Brain Simulation Platform Public Member

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Workspace Brain Simulation Platform Monitor

Real-time usage Refresh

users: 1 last 60s

visited pages: Guidebook (blue), Brain Simulation Platform Monitor (red)

use cases: 10 last 24h

use cases: Circuit Building (blue), Morphology (green), Single Cell Modeling (yellow), Trace Analysis (pink)

Source: Google Analytics Source: BSP Analytics

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The BSP – HPC Status Monitor

The screenshot shows the 'HPC Status Monitor' section of the Brain Simulation Platform. The left sidebar lists various navigation options, with 'HPC Status Monitor' highlighted. The main workspace displays four HPC systems: JURECA (JSC), PIZDAINT (CSCS), Galileo (CINECA), and NSG. Each system has three status indicators: 'HPC Status' (green checkmark for JURECA, PIZDAINT, Galileo; red X for NSG), 'Service Account available (SA)' (red X for JURECA, green checkmark for PIZDAINT, red X for Galileo, green checkmark for NSG), and a 'User's Details' section (not fully visible). A 'Collaboration' button is at the bottom right.

Brain Simulation Platform Public Member

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Workspace

HPC Status Monitor

HP HPC Status Monitor

HPC Systems

JURECA (JSC)

PIZDAINT (CSCS)

Galileo (CINECA)

NSG

HPC Status

Service Account available (SA)

User's Details

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Collaboration

The BSP – Platform News

Brain Simulation Platform Public Member

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Welcome to our first Brain Simulation Platform news of 2020!

In these short news pieces, we aim to update you with regular news from the Brain Simulation Platform: new use cases, features and tools. We will also highlight our relevant publications and workshops.

We hope you will find it useful! If you have any feedback or ideas, do [drop us a line](#).

If you haven't got access to the Platform or have misplaced your account details, [email us](#) and we will send you an invitation to the Platform.

New KappaNeuron Demo Notebook



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The BSP – Online Use Cases 1/2

Brain Simulation Platform Public Member

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- Circuit Building
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- Small Circuit In Silico Experiments
- Brain Area Circuit In Silico Experiments
- Model Validation
- NEST Desktop

Workspace Molecular Level

Please select a use case

Calculate protein-protein bimolecular association rate constants with webSDA

Starting from a structure of the complex formed between adenylyl cyclase 5 and Gaolf obtained from a molecular dynamics simulation, set up all the files required to perform a Brownian dynamics simulation with SDA.

Credits:

Contributor(s): Stefan Richter - mcmsoft@h-its.org | Daria Kokh - mcmsoft@h-its.org | Rebecca Wade - mcmsoft@h-its.org | Neil Bruce - mcmsoft@h-its.org

 Everybody BETA jupyter

Analyse the results of a Brownian dynamics simulation for calculating protein-protein association rate constants

Analyse the results of an SDA Brownian dynamics simulation to calculate the rate constant of Gaolf associating to adenylyl cyclase 5, and estimate the error in this prediction via bootstrapping.

 Everybody BETA jupyter

Calculate the electrostatic potential of a protein from its atomic structure

Use the multipipsa package to assign atomic charges and radii to a protein structure then solve the Poisson-Boltzmann equation to calculate the electrostatic potential.

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The BSP – Online Use Cases 2/2

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Small Circuit In Silico Experiments

Brain Area Circuit In Silico Experiments

Model Validation

NEST Desktop

Workspace Trace Analysis

Please select a use case

Feature extraction

Extracts electrophysiological features; traces can be from Neuroinformatics Platform or uploaded

Credits:

Contributor(s): Luca Leonardo Bologna - lucleonardo.bologna@cnr.it | Roberto Smiriglia - roberto.smiriglia@pa.ibf.cnr.it

Everybody  Interactive Tutorial

Synaptic events fitting

Fitting synaptic events using data and model in Neuroinformatics Platform

Credits:

Contributor(s): Carmen Alina Lupascu - carmen.lupascu@pa.ibf.cnr.it | Roberto Smiriglia - roberto.smiriglia@pa.ibf.cnr.it | Luca Leonardo Bologna - lucleonardo.bologna@cnr.it

Power users  Interactive Tutorial

Synaptic events fitting with user model

Fitting synaptic events using data in Neuroinformatics Platform and user's model

Credits:

Contributor(s): Carmen Alina Lupascu - carmen.lupascu@pa.ibf.cnr.it | Roberto Smiriglia - roberto.smiriglia@pa.ibf.cnr.it | Luca Leonardo Bologna - lucleonardo.bologna@cnr.it

Experts  Interactive Tutorial

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The BSP – Feature Extraction 1/2

Workspace Feature extraction GUI

Trace selection/upload Feature Extraction Home

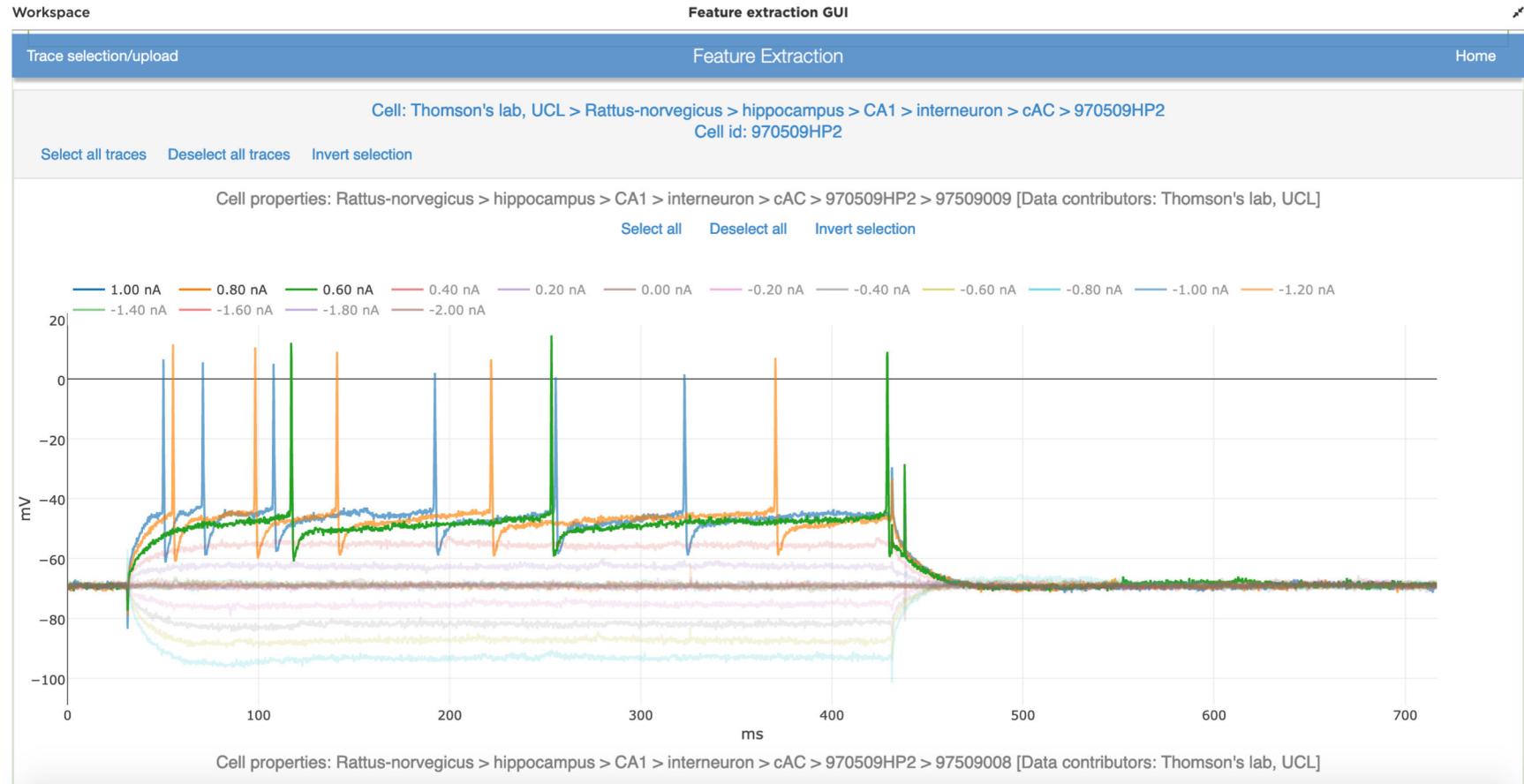
Filter dataset files and select individual traces

Contributors	Species	Structure	Region	Type	EType
Thomson's lab, UCL Segev's lab, ELS Grillner's Lab, Dept Neuroscience, KI D'Angelo's lab, UNIPV Allen Institute for Brain Science	Rattus-norvegicus Human Mus-musculus mus-musculus	hippocampus cortex striatum cerebellum visp5	CA1 675-um-below-pia 876-um-below-pia 789-um-below-pia 945-um-below-pia dorsal-striatum unknown primary-visual-area--layer-5	interneuron pyramidal-cell principal-cell granule-cell unknown	cAC unknown cNAC bAC

Cell properties:

Apply Reset

The BSP – Feature Extraction 2/2



The BSP – Small Circuit In Silico Experiments 1/4

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Workspace Small Circuit In Silico Experiments

Please select a use case

Configure and run a small circuit extracted from the current release of the HBP hippocampus CA1 large-scale detailed model Everybody

Configure and run a simplified cortical circuit with the CxSystem2 simulation framework Everybody

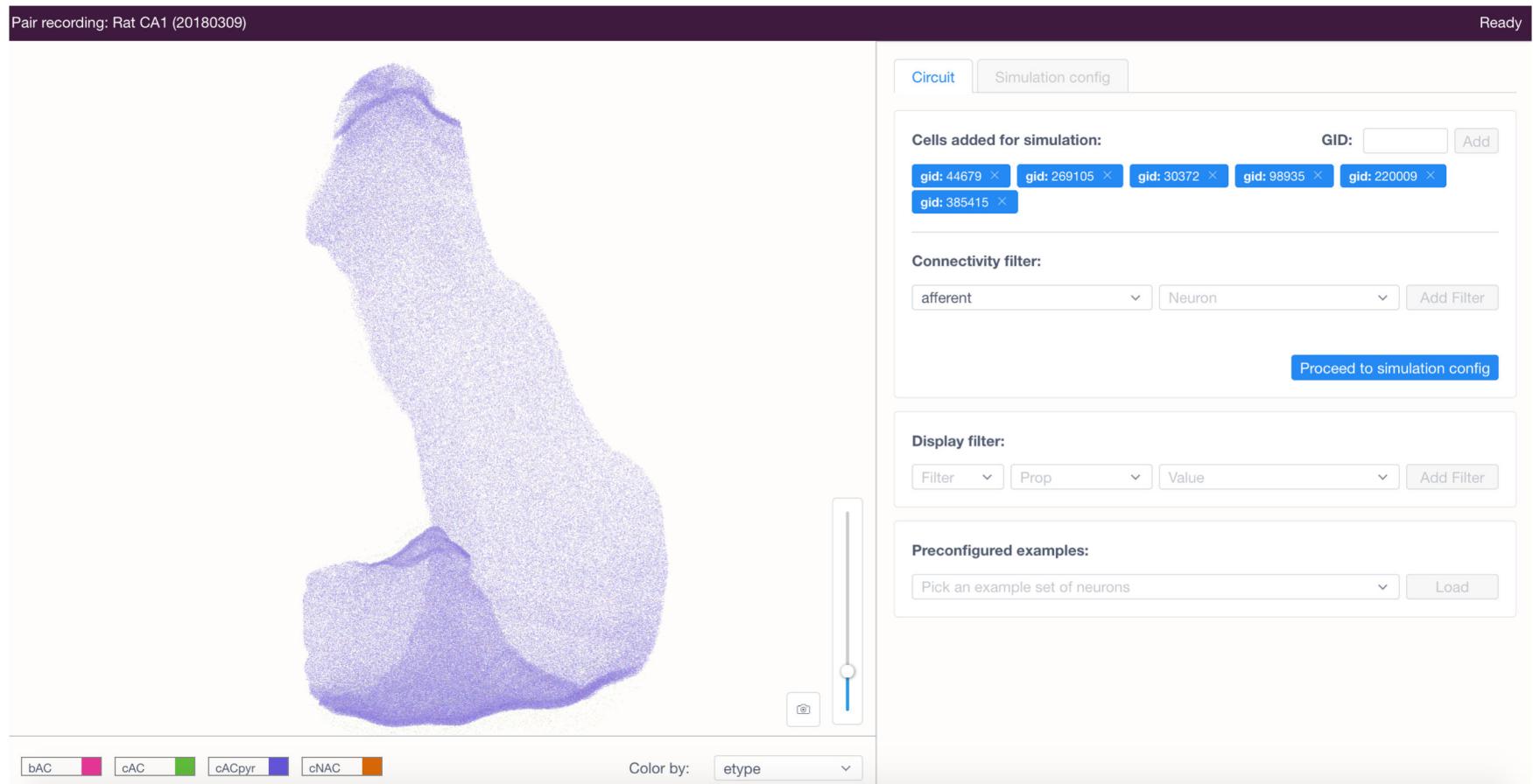
Credits:
Contributor(s): Vafa Andalibi - vafandal@indiana.edu | Henri Hokkanen - henri.hokkanen@helsinki.fi | Simo Vanni - simo.vanni@helsinki.fi

Coming Soon
Configure and run a small circuit using HBP model and data Power users

Collaboration

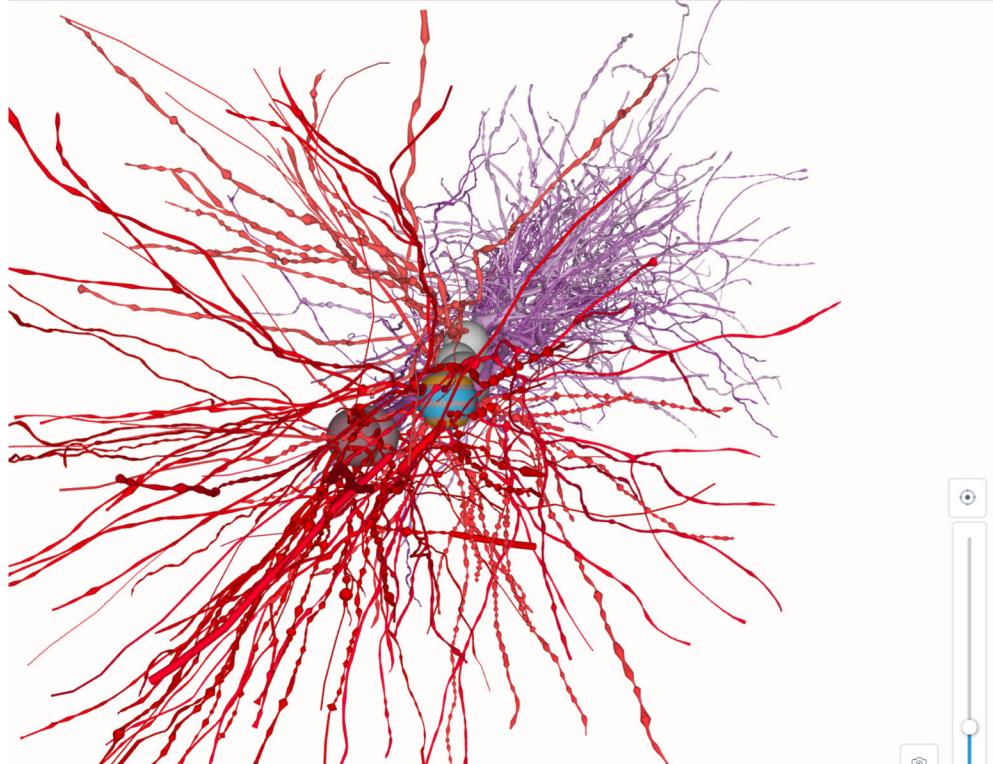
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The BSP – Small Circuit In Silico Experiments 2/4



The BSP – Small Circuit In Silico Experiments 3/4

Pair recording: Rat CA1 (20180309) Ready



Circuit Simulation config

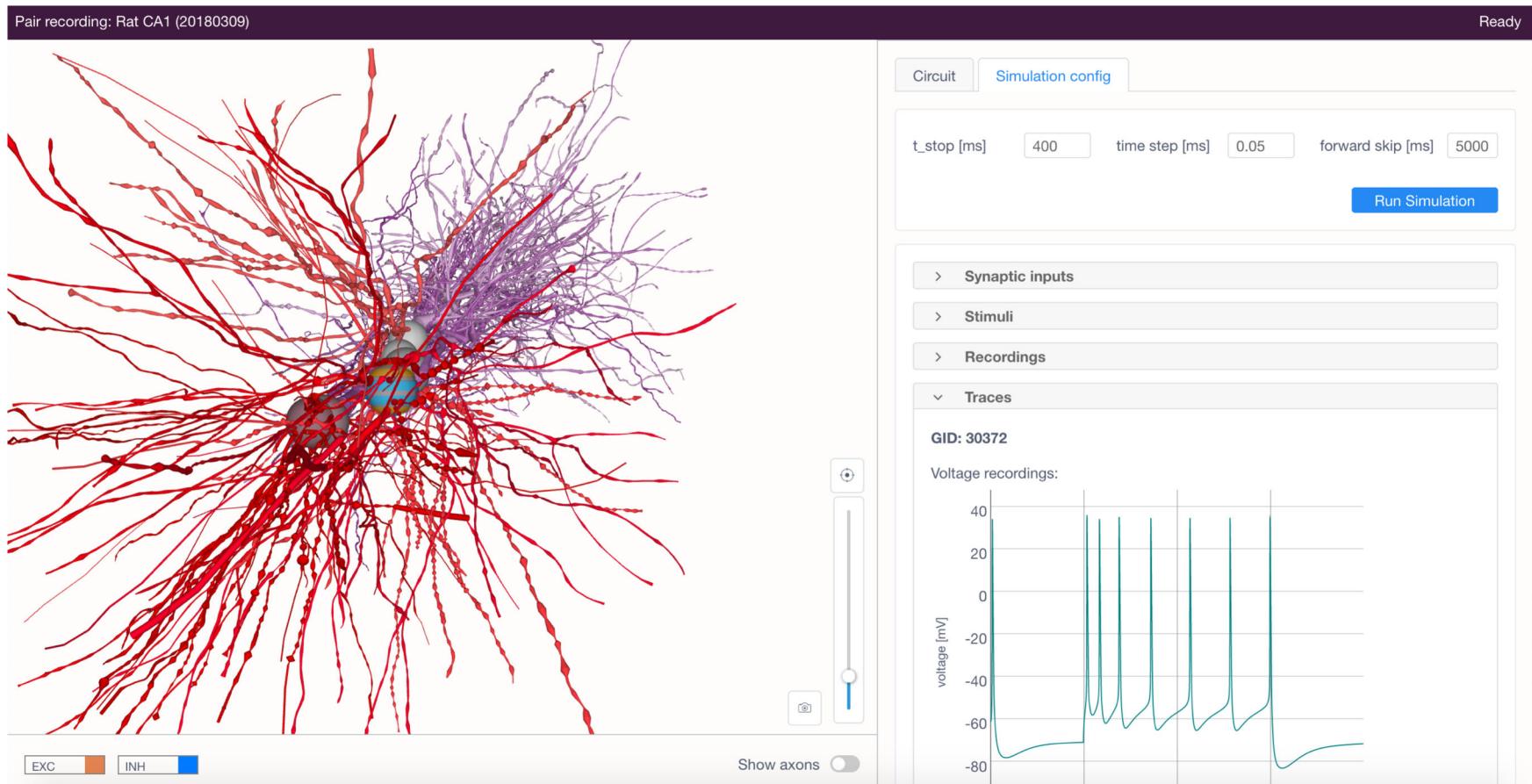
t_stop [ms] 400 time step [ms] 0.05 forward skip [ms] 5000 Run Simulation

Synaptic inputs
Select a pre-synaptic cells to add synapses with Poisson process with given frequency
Add synaptic input

Stimuli
GID: 30372
Sec: soma[0]
Step current
delay [ms] 100 dur [ms] 200 amp [nA] 0.7
Add stimulus

Recordings
GID: 30372
soma[0]

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The BSP – Brain Area In Silico Experiments

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Brain Area Circuit In Silico Experiments

Please select a use case

Hippocampus

Cerebellum

Cerebro-Cerebellar loops

This use-case shows a modeling effort of whole brain functionalities by leveraging on the existing cerebellar models. We model and simulate the forward and inverse controller functions of the cerebrocortical-cerebellar loops in a closed-loop setting, emulating error-based learning and action prediction.

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The BSP – Model Validation

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Workspace **Model Validation**

Please select a use case

Validation Framework Demo (Walkthrough)
Demonstrates the use of the validation framework
Credits:
Contributor(s): Shailesh Appukuttan - shailesh.appukuttan@unic.cnrs-gif.fr | Andrew Davison - andrew.davison@unic.cnrs-gif.fr | Lungsi Sharma - lungsi.sharma@unic.cnrs-gif.fr

Hippocampus Single Cell Model Validation
Validates single cell models of Hippocampus optimized via BluePyOpt
Credits:
Contributor(s): Sáray Sára - saray.sara@koki.mta.hu | Shailesh Appukuttan - shailesh.appukuttan@unic.cnrs-gif.fr

Basal Ganglia Single Cell Validation
Validates single cell basal ganglia models optimized via BluePyOpt for various features offered by eFEL; models contain multiple hall of fame parameter sets
Credits:
Contributor(s): Shailesh Appukuttan - shailesh.appukuttan@unic.cnrs-gif.fr

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The BSP - MOOC

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Please select a course to initialize

Mooc Initialization

Reconstruction and simulation of neural tissue I: Neurons and Synapses
Exercises for the EdX MOOC Simulation Neuroscience

In Silico Neuroscience Course 2018
Study of the nervous system using data, analysis, classification, prediction, modelling, simulation, theory and computing technology

The Multi-scale brain
Exercises for the Courseware MOOC The Multi-scale brain

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<https://collab.humanbrainproject.eu> Human Brain Project, 2019 [Cookie statement](#) [Terms of Service](#)

The BSP - Models

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Model Catalog

What is a Scaffold Model?

Life Cycle Model for Data-Driven Models

Signalling Cascades

Inhibition & Calcium Cascades

Molecular Models

Multiscale Modelling

Human Neurons

Basal Ganglia

Cerebellum

Hippocampus

Somatosensory Cortex

Whole Mouse Brain

Workspace Hippocampus

Resources

- Components of the hippocampus models (cells, microcircuit, region model) have been deployed in online use cases of the Brain Simulation Platform (BSP):
 - online use case - [single cells](#)
 - online use case - [paired recordings](#)
 - online use case - [in silico experiment on circuit](#)
 - online use case - [validation](#)

The hippocampus ([wikipedia](#), [scholarpedia](#)) is a brain region that is known to play a key role in memory and spatial navigation, and is also heavily involved in brain disorders such as Alzheimer's disease and epilepsy. Yet, despite intensive experimental and theoretical studies, the mechanisms through which the hippocampus contributes to these cognitive functions and dysfunctions are poorly understood.

What makes the hippocampus special?

The hippocampus is an



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The BSP – Open Source Tools

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- BlueNaaS(Blue NEURON as a Service)
- BluePyEFE
- BluePyMM
- BluePyOpt**
- Brain Simulation Platform Service Account
- BRAYNS
- Brion
- CoreNeuron
- DataModelsAndTests

Workspace BluePyOpt

BluePyOpt

The Blue Brain Python Optimisation Library (BluePyOpt) is an extensible framework for data-driven model parameter optimisation that wraps and standardises several existing open-source tools. It simplifies the task of creating and sharing these optimisations, and the associated techniques and knowledge. This is achieved by abstracting the optimisation and evaluation tasks into various reusable and flexible discrete elements according to established best-practices. Further, BluePyOpt provides methods for setting up both small- and large-scale optimisations on a variety of platforms, ranging from laptops to Linux clusters and cloud-based compute infrastructures.

library version 1.9.3

README

Introduction

The Blue Brain Python Optimisation Library (BluePyOpt) is an extensible framework for data-driven model parameter optimisation that wraps and standardises several existing open-source tools. It simplifies the task of creating and sharing these optimisations, and the associated techniques and knowledge. This is achieved by abstracting the optimisation and evaluation tasks into various reusable and flexible discrete elements according to established best-practices. Further, BluePyOpt provides methods for setting up both small- and large-scale optimisations on a variety of platforms, ranging from laptops to Linux clusters and cloud-based compute infrastructures.

Citation

Metadata

Category	library
Tags	sp6, electrophysiology
Partners	École Polytechnique Fédérale de Lausanne
Maintainers	werner.vangeit@epfl.ch
Contributors	michael.gevaert@epfl.ch, werner.vangeit@epfl.ch
Homepage	https://github.com/BlueBrain/BluePyOpt
Documentation	http://bluebrain.github.io/BluePyOpt

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The Brain Simulation Platform
"Live Papers"

The "Live Papers" of the Human Brain Project Brain Simulation Platform are interactive documents that refer to recently published scientific articles whose content is related to the work, tools and services publicly available on the Platform. Interactivity is the unique feature of the "Live Papers": specific links on the documents will allow you to download, visualize or simulate data, models and results presented in the articles.

By clicking on the paper link, the "Live Paper" will be opened on a different tab of your browser window. By clicking on the HBP icon , you will open, instead, the document inside the HBP Collaboratory workspace -Collab- that the authors have created for the article to collect additional comments, data or tools they may want to share*.

* Some of the tools used in the "Live Papers" and the article Collabs require an account on the HBP Collaboratory platform. If you do not have an account yet and are willing to get one, please send us an email to [bsp-support \[AT\] humanbrainproject.eu](mailto:bsp-support@humanbrainproject.eu)

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Some of the tools used in the Live Papers and the article below require an account on the HBP Collaboratory platform. If you do not have an account yet and are willing to get one, please send us an email to [bsp-support \[AT\] humanbrainproject.eu](mailto:bsp-support@humanbrainproject.eu)

Live Papers

2020

Amsalem O, Eyal G, Rogozinski N, Kumbhar P, Schürmann F, Segev I (2020) *An efficient analytical reduction of detailed nonlinear neuron models*. Nature Communications.

Giacopelli G, Migliore M, Tegolo D (2020) *Graph-theoretical derivation of brain structural connectivity*. Applied Mathematics and Computation.

Hjorth J, Kozlov A, Carannante I, Frost Nylén J, Lindroos R, Johansson Y, Tokarska A, Dorst MC, Suryanarayana SM, Silberberg G, Hellgren Koteleski J, Grillner S, (2020) *The microcircuits of striatum in silico*. Proceedings of the National Academy of Sciences of the United States of America.

Lupascu CA, Morabito A, Ruggeri F, Parisi C, Pimpinella D, Pizzarelli R, Meli G, Marinelli S, Cherubini E, Cattaneo A, Migliore M (2020) *Computational modeling of inhibitory transsynaptic signaling in hippocampal and cortical neurons expressing intrabodies against gephyrin*. Frontiers in Cellular Neuroscience.

Masoli S, Tognolina M, Laforenza U, Moccia F, D'Angelo E (2020) *Parameter tuning differentiates granule cell subtypes enriching the repertoire of retransmission properties at the cerebellum input stage*.

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The BSP – Live Papers 3/4



The Brain Simulation Platform "Live Papers"

The physiological variability of channel density in hippocampal CA1 pyramidal cells and interneurons explored using a unified data-driven modeling workflow

Authors: Rosanna Migliore ¹, Carmen A. Lupascu ¹, Luca L. Bologna ¹, Armando Romani ², Jean-Denis Courcol ², Stefano Antonel ², Werner A.H. Van Geit ², Alex M. Thomson ³, Audrey Mercer ³, Sigrun Lange ^{3,4}, Joanne Falck ³, Christian A. Rössert ², Ying Shi ², Olivier Hagens ⁵, Maurizio Pezzoli ⁵, Tamas F. Freund ^{6,7}, Szabolcs Kali ^{6,7}, Eilif B. Muller ², Felix Schürmann ², Henry Markram ², and Michele Migliore ¹

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Corresponding author: Rosanna Migliore (rosanna.migliore@cnr.it)

Journal: [Plos Computational Biology](#)

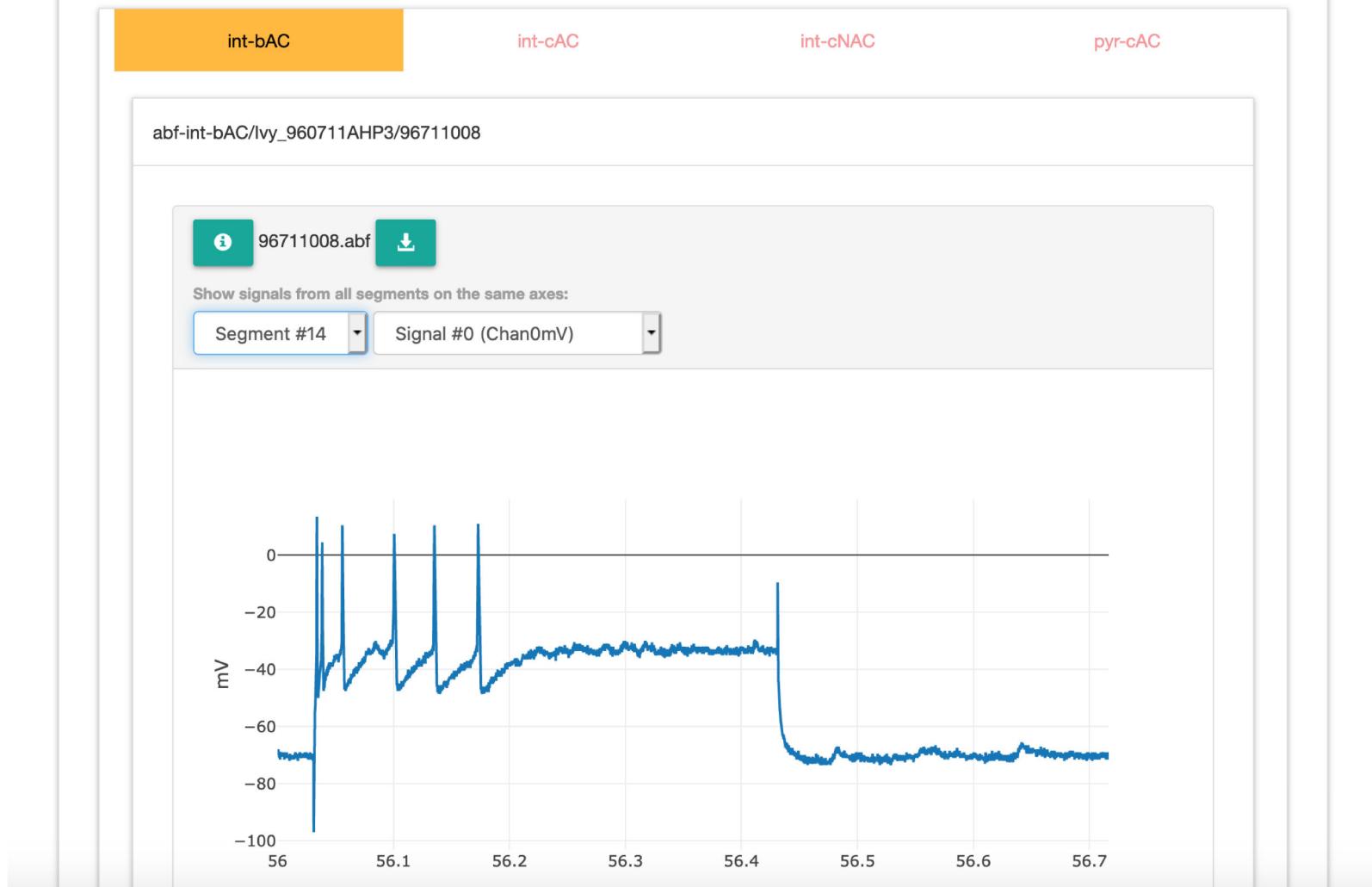
Download Url: <https://doi.org/10.1371/journal.pcbi.1006423>

Citation: Migliore R, Lupascu CA, Bologna LL, Romani A, Courcol J-D, Antonel S, et al. (2018) The physiological variability of channel density in hippocampal CA1 pyramidal cells and interneurons explored using a unified data-driven modeling workflow. PLoS Comput Biol 14(9): e1006423.

DOI: <https://doi.org/10.1371/journal.pcbi.1006423>

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The BSP – Contacts

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Contacts

We are always happy to hear from users and to get feedback to improve the Platform.

Drop us an email with your feedback to bsp-community@humanbrainproject.eu
Ask your questions to bsp-support@humanbrainproject.eu
Add your request to our [Github Issue Tracker](#) or to our [Forum](#)

You can also follow us on our social channel:

[Twitter](#)

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Acknowledgements

CNR, Palermo, Italy

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IRB, Barcelona, Spain

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KTH, Stockholm, Sweden

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PI: Rebecca Wade