



Human Brain Project



Hackathon on CEREBELLUM MODELLING

Pavia, 13-15 January, 2020

Organized by Neurocomputation Laboratory, Dept. of Brain and Behavioural Sciences, University of Pavia, Via Forlanini 6 - 27100 - Pavia, Italy

The Hackathon on CEREBELLUM MODELLING will illustrate cerebellum models and provide tutorials for their development and applications. The course is designed with selected presentations and large space for hands-on experience. The attendees will be introduced to the main themes of cerebellum modelling and to the use of the HUMAN BRAIN PROJECT research infrastructure, Brain Simulation Platform and future EBRAINS, addressing the principles of multiscale brain modelling.

In this Hackathon, the attendees will elaborate and simulate computational models of neurons and networks of the cerebellum. Topics will include:

- an illustration of the Brain Simulation Platform models and use cases and of the related modelling languages (PYTHON, NEURON, NEST, PYNN, SONATA, ARBOR)
- the foundations of realistic data-driven neuronal modelling, including biophysical principles, model matching to experimental data (optimization), supervised model simplification.
- the foundations of realistic data-driven microcircuit modelling, especially cell placement and connectivity in microcircuit scaffolds
- the scale-up to large-scale and brain models and their incorporation in robots, neuromorphic hardware and virtual brain.

Venue:

[Aula Magna](#), Università degli Studi di Pavia, Piazza Leonardo Da Vinci, 12, 27100 Pavia PV

Contacts:

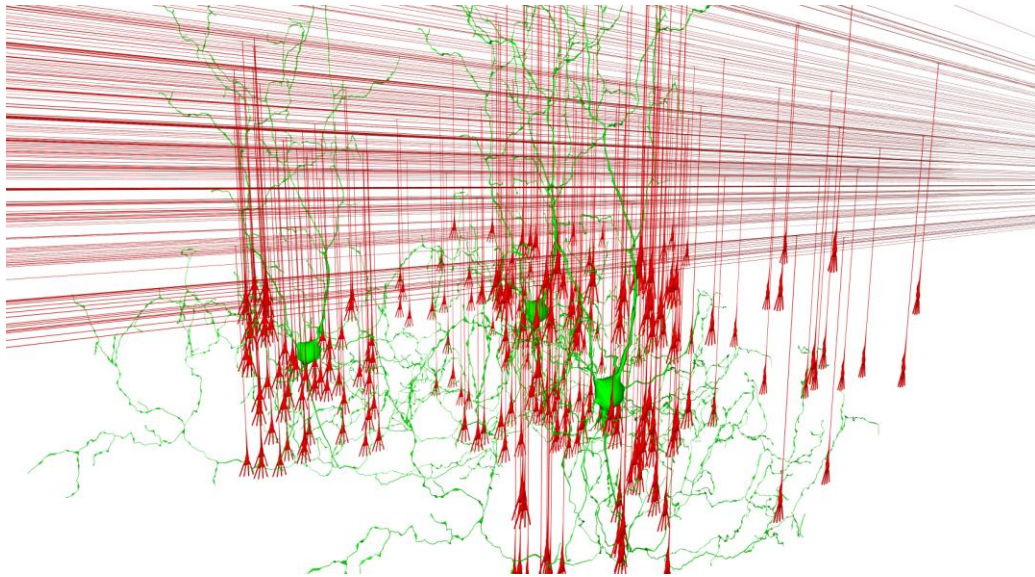
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Pre-requisites (basic principles and installation on personal laptop)

The hall is provided with an internet connection. Please bring your laptop with the following software installed:

- Python
- pyNEURON, BluePyOpt
- pyNEST
- TVB

Please also make sure to have Collaboratory access for the Brain Simulation Platform (BSP) and local installation of the Neuro Robotic Platform (NRP).

Details with more specific instructions will follow soon.



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Monday, January 13, 2019 Models and tools

8:30-9:00 **Welcome and Introduction**

9:00-10:00 **Main lecture - Cerebellum modelling: from single neurons to closed-loop controllers and virtual brains** (Egidio D'Angelo [Neurocomp lab, Pavia])

10:00-10:30 *Coffee break*

10:30-11:30 **Data-driven modelling:**

- Principles of cerebellar microcircuit modeling (Claudia Casellato [Neurocomp lab, Pavia])
- Detailed single neuron models of cerebellum (Stefano Masoli [Neurocomp lab, Pavia])
- Detailed synapse models of cerebellum (Thierry Nieuwenhuis [Sacco Institute, Milano])

11:30-12:30 **Modeling languages:**

- Single neuron modelling using NEURON (Oren Amasalem [ELSC, Tel Aviv])
- NEST simulator: single point neuron and networks (Charl Linssen [NEST community, Jülich])
- The new ARBOR language (Ben Cumming [CSCS, Zurich])

12:30-14:00 *Lunch*

14:00-16:00 **Tutorial on construction of single neuron models** (Stefano Masoli, Martina Rizza, Alessandra Ottaviani [Neurocomp lab, Pavia])

16:00-16:30 *Coffee break*

16.30-18:30 **Tutorial on construction of microcircuit models: focus on connectivity strategies** (Stefano Casali, Robin DeSchepper [Neurocomp lab, Pavia], Johannes Hjorth [KTH, Stockholm], Armando Romani [EPFL, Geneva])

20:00 *Dinner (apericena)*





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Tuesday, January 14, 2019
Model optimization, simplification and simulation

9:00-10:00 **Featured lecture - The Brain Simulation Platform and EBRAINS** (Michele Migliore [CNR, Palermo])

10:00-10:30 *Coffee break*

10:30-11:30 **HPC and HW for neuroscience:**

- HPC on FENIX-ICEI (Cristiano Padrin [CINECA, Bologna])
- Cerebellar GPU models (Francesco Loporati [Bioeng, Pavia])
- Human-scale cerebellum on K computer (Hiroshi Yamaura [Numerical Brain, Tokyo])
- Neuromorphic hardware: PYNN to SpiNNaker (Petrut Bogdan [SpiNNaker lab, Manchester])

11:30-12:30 **Optimization, validation, simplification:**

- Optimization with BluePyOpt (Werner Van Geit [EPFL, Geneve])
- Experimental model validation (Egidio D'Angelo [Neurocomp lab, Pavia])
- Simplification to single point neurons (Alice Geminiani [Neurocomp lab, Pavia])

12:30-14:00 *Lunch*

14:00-16:00 **Tutorial on cerebellar neuron optimization and simulation** (Stefano Masoli, Martina Rizza, Alessandra Ottaviani [Neurocomp lab, Pavia], Werner Van Geit [EPFL, Geneve])

16:00-16:30 *Coffee break*

16:30-18:30 **Tutorial on cerebellar microcircuit simulation** (Stefano Casali, Robin DeSchepper, Alice Geminiani [Neurocomp lab, Pavia], Johannes Hjorth [KTH, Stockholm], Armando Romani [EPFL, Geneve])

20:00 *Dinner (apericena)*



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Wednesday, January 15, 2019

Model transformation and applications

9:00-10:00 **Featured lecture - Cerebellar spiking networks in robots** (Egidio Falotico [SSSA, Pisa])

10:00-10:30 *Coffee break*

10:30-12:30 **Applications and system integration:**

- Modular control system: cerebellar connectivity and plasticity, in pyNEST (Alberto Antonietti [Neurocomp lab, Pavia])
- The virtual mouse brain embedding cerebellar nodes (Fulvia Palesi [Neuroimaging lab, Pavia]; Spase Petkoski [TVB lab, Marseille])
- Cerebellar neural masses (Claudia Casellato [Neurocomp lab, Pavia])
- Cerebellar networks in closed-loop controllers and real robots (Francisco Naveros [CITIC-UGR, Granada]; Alessandra Pedrocchi [POLIMI, Milano])

12:30-14:00 *Lunch*

14:00-16:00 **Tutorial on TVB embedding cerebellum** (Fulvia Palesi [Neuroimaging lab, Pavia], Spase Petkoski [TVB lab, Marseille])

16:00-16:30 *Coffee break*

16:30-18:30 **Tutorial on cerebellar control system into NRP** (Alberto Antonietti, Edoardo Negri [Neurocomp lab, Pavia])

18:30-19:00 **Concluding remarks: Perspectives for brain modelling** (Sten Grillner [KI, Stockholm])

20:00 *Farewell party and conclusions*