Research position in Computational Neuroscience

Generation and simulation of a cerebellar robotic controller

A research position (Postdoc level) is open by the *University of Pavia* on the European Project "A Research Infrastructure to Advance Neuroscience and Brain Health" - EBRAINS 2.0.

Working environment

The Researcher will work in the Neurophysiology Unit of the Department of Brain and Behavioural Sciences (University of Pavia, Italy, https://web.unipv.it/). The Neurophysiology Unit is composed by three laboratories (Cellular Neurophysiology, Neurocomputation, Neuroimaging and Brain Modelling) and generates state of the art concepts, models, and theories about brain functioning. The research unit has a specific expertise in the study of neurons and circuits of the cerebellum in health and disease and is actively investigating multiscale brain processing in experimental and computational settings. An overview of laboratory activities and organization can be found at https://dangelo.unipv.it/. The researcher will take part to the EBRAINS 2.0 project and collaborate with other EU projects (Virtual Brain Twins, TEF-Health, CEN) and Italian PNRR (EBRAINS-Italy, PNRR-MNESYS, PNRR-CN1, PNR Fit4MedRob) and PRIN projects running in the research unit.

Research subject

The project aims to simulate active object manipulation using a biologically realistic hybrid controller operating in closed-loop and integrating a spiking neural network (SNN) of the cerebellar circuit. Here, starting from previous models developed in the laboratory, we will generate the cerebellar SNN performing sensorimotor prediction based on error-driven learning and integrate it into multiple control loops with a commander, planner and pattern recognition centers. The SNN will be implemented with BrainScaffoldBuilder (BSB) and NEST software and connected through the thalamus to an abstract representation of the cerebral cortex and basal ganglia. In collaboration with other European groups, the controller will be integrated with AI algorithms (such as deep convolutional and recurrent neural networks) for object recognition and will eventually be operated through the Neurorobotic platform acting as a middleware to synchronise all simulation models and manage signal communication and the interaction with the environment.

Details on the call

The official call will appear on the website of the University of Pavia in the next few weeks (https://unipv.portaleamministrazionetrasparente.it/archivio22_bandi-di-concorso_0_19790_640_1.html). Expected starting date: 1 June 2023. Duration: 3 years. No teaching activity is requested for these positions except for seminars and lectures to master's degree and PhD students.

The evaluation of candidates will include CV, publications, reference letters, oral discussion including English language assessment (details to come).

Contact and info

Any details on the call, research activities and the specific project will be discussed with the applicants. Curriculum Vitae, reference letters and other inquiries should be emailed to dangelo@unipv.it and simona.tritto@unipv.it.

Research position in Computational Neuroscience

Spiking neural networks for digital brain twins of schizophrenia

A research position (Postdoc level) is open by the *University of Pavia* on the European Project "VIRTUAL BRAIN TWIN FOR PERSONALISED TREATMENT OF PSYCHIATRIC DISORDERS" - VBT.

Working environment
The Researcher will work in the Neurophysiology Unit of the Department of Brain and Behavioural Sciences (University of Pavia, Italy, https://web.unipv.it/). The Neurophysiology Unit is composed by three laboratories (Cellular Neurophysiology, Neurocomputation, Neuroimaging and Brain Modelling) and generates state of the art concepts, models, and theories about brain functioning. The research unit has a specific expertise in the study of neurons and circuits of the cerebellum in health and disease and is actively investigating multiscale brain processing in experimental and computational settings. An overview of laboratory activities and organization can be found at https://dangelo.unipv.it/. The researcher will take part to the VBT project and collaborate with other EU projects (EBRAINS 2.0, TEF-Health, CEN) and Italian PNRR (EBRAINS-Italy, PNRR-MNESYS, PNRR-CN1, PNR Fit4MedRob) and PRIN projects running in the research unit.

Research subject
The overarching objective of the VIRTUAL BRAIN TWIN project is to design and validate a specialised ecosystem for personalised treatment of psychiatric disorders, utilising a patient-specific multiscale virtual brain model. Here, we will simulate enhanced microcircuit models of the cerebellar circuit mainly using BSB/NEURON as simulation engine and, to help bridging data at a mesoscopic level, we will also use LFP to estimate local field potentials from the different model modules. Starting from models available in the laboratory, we will also include components on intracellular and molecular cascades provided by project collaborators. Variation of neuromodulation and balance in excitation/inhibition changes (e.g. via modifying the AMPA/NMDA balance in glutamatergic synapses onto both principal neurons as well as interneurons) will be performed. We will simulate plasticity and its alterations, since plasticity is involved in the physio-pathogenesis of psychoses and in their pharmacotherapy, as well as the changes in AMPA/NMDA/GABA balance that are critical to modify the LTP/LTD balance and reshape network dynamics. This will allow us to test different hypotheses of circuit dysfunction (e.g. "cognitive dysmetria") subtending brain alterations in schizophrenia. Computationally intensive simulations will make use of HPC resources.

Details on the call
The official call will appear on the website of the University of Pavia in the next few weeks (https://unipv.portaleamministrazionetrasparente.it/archivio22_bandi-di-concorso_0_19796_874_1.html).
Expected starting date: 1 June 2023. Duration: 2 years that can be extended up to a maximum of 4 years.
No teaching activity is requested for these positions except for seminars and lectures to master's degree and PhD students.
The evaluation of candidates will include CV, publications, reference letters, oral discussion including English language assessment (details to come).

Contact and info
Any details on the call, research activities and the specific project will be discussed with the applicants. Curriculum Vitae, reference letters and other inquiries should be emailed to dangelo@unipv.it and simona.tritto@unipv.it.

Research position in Neuroinformatics

Workflow design and signal analysis

A research position is open by the *University of Pavia* on the European Project "A Research Infrastructure to Advance Neuroscience and Brain Health" - EBRAINS 2.0.

Working environment
The Researcher will work in the Neurophysiology Unit of the Department of Brain and Behavioural Sciences (University of Pavia, Italy, https://web.unipv.it/). The Neurophysiology Unit is composed by three laboratories (Cellular Neurophysiology, Neurocomputation, Neuroimaging and Brain Modelling) and generates state of the art concepts, models, and theories about brain functioning. The research unit has a specific expertise in the study of neurons and circuits of the cerebellum in health and disease and is actively investigating multiscale brain processing in experimental and computational settings. An overview of laboratory activities and organization can be found at https://dangelo.unipv.it/. The researcher will take part to the EBRAINS 2.0 project and collaborate with other EU projects (Virtual Brain Twins, TEF-Health, CEN) and Italian PNRR (EBRAINS-Italy, PNRR-MNESYS, PNRR-CN1, PNR Fit4MedRob) and PRIN projects running in the research unit.

Activity
Optical imaging is largely used to investigate brain activity but the workflows for advanced recording techniques often need to be designed or customized. This project aims to generate a workflow for signal analysis and to perform the analysis of biological datasets obtained from cellular imaging experiments in vivo. The data are recorded from freely behaving animals and stored for analysis offline. This typically involves operations of spatial-temporal filtering, motion correction and feature extraction to identify active neuronal units and quantify their activity. Extensive datasets will be analysed to extract relevant physiological information. The research will address the discharge of cerebral and cerebellar neurons in vivo during sensorimotor tasks and during learning of associative behaviours.

Details on the call
The official call will appear on the website of the University of Pavia in the next few weeks (https://unipv.portaleamministrazionetrasparente.it/archivio22_bandi-di-concorso_0_19797_874_1.html). Expected starting date: 1 June 2023. Duration: 1 year that can be extended up to a maximum of 3 years. No teaching activity is requested for these positions except for seminars and lectures to master's degree and PhD students.
The evaluation of candidates will include CV, publications, reference letters, oral discussion including English language assessment (details to come).

Contact and info
Any details on the call, research activities and the specific project will be discussed with the applicants. Curriculum Vitae, reference letters and other inquiries should be emailed to dangelo@unipv.it and simona.tritto@unipv.it.