



Offre n°2025-09545

## Post-Doctoral Research Visit F/M Neural Gain & Adaptive Learning (LENGA Project)

**Contract type** : Fixed-term contract

**Level of qualifications required** : PhD or equivalent

**Fonction** : Post-Doctoral Research Visit

**Level of experience** : From 3 to 5 years

### About the research centre or Inria department

The Inria research centre in Lyon is the 9th Inria research centre, formally created in January 2022. It brings together approximately 300 people in 17 research teams and research support services.

Its staff are distributed in Villeurbanne, Lyon Gerland, and Saint-Etienne.

The Lyon centre is active in the fields of software, distributed and high-performance computing, embedded systems, quantum computing and privacy in the digital world, but also in digital health and computational biology.

### Context

Cophy is a project team between Inria, Inserm and CRNS, which gathers an international team of researchers, engineers, clinicians and students interested in studying brain networks, to shed light on information processing, its modulation by attention, prediction and learning, as well as the intricate coupling between action and perception. Our research combines (1) cross-species in-vivo observations of brain electrical and neurotransmitter dynamics in health and pathology; (2) in silico models, including Bayesian models, neural mass models and spiking neural networks; (3) in vitro neuronal network measurements. Our aim is to innovate in neurotechnologies in the broadest sense, both for research and for clinical applications, particularly in neurodevelopmental disorders.

### Assignment

Adaptive behavior depends on selecting advantageous actions while avoiding detrimental ones, a process that requires continuously updating the relationship between actions and outcomes based on experience. In stable environments, such adaptation can rely on gradual adjustments in learning rates, but in dynamic contexts, flexibility demands faster mechanisms that preserve prior knowledge while enabling rapid behavioral change. This raises a fundamental question: how does the brain achieve immediate adaptation without relying solely on slow synaptic modification?

Our recent theoretical and experimental work explores how dynamic mechanisms operating at the network level may enable rapid behavioral adaptation alongside more traditional forms of learning. This framework seeks to bridge fast, state-dependent computations and slower, experience-driven plasticity, contributing to a more unified understanding of behavioral adaptation.

The project aims to:

- Develop and analyze computational models that capture flexible, multi-timescale learning and adaptation in recurrent neural circuits.
- Test model predictions in behavioral experiments.
- Investigate how principles of biological adaptability can inform the design of efficient and robust learning algorithms for artificial systems.

The candidate will contribute to modeling and analysis of adaptive learning mechanisms, evaluation of their performance across behavioral and computational contexts, and formulation of testable predictions for experimental validation. The recruited person will be in connection with Romain Ligneul and Renato Marciano Maciel from the Cophy Team, and with Pascal Chossat (MathNeuro Team, Inria Branch at the University of Montpellier) and Frédéric Lavigne (BCL Laboratory, University of Côte d'Azur).

### References:

1. E. Behrens, M. W. Woolrich, M. E. Walton, and M. F. Rushworth, "Learning the value of information in an uncertain world," *Nature Neuroscience*, vol. 10, no. 9, pp. 1214–1221, 2007.
2. A. Ferguson and J. A. Cardin, "Mechanisms underlying gain modulation in the cortex," *Nature Reviews Neuroscience*, vol. 21, no. 2, pp. 80–92, 2020.
3. D. Grossman and J. Y. Cohen, "Neuromodulation and neurophysiology on the timescale of learning and decision-making," *Annual Review of Neuroscience*, vol. 45, pp. 317–337, 2022.
4. Kim, Y. Li, and T. J. Sejnowski, "Simple framework for constructing functional spiking recurrent neural networks," *PNAS*, vol. 116, pp. 22811–22820, 2019.

5. Köksal-Ersöz, P. Chossat, and F. Lavigne, "Gain modulation of actions selection without synaptic relearning," PLoS ONE, 20(9): e0333350, 2025.
6. Mei, E. Müller, and S. Ramaswamy, "Informing deep neural networks by multiscale principles of neuromodulatory systems," Trends in Neurosciences, vol. 45, pp. 237–250, 2022.
7. Ligneul and Z. F. Mainen, "Serotonin," Current Biology, vol. 33, pp. R1216–R1221, 2023.

## Main activities

- Design, implement and optimise learning rules
- Process electrophysiological and behavioural datasets.
- Run numerical simulations to explore different learning time-scales and environmental conditions.
- Work closely with the experimental team.
- Writing research papers for submission to top-tier conferences and journals in the field
- Disseminating research findings through presentations at conferences, seminars, and workshops.
- Follow the principals of open-science.

## Skills

- Strong background in recurrent neural networks (rate-based & spiking).
- Prior work on learning algorithms.
- Familiarity with neuromodulatory concepts
- Familiarity with dynamical systems
- Experience analysing behavioural or electrophysiological data is a plus.
- Proficiency in Python, especially scientific libraries (NumPy, SciPy) and simulation frameworks (Brian 2, NEST).
- Ability to work autonomously and in interdisciplinary teams.
- Good scientific writing (English) and presentation skills.

## Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

## Remuneration

2788 € gross salary / month

## General Information

- **Theme/Domain** : Computational Neuroscience and Medicine  
Biologie et santé, Sciences de la vie et de la terre (BAP A)
- **Town/city** : Bron
- **Inria Center** : [Centre Inria de Lyon](#)
- **Starting date** : 2026-04-01
- **Duration of contract** : 2 years
- **Date limite pour postuler** : 2026-01-31

## Contacts

- **Inria Team** : [COPHY](#)
- **Recruiter** :  
Köksal Elif / [elif.koksal@inria.fr](mailto:elif.koksal@inria.fr)

## About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

## The keys to success

- Strong background in recurrent neural networks (rate-based & spiking).
- Prior work on learning algorithms.
- Proficiency in Python, especially scientific libraries (NumPy, SciPy) and simulation frameworks

(Brian 2, NEST).

**Warning** : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

## Instruction to apply

*Applications must be submitted online via the Inria website. Processing of applications submitted via other channels is not guaranteed.*

### **Defence Security :**

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

### **Recruitment Policy :**

As part of its diversity policy, all Inria positions are accessible to people with disabilities.