CNS*2024 Natal

TYPE - WORKSHOP • JULY 23 • TUESDAY

| W | Workshop

JULY 23 • TUESDAY

9:00am –
12:30pm

W **Brain Modes: Uncovering fundamental dimensions of brain structure and function**   Cedro II
Speakers: James Pang, Alex Fornito
A major challenge in neuroscience is to understand the organizational principles of the brain's structure and
function. Advances in brain imaging and neural recordings at micro-, meso-, and macroscopic scales have
provided unprecedented detail into multiscale brain organization, but the complexity of these multimodal data
must necessarily be reduced in some accessible and interpretable way. Mode decompositions of multivariate
neural recordings offer a simple yet powerful framework to address this problem and recover the low-dimensional
components of data, which can shed light on fundamental principles and mechanisms shaping brain structure
and function.

In this workshop, we will explore diverse ways of decomposing multivariate neurobiological data. We will
highlight the latest developments and tools used in the field and the advantages of mode-based analysis, thus
greatly expanding the analytic repertoire of the workshop's participants.

Schedule:
09:00-09:30 James Pang, Monash University, Australia
   Linking brain structure and function via eigenmodes of cortical geometry
09:30-10:00 Sara Solla, Northwestern University, USA
   Low dimensional manifolds for neural dynamics *(virtual presentation)*
10:00-10:30 Daniel Margulies, Centre National de la Recherce Scientifique (CNRS), France
      Connectivity-based spaces for mapping cortical function

10:30-11:00 Coffee Break

11:00-11:30 Nikitas Koussis, University of Newcastle, Australia
       Mapping the morphospace of the human brain by resampling its intrinsic geometric constraints
11:30-12:00 Sofie Valk, Max Planck Institute for Human Cognitive and Brain Sciences, Germany
       From microcircuits to a resilient development in the adolescent brain *(virtual presentation)*
12:00-12:30 Shinwon Park, Child Mind Institute, USA
        A shifting role of thalamocortical connectivity in shaping large-scale functional brain
organization across lifespan development

12:30 End of Workshop and Lunch Break

| 9:00am – 12:30pm | W | **Career development** | Cedro V |

Speakers: Ankur Sinha

"Beyond Academia"

The OCNS career development workshop at CNS*2024 Natal will host a session on careers "beyond academia". A panel of academics who have worked or are currently working in non-traditional academic research roles will discuss their experiences and answer questions from the audience.

The goal of the session is to increase awareness on the similarities and differences between traditional academic research careers and careers outside academia to better prepare us for working in both sectors.

Panellist profiles

The pannelists will join us via Zoom:

- **Malin Sandstrom (Research officer at Swedish research council): https://www.linkedin.com/in/malinsandstrom**

  Dr. Malin Sandström lives and works in Stockholm, Sweden. She is married with two kids and has a MSC in Engineering Physics and a PhD in computational neuroscience, both from The Royal Institute of Technology in Sweden. During the last year of her PhD studies, she joined the INCF (International Neuroinformatics Coordinating Facility) as a part-time Scientific Communications and PR Officer, and continued in that position fulltime afterwards for two more years. After her maternity leave, in 2013, she took up a new role at INCF as Community Engagement Officer, which she held for nearly ten years. She was a fellow in the inaugural 2017 AAAS Community Engagement Fellows program and during 2021-2022 a member of the board of directors of OCNS as Training and Education Assistant.

  In late 2022, Malin started work as a Senior Research Officer at Sweden's largest research funder, the Swedish Research Council (SRC), at the Department of Research Infrastructure unit for research Infrastructure support. Her primary area of responsibility is e-infrastructure, mainly high-performace computing. She is the alternate Swedish delegate to the EuroHPC Governing Board, the Swedish member of the LUMI supercomputer Consortium Steering Committee and the SRC case manager for the Swedish National Infrastructure for Scientific Computing.

  Malin's professional interests center on collaboration, including FAIR, open science, community standards and scientific community engagement. In her spare time she volunteers as a Community Champion for FAIRSharing and Software Heritage, and occasionally writes popular science blog posts for the Swedish Astronomy magazine Populär Astronomi.

- **Annik Yalnizyan-Carson (AI Redifined): https://www.linkedin.com/in/annik-carson/**

  Annik is broadly interested in the processes which enable efficient learning and memory, and her research has focused on developing models of the processes which underlie these phenomena at various levels of processing. She currently works as the technical product lead for Adaptive Learning at AI Redefined, a Montreal-based startup focused on human-machine interaction. Annik completed her PhD in 2022 at the University of Toronto, where her work focused on using reinforcement learning as a model for animal decision making in changing environmental conditions. Prior to this, she completed a masters in Cell Biology modeling the cellular mechanisms involved in regulating inhibitory synaptic plasticity in hippocampus. Annik has a passion for teaching and effective scientific communication, and has been involved in several projects to share her love of computational neuroscience with the broader public or other researchers who are new to the field. When deciding to transition from academia to industry, she focused her efforts on roles which would make use of both her research and communication skills, finally landing on Product Management within an AI-focused startup. As a bonus, her current role leverages her enthusiasm for both teaching and learning, working in the context of training skilled operators and using AI to identify and target key areas for additional focus to develop their skills.

- **Alexander Antrobus (CoMind): https://www.linkedin.com/in/alexander-antrobus/**

- **Guy Billings (Balyasny Asset Management): https://www.linkedin.com/in/guybillings/**

  Guy Billings is a senior Quantitative Developer working on a commodities trading desk at one of the worlds best known hedge funds, Balyasny Asset Management. His day to day work cosists of building trading systems, solving computaional problems and fixing more code than he writes. His undergraduate studies were in Physics, but he became interested in the brain and completed a PhD in the computaional neurocience of memory at the University of Edinburgh working in the group of Mark van Rossum. After this he did a postdoc in Angus Silver's lab at UCL where he modelled the cerebellar granule cell layer using information theory. Since leaving academia he has worked in quantitative analysis roles at several 'buy side' firms including 2 of the worlds top hedge funds. He has also held roles in financial technology more broadly; having worked in the crypto currency sector and headed up software engineering teams for investment and banking technology startups. When not in London he lives in Hampshire England with his wife and three children.

Agenda

A list of questions for the panellists to guide the session is below.
Please e-mail Ankur at (ankur DOT sinha AT ucl DOT ac.uk) to suggest new questions or add them directly/ anonymously to the shared document here.

General

- Could you please summarise your career trajectory? What do you do now and how did you get there?
- What is your main daily role: is it still research related (or is it non-research like development/engineering/ design/outreach)?Was this your planned path (roughly)?
- If it was, what steps did you take at various times in your career to ensure you reached your targets? (see questions on skills below too) If it wasn't: how does it differ from what you had in mind? What made you change your plan?

Moving to industry

- What were the similarities/differences in the hiring processes you've experienced in academia vs industry?
- What skills from your academic research work were important for your move to industry? What skills were not?
- Would you have any tips on translating academic work to an industry audience (folks in industry don't necessarily understand what day to day academic research work is and vice-versa)?
- Would you have any tips on building our industry networks before applying/working in industry (internships/ partnerships/conferences/outreach/volunteering)?

Your work:

- What skills from your academic research work do you actively use in your industry work? What skills do you not?
- What skills were not stressed enough on in the academic work that you think you'd have benefitted from in industry, both during hiring and in daily work?
- What are your observations on differences between working in research/academia and industry?
- What issues did you face in academia that you do not face in industry? (what do you not miss about academia/prefer in industry)
- What issues do you face in industry that you didn't face in academia? (what do you miss about academia/ preferred in academia)
- What issues did you face in academic that you still face in industry? (what common issues remain in both)
- What would your advice to current students/ECRs be?

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| 9:00am – 12:30pm | W | **Social Behavior: Evolution, Ecology, Neural Circuit** | Cedro IV |

Speakers: Daniel Takahashi, Kerstin Schmidt, Fred Wolf

Full program on the workshop website

Social behaviors are the cornerstone of animal societies, binding individuals together in intricate webs of interaction. A comprehensive understanding of animal behavior necessitates studying individuals within the context of their social groups. Yet, unraveling the complexities of how group dynamics influence individual physiology remains a formidable challenge. To surmount this hurdle, we must convene researchers from diverse disciplines, including ecology, evolutionary biology, ethology, and neurophysiology. In this workshop we propose to investigate the nuanced interplay between evolutionary processes, ecological dynamics, and neural mechanisms governing sensory perception and social behaviors. To this end, the workshop will showcase presentations by experts in the field, presenting recent advancements in understanding the evolutionary origins of cognition, social behaviors and sensory processing in primates, rodents and electric fishes.

Organizers: Daniel Takahashi, Kerstin Schmidt, Fred Wolf

9.00 – 9.05 Daniel Takahashi, Brain Institute, UFRN, Natal

Introductory remarks

9.05- 9.35 Kerstin Schmidt, Brain Institute, UFRN, Natal

Functional visual circuitry in large rodents and in carnivores

9.35 – 10.20 Martin Vinck, Ernst-Struengmann Institute, Frankfurt

Monkey vs. mouse: a comparison of local and inter-areal interactions

10:20-10:50 Coffee Break

10:50 - 11:30 Claudia Fichtel, German Primate Center, Göttingen

On the links between cognition, ecology, and fitness in wild mouse lemurs

11:30 - 12:10 Jan Benda, University of Tübingen

Encoding of behaviorally relevant high-frequency beats in electrosensory afferents

12:10 - 12:30 Questions and debate

12:30 End of Workshop and Lunch Break

| 9:00am – 12:30pm | W | **The Raw and the Cooked** | Cedro III |

Speakers: Antonio Roque, William Lytton, Christophe Pouzat

Topic: bottom-up vs top-down modeling for neuroscience. I am aiming for a true workshop -- *i.e.* discussion >> presentation. As such anyone in attending is welcome to come up and make some comments and add to the whiteboard or to the marker boards (we will even have markers according to the organizers but I'll bring some just in case). This workshop was originally intended to begin with a brief debate/discussion/argument between me and the other organizers ... but my fellow organizers will be absent due to family exigencies . I am taking the *raw* position and welcome those who are more *cooked* -- *e.g.* using AI as a model for the brain; high-level physics/math concepts as models (*cf* Dayan, Sompolinsky, Abbott *et al*); control theory and engineering perspective (*cf* Cosyne meeting).

More fanciful detail is here in the abstract:

Title: The Raw and the Cooked
Organizers: Antonio Roque; Christophe Pouzat; Bill Lytton

Claude Levi-Strauss' "The Raw and the Cooked" was an influential 1960s book that studied Brazilian indigenous peoples and their myths. His concepts came into quantitative research via data-science: raw data -- data as gathered; vs cooked data -- data as summarized statistically. These same concepts can also be applied as we stretch beyond statistics in computational neuroscience -- raw biophysical simulation that attempts to include as much as is known and is computationally tractable; cooked simulations (and sometimes closed-form solutions) that utilize more classical methods to encapsulate biological phenomenology in a way that is more readily understood. Raw and cooked simulation are sometimes seen as (antagonistic) alternatives. We postulate that they can instead be mutually supportive. This workshop will give leading proponents of both approaches the opportunity to both present the strengths and accomplishments of their raw or cooked perspective and to consider how these two perspectives (and their acolytes) might be encouraged to be mutually supportive, politically and educationally as well as in research. The format of the workshop will feature both individual speakers and raw/cook paired speakers -- presentations limited to blackboard or marker board. As a workshop dedicated to working out some things, audience interruptions and participation will be encouraged; fisticuffs forbidden. Although Levi-Strauss' work is not nowadays considered scientific (it is somewhat in the Freudian style), it featured a few appealing quotes: "Scientific knowledge advances haltingly and is stimulated by contention and doubt."; "The scientific mind does not so much provide the right answers as ask the right questions."

| 9:00am – 12:30pm | W | **Virtual Brains: From data to modeling and back** | Cedro I |

Speakers: Marie-Constance Corsi, Damien Depannemaecker, Spase Petkoski, Pierpaolo Sorrentino, Leonardo L. Gollo

| 9:00am – 12:45pm | W | **The structure-function binomial of cortical circuits across multiple scales** | Cedro VI |

Speakers: Patricio Orio, Maurizio De Pitta, Pamela Illescas-Maldonaldo

Workshop homepage + program: https://sites.google.com/view/cns2024-structure-function/home

Day 1:

09.00--09.35 **Claudia Clopath**, Theory of neuronal perturbome in cortical networks

09.35--10.10 **Camilo David Libedinsky**, A mixed bump-attractor, and random connectivity architecture model helps explain differences between lateral prefrontal regions.

10.10--10.45 **Scott Rich**, Resilience through diversity: Biophysical heterogeneity protects physiological neurocircuit activity

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10.45--11.00 Coffee Break

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11.00--11.35 **Patricio Orio**, The emergence of high-order interdependencies in learning neural networks

11.35--12.10 **Marylin Gatica**, Whole-brain modeling of high-order functional interactions in clinical applications: healthy aging and transcranial ultrasound stimulation

12.10--12.45 **Maurizio De Pitta**, A network framework to model neuron-glial circuits

https://sites.google.com/view/cns2024-structure-function/home

W   Workshop

JULY 24 • WEDNESDAY

9:00am – 12:00pm	W **The structure-function binomial of cortical circuits across multiple scales**	Cedro VI

Speakers: Pamela Illescas-Maldonaldo, Patricio Orio, Maurizio De Pitta

Workshop homepage + program: https://sites.google.com/view/cns2024-structure-function/home

Day 2:

09.00--09.35 **Salvador Dura-Bernal**, Multiscale biophysical modeling of thalamocortical circuits to study brain function and disease.

09.35--10.15 **Alessandro Sanzemi**, Connectome-based models of feature selectivity in a cortical circuit.
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10.15--10.30 Coffee Break
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10.30--11.05 **Samy Castro**, Compensating functional connectivity changes due to structural connectivity damage via modifications of local dynamics in multiscale modeling.

11.05--11.45 **Andre Longtin**, Meta-parameters for brain rhythms.

9:00am – 12:30pm	W **Advances in Natural Language Processing for Computational Neuroscience**	Cedro I

Speakers: Marina Ribeiro, Aline Villavicencio, Bárbara Malcorra, Cesar Renno-Costa, Rodrigo Wilkens

Wednesday, July 24, 2024 (9 am to 12:30)

09:00 – 09:15 – Welcoming
09:15 – 10:20 – Invited Speakers (section 1)
10:20 – 10:50 – Coffee break
10:50 – 12:10 – Invited Speakers (section 2)
12:10 – 12:30 – Closing section

Section 1 (60min):
2 x 30 min (25 min for presenting and 5 for Q&A)
Section 2 (80min):
3 x 25 min (20 min for presenting and 5 for Q&A)

1. Aline Villavicencio (**Testing the Language Limits of Large Language Models: The strange case of the idiomatic eager beaver in cloud nine**)
2. Bárbara Malcorra (**NLP in the context of healthy aging and Alzheimer's disease**)
3. Marina Ribeiro (**SLIME: Statistical and Language Insights for Model Explanation**)
4. Rodrigo Wilkens (**Modeling Reading Proficiency**)

| 9:00am – 12:30pm | W | **From Computational Neuroscience to Biomimetic Embodied AI** | Cedro V |

Speakers: Thomas Nowotny, Renan Moioli
Full program on the Workshop Website.

In this workshop, we will explore how animal brains solve problems, and how AI can take inspiration from biological systems that have evolved specifically to solve problems flexibly and rapidly, and to adapt over the lifetime of an individual, whilst being computation- and energy-efficient. Topics will include computational models to explore how brain circuits can solve problems and how this creates new hypotheses to explore experimentally. We will also examine how this can contribute to solving problems in autonomous robotics and provide inspiration for other AI applications.

Schedule:
9:00-9:25 Daniel Yasumasa Takahashi, Federal University of Rio Grande do Norte
Stochastic dynamical systems model of vocal turn-taking and its development in marmoset monkeys
9:25-9:50 Marcelo Bussotti Reyes, Universidade Federal do ABC (UFABC)
Temporal Decoding Dynamics: Insights from Prefrontal Cortex and Striatum During Rapid Learning
9:50-10:15 Rachael Stentiford, University of Sussex
Insect visual navigation in natural scenes: Maintaining head direction estimates with a spiking neural network model of the central complex and active behavioural strategies
10:20-10:50 Coffee Break
10:50-11:15 Renan Moioli, Federal University of Rio Grande do Norte
A Neurorobotics Model of the Cerebellar-Basal Ganglia Circuitry: decision making and motor control in healthy and diseased states
11:15-11:40 Thomas Nowotny, University of Sussex
Training Spiking Neural Networks for keyword recognition with Eventprop in GeNN
11:40-12:30 Questions and Debate
12:30 End of Workshop and Lunch Break

Full program on the Workshop Website.

9:00am –
12:30pm

W   **Whole Brain Network Modeling for Clinical Application**   Cedro IV
  Speakers: Simon Adriano Munoz Lagunas, Petra Ritter
  <u>Whole Brain Network Modeling for Clinical Application (9:00 - 12:30)</u>

In this workshop we give first an overview and introduction how personalized brain network modeling is presently used for clinical translational research.

We then show different concrete examples how this approach is used for understanding mechanisms of **a) brain network interactions b) dynamics during brain stimulation/perturbation c) brain disease.**

<u>**Workshop Schedule**</u>

<u>**Part 1: 9:00 - 10.20**</u>

09:00-09:20: Introduction to Brain Network Modeling for Clinical Translation, *Petra Ritter*
09:20-09:40: Exploration of altered brain dynamics in disease using brain network models, *Jeehye An*
09:40-10:00: Analysis of Chaos in Brain Network Models, *Simon Adriano Munoz Lagunas*
10:00-10:20: Modeling of drug effects using brain network models, *Jennifer Them*

Coffee Break 10:20-10:50

<u>**Part 2: 10:50 - 12:30**</u>

10:50-11:15 Brain network modeling of TMS effects, *Timo Hofsähs*
11:15-11:40: Netpyne-TVB Modeling, *Salvador Dura-Bernal*
11:40-12:05: Multiscale computational brain modeling with TVB-multiscale, *Valerii Brahin*
12:05-12:30: Data-Driven Reconstruction of Subthalamic Nucleus: Understanding the Microcircuitry, *Qin Liu*
Lunch break and end of workshop 12:30

9:00am – 5:00pm   W   **Cerebellar learning and models of learning involving the cerebellum**   Cedro II
Speakers: Volker Steuber, Arnd Roth
The crystalline structure of the cerebellar cortex has long inspired theories of learning in the cerebellum that made testable predictions. The discovery of parallel fiber-Purkinje cell long-term depression, fulfilling one of these predictions, cemented the influence of classical theories of cerebellar learning on our views of cerebellar function. Since then, however, plasticity has turned out to be ubiquitous in cerebellar synapses, and the recent observations of reward signals conveyed by both the mossy fiber and climbing fiber inputs to the cerebellar cortex indicate that the roles of the instructive signals for cerebellar plasticity are more complex than envisioned by early theories. The presence of reward signals suggests that the cerebellum may be involved in reinforcement learning, for example making it more efficient by predicting the consequences of different actions. The cerebellum can also serve as an inspiration for new approaches in machine learning, for example offering biologically plausible alternatives to the backpropagation algorithm.

Tentative Schedule
10:20-10:45 coffee
10:45-11:00 introduction, Volker Steuber and Arnd Roth
11:00-11:45 Angus Silver, UCL, Exploring population activity in the input layer of the cerebellar cortex during behaviour
11:45-12:30 Samuel Muscinelli, Columbia University, The role of bottlenecks for learning in cerebellum-like structures
12:30-14:00 lunch break
14:00-14:45 Elias Fernandez Santoro, Erasmus Medical Center Rotterdam, Bidirectional Control by Cerebellar Modules
14:45-15:30 Marlies Oostland, University of Amsterdam, Enhanced learning in a cerebellum-specific mouse model of autism (zoom)
15:30-15:50 coffee break
15:50-16:35 Claudia Clopath, Imperial College London, Modelling motor adaption (zoom)
16:35-17:20 Huu Hoang, ATR CNS Laboratories Japan, A Modular Framework for Reinforcement Learning in the Cerebellum
17:20-17:45 concluding discussion

9:00am – 5:30pm	W	**Neuronal Oscillations: From Mechanisms to Computation**	Cedro III

Speakers: Horacio G. Rotstein

General Description

Oscillations at various frequency ranges have been observed in several brain structures and have been argued to play significant roles in cognition and motor behavior both in the healthy and diseased brains. The mechanistic basis of these rhythms have been studied at the single cell level, as the result of the interaction of a neuron's intrinsic properties, at the network level, as the result of the interaction between the participating neurons and neuronal populations, and at higher levels of organization involving several brain regions. Advances in this field have benefited from the interaction between experiment and theory, and the use of models with varying levels of detail.

The primary purpose of this workshop is to bring together modelers, experimentalists and theorists with the goal of sharing and discussing their current results and ideas on the underlying mechanisms that govern the generation of these rhythms at various levels of organization, and their functional implications.

Final Discussion

The workshop will conclude with a general open discussion about (i) the role of oscillations for neural computation, and (ii) the opportunity that presents to the community to apply the insights from oscillatory dynamics in the brain to the design of artificial neural networks (ANNs). We expect this discussion to take place after the regular workshop schedule to allow for a larger group of participants. Please contact the organizers if interested to (briefly) present.

Spontaneous Presentations and Data Blitz

Following the tradition of this workshop we reserve slots for students and postdocs to speak and we will allow for ample time for discussion by keeping the talks relatively brief. With the goal of making this workshop as inclusive as possible, time permits, we intend to allow additional contributed presentations from scientists who wish to speak, but are not included in this list. Please contact the organizers if interested.

We will also continue with the tradition established in previous versions of the workshop of calling for a spontaneous five minutes long data blitz where interested students and postdocs can briefly present their work and contribute to the discussion. Please contact the organizers if interested.

Schedule (At least 15 mins discussion time in each slot. Talks can be shorter than 30 mins)

  9:00 - 9:10 Introduction & preliminary words

  9:10 - 9:50 Astrid Prinz

  9:50 - 10:30 Leonid Rubchinsky

10:30 - 11:10 Laura Green

11:10 - 11:50 Adriano Tort

 11:50 - 12:30 Jozef Csicsvari

 2:00 - 2:40   Horacio G. Rotstein

 2:40 - 3:20   MB (T)

 3:20 - 5:30   Spontaneous presentations, Data blitz and Final Discussion

2:00pm – 5:30pm	W	**Workshop on Methods of Information Theory in Computational Neuroscience**	Cedro I

Speakers: Joseph T. Lizier, Abdullah Makkeh, Pedro Mediano, Marilyn Gatica, Michael Wibral

https://kgatica.github.io/CNS2024-InfoTeory-W.io/