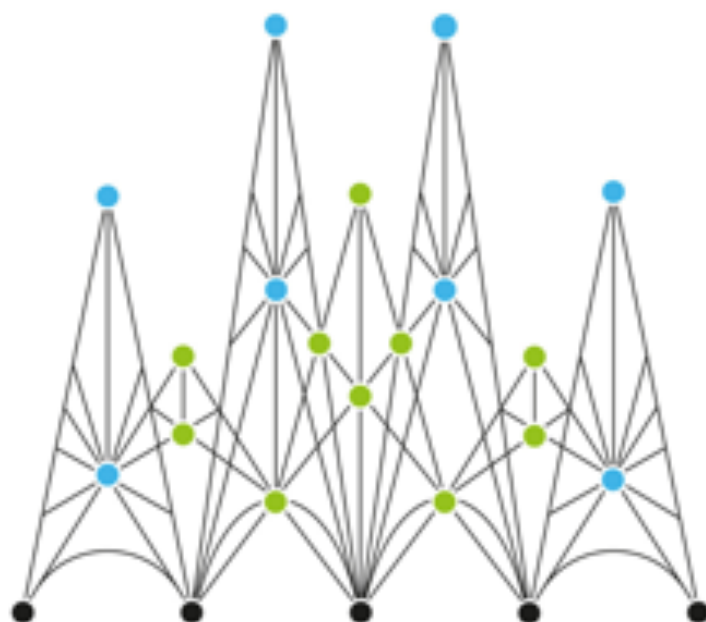


28TH ANNUAL COMPUTATIONAL NEUROSCIENCE MEETING

**CNS\*2019**

FROM JULY 13 TO JULY 17, 2019



**CNS 2019 BARCELONA**

BARCELONA / SPAIN



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We are grateful to the following organizations for their support  
without which none of this would be possible:





# frontiers Research Topics

## Frontiers in Computational Neuroscience welcomes all the CNS\*2019 attendees to contribute to the Advances in Computational Neuroscience Research Topic.

Since the seminal works of Hodgkin and Huxley on models of electrically active neuron membranes and the visionary ideas of David Marr, Computational Neuroscience has rapidly developed into a strongly interdisciplinary field of research where theoreticians, computational scientists and experimenters work in close collaboration, using models and experimental data at multiple different scales. The works collected in this topic come together in linking the diverse fields of cell and molecular biology, neuroscience, cognitive science, and psychology with electrical engineering, computer science, mathematics, and physics. In this Research Topic we collect highlights from meeting CNS\*2019, accepting all article types. All contributors to #CNS2019Barcelona are strongly encouraged to submit their work to the topic, however, all investigators are welcome to contribute whether or not they attend the conference.



### Topic Editors:

**Thomas Nowotny**

University of Sussex, UK

**Sacha Jennifer van Albada**

Julich Research Centre, Germany

**Tatyana Sharpee**

Salk Institute for Biological Studies, USA

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University of Arizona, USA

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Technische Universität Berlin, Germany



For more information:

[frontiers.in/sLcf](https://frontiers.in/sLcf)

Visit the journal or contact us:

[frontiersin.org/computationalneuroscience](https://frontiersin.org/computationalneuroscience)

[computationalneuroscience@frontiersin.org](mailto:computationalneuroscience@frontiersin.org)

# Bernstein Conference

## Berlin, Sept 17-20, 2019

### Confirmed speakers

Dora Angelaki (USA)  
Matthias Bethge (Germany)  
Matthew Botvinick (USA)  
Nicolas Brunel (USA)  
Claudia Clopath (UK)  
Hopi Hoekstra (USA)  
Gilles Laurent (Germany)  
Eve Marder (USA)  
Haim Sompolinsky (Israel/ USA)  
Gašper Tkačik (Austria)  
Nachum Ulanovsky (Israel)

Back to back with



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Sept 13-16



Bernstein Network  
Computational Neuroscience

[www.bernstein-conference.de](http://www.bernstein-conference.de)



# Overview

# Organization for Computational Neurosciences (OCNS)

## 2019 Board of Directors

---

- **President: Volker Steuber** (University Hertfordshire, UK).
- **Vice-President and Secretary: Sharon Crook** (Arizona State University, USA).
- **Past President: Astrid Prinz** (Emory University, USA).
- **Treasurer: Leonid Rubchinsky** (Indiana University, USA).
- **CNS Program Chair: Thomas Nowotny** (University of Sussex, UK).
- **CNS Publications Chair: Ingo Bojak** (University of Reading, UK).
- **OCNS Education and Training Chair: Sharmila Venugopal** (University of California Los Angeles, USA).
- **OCNS Website Administrator: Ankur Sinha** (University Hertfordshire, UK).
- **Past Website Administrator: Pierre Yger** (Institut de la Vision, France).
- **Local Org. Committee Rep. CNS 2019: Alex Roxin** (Centre de Recerca Matemàtica, Spain).
- **OCNS Member Approval: Peter Jedlicka** (Goethe University Frankfurt, Germany).
- **OCNS Social Media Chair: Joanna Jedrzejewska-Szmek** (University of Warsaw, Poland).
- **OCNS Social Media Chair Assistant: Renaud Jolivet** (University of Geneva, Switzerland).
- **OCNS Newsletter Editor: Anca Doloc-Mihu** (Georgia Gwinnett College, USA).
- **CNS Tutorials Organizer: Hermann Cuntz** (ESI and FIAS, Frankfurt/Main, Germany).
- **CNS Tutorials Assistant: Anthony Burkitt** (University of Melbourne, Australia).
- **CNS Sponsorship Chair: William Lytton** (SUNY Downstate, USA).
- **CNS Meeting Registration: Cecilia Romaro** (University of Sao Paulo, Brazil).
- **CNS Travel Awards: Taro Toyozumi** (RIKEN Brain Science Institute, Japan).
- **CNS Travel Award Assistant: Boris Gutkin** (Ecole Normale Superieure, France).
- **CNS Workshop Organizer: Martin Zapotocky** (Czech Academy of Sciences, Czech Republic).

## 2019 Program Committee

---

- **CNS Program Chair: Thomas Nowotny** (University of Sussex, UK).
- **CNS Publication Chair: Ingo Bojak** (University of Reading, UK).
- **Sacha van Albada** (Research Centre Jülich, Germany).
- **Maxim Bazhenov** (University of California San Diego, USA).
- **Jean Marc Fellous** (University of Arizona, USA).
- **Tomoki Fukai** (Riken University, Japan).
- **Julie Haas** (Lehigh University, USA).
- **Dieter Jaeger** (Emory University, USA).
- **Renaud Jolivet** (University of Geneva, Switzerland).
- **Cliff Kerr** (SUNY Downstate Medical Center, USA).
- **Sukbin Lim** (NYU Shanghai, China).
- **Christoph Metzner** (University of Hertfordshire, UK).
- **Steven A Prescott** (University of Toronto, Canada).
- **Tatyana Sharpee** (Salk Institute, San Diego, USA).

## 2019 Local Organizers

---

- **Head Coordinator: Alex Roxin** (Centre de Recerca Matemàtica, Spain).
- **Head Coordinator: Klaus Wimmer** (Centre de Recerca Matemàtica, Spain).
- **Coordinator: Albert Compte** (Institut d'Investigacions Biomèdiques August Pi i Sunyer, Spain).
- **Coordinator: Jaime de la Rocha** (Institut d'Investigacions Biomèdiques August Pi i Sunyer, Spain).
- **Coordinator: Gemma Huguet** (Universitat Politècnica de Catalunya, Spain).

## Fundraising

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OCNS, Inc is a US non-profit, 501(c)(3) serving organization supporting the Computational Neuroscience community internationally. We seek sponsorship from corporate and philanthropic organizations for support of student travel and registration to the annual meeting, student awards and hosting of topical workshops. We can also host booth presentations from companies and book houses. For further information on how you can contribute please email <http://sponsorship@cnsorg.org>.



# Timetable

	TUTORIALS	MAIN MEETING	MAIN MEETING	MIXED DAY	WORKSHOPS ONLY	
	Saturday, July 13th	Sunday, July 14th	Monday, July 15th	Tuesday, July 16th	Wednesday, July 17th	
	Universitat de Barcelona	Universitat de Barcelona	Universitat de Barcelona	Universitat de Barcelona	Universitat de Barcelona	
8:30	Registration Opens	Registration Opens	Registration Opens	Registration Opens	Registration Opens	8:30
9:30		Announcements	Announcements			9:30
9:40	TUTORIALS	Keynote 2 Kenji Doya	Keynote 3 Mavi Sanchez-Vives	WORKSHOP SESSION 1	WORKSHOP SESSION 2	9:40
10:40	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	10:40
10:50				(Varies by Workshop)	(Varies by Workshop)	10:50
11:30	OCNS Board Meeting All Day	ORAL SESSION 1 Large-scale Networks	ORAL SESSION 4 Cognition			11:30
12:10						12:10
12:40	Lunch Break	Lunch Break Program Committee Meeting	Lunch Break OCNS Board Meeting			12:40
13:10				Lunch Break Program Committee Meeting	Lunch Break	13:10
14:30						14:30
14:50	TUTORIALS	ORAL SESSION 2 Network Structure and Dynamics	ORAL SESSION 5 Cells and Circuits	Keynote 4 Ila Fiete	WORKSHOP SESSION 3	14:50
15:50			Coffee Break	Coffee Break		15:50
16:00	Coffee Break	Coffee Break			Coffee Break	16:00
16:20					(Varies By Workshop)	16:20
16:30		ORAL SESSION 3 Vision	ORAL SESSION 6 Data Analysis	OCNS Members Meeting		16:30
17:00						17:00
17:20						17:20
17:30						17:30
17:50	Welcome		POSTER SESSION 2 P121-P240 17:00-19:40			17:50
18:00	Keynote 1 Ed Bullmore	POSTER SESSION 1 P1 - P120 17:30-20:20		POSTER SESSION 3 P241-P357 17:20-20:10		18:00
18:40						18:40
19:00	Welcome Reception 19:00-21:00					19:00
19:40						19:40
20:20		Travel to Banquet	Dinner on your Own Travel to Party			20:20
21:00		BANQUET DINNER 21:00-23:30 El Cangrejo Loco	CNS PARTY 21:00-01:30 Bambú Beach Bar			21:00

## Ground Floor of Venue

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# First Floor of Venue



# General Information

## Meeting Venue

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CNS 2019 will be held at the Historical Building of the Universitat of Barcelona (UB), which is located in downtown Barcelona.

Adress: Edifici Històric de la Universitat de Barcelona, Gran Via de les Corts Catalanes, 585, 08007 Barcelona

The historical building of the Universitat de Barcelona, built between 1863 and 1889, was designed by Elies Rogent, a friend of Ildefons Cerdà, who had just submitted his plan for the city's new expansion; the Eixample. It was the first monumental structure of the new part of the city, and Rogent designed it in accordance with the neo-Gothic style of the time with neo-Arabic and Byzantine decoration.

The building, located at Plaça Universitat, is organised into two lateral structures: the one on the right for scientific studies and the one on the left for humanities. It also has a central structure which is home to its assembly hall and staircase of honour. The cloisters consist of two covered floors and a third uncovered floor. The capitals of the medieval-style columns are all different.

The assembly hall occupies the centre of the architectural composition and is its most important space because it is where solemn ceremonies take place, such as the awarding of honorary degrees and the inauguration of the academic year. In contrast to the rest of the building, its decoration is profuse, combining neo-Mudejar and plateresque elements. The gallery of the assembly hall exhibits the shield of King Charles I, who chaired the old studium generale on La Rambla, which was destroyed in 1843. Only this emblem was saved.

Now the University of Barcelona has multiple centres in the city, but this historic building is still home to the faculties of Philology and Mathematics.

## Tutorials and Workshops Locations

All tutorials and workshops will be held at the main meeting venue, the Historical Building of the Universitat de Barcelona. Meeting rooms are listed in the sections below. Any room changes will be posted at the registration desk.

Please bring your conference badge to tutorials, workshops, and all other conference events.

## Travel from the Airport to the Downtown Area

**By Bus:** Aerobus is the shuttle bus service that connects the airport with Barcelona's city centre (Plaça Catalunya). It has two separated lines depending on the terminal. It costs 5.90 Euros and the journey lasts about 35 minutes.

<http://www.aerobusbcn.com/en/>.

**By Metro:** The metro line L9 Sud connects both terminals with Barcelona, with connections with other metro lines L1 (Torrassa station) L5 (Collblanc station), and L3 (Zona Universitària station). The ticket costs 4.50 Euros.

<https://www.tmb.cat/en/barcelona/metro/-/lineametro/L9S>.

**By Taxi:** There are taxi ranks opposite the arrivals area of each terminal.

<http://www.aena.es/en/barcelona-airport/taxi.html>.

**By Train:** The train line R2 Nord connects airport's terminal T2 with Barcelona's city centre. From T1 there is a connection bus between T1 and T2. This line has stops at Sants and Passeig de Gràcia stations in the city.

<http://rodalies.gencat.cat/en/inici/>.

## Welcome, First Keynote, and Reception

All activities during the meeting will be held in locations throughout the Edifici Històric de la Universitat de Barcelona (Historic Building of the UB). The Welcome remarks and first keynote will be held on Saturday July 13<sup>th</sup> at 5.50pm at the UB Paranymph, which is a large historical auditorium. **Please plan to arrive early if you wish to ensure a seat in the Paranymph.** Overflow seating with a live video stream of the presentation will be located in the Aula Magna room, which is air conditioned.

The welcome reception will follow the keynote talk and will take place at the UB central garden (Ferran Soldevila Central Garden).

## Information for Poster Presentations

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The poster presentations will be held in the Main Vestibule, located in the same area as registration. Panels will be numbered, and pins will be provided.

Poster sessions will be held on July 14<sup>th</sup> at 5.30-8.20 pm, July 15<sup>th</sup> at 5-7.50 pm, and July 16<sup>th</sup> at 5.20-8.10 pm. Presenters are expected to be at the session until at least 7.00 pm. Panels will be available in the morning so that presenters can set up their posters.

Posters should be removed promptly at the end of the poster session every day. Presenters who leave before 7.00pm should take their posters with them at that time.

Posters that are not removed by the end of the day of the session will be discarded. The organizers are not responsible for loss or damage to posters not removed by their owners.

## Registration and Locations

---

Registration will be held in the Universitat de Barcelona at the Main Vestibule (ground floor).

REGISTRATION HOURS:	
Day	Schedule
Saturday July 13 <sup>th</sup>	8.30 am to 6.00 pm
Sunday July 14 <sup>th</sup>	8.30 am to 6.00 pm
Monday July 15 <sup>th</sup>	8.30 am to 6.00 pm
Tuesday July 16 <sup>th</sup>	8.30 am to 6.00 pm
Wednesday July 17 <sup>th</sup>	8.30 am to 6.00 pm

Please bring your conference badge to all conference events, including offsite social events. During the party event, you will need to show your name tag at the beginning in order to identify yourselves, but it will not be necessary to wear it during the whole night.

## Local information

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### Good to Know:

Travel tips for Barcelona are available at [Barcelona Turisme](#).

### Safety:

Unfortunately, officials warn of pickpocketing in the tourist areas of Barcelona. Also, please be aware that laptops have been stolen in the University of Barcelona area when left unattended.

### Official Language:

The official language of the meeting is English. Interpreting is not provided.

**Insurance:**

The organizers do not accept responsibility for individual medical, travel or personal insurance. All participants are advised to take out their own personal insurance before traveling to Seattle.

**Currency & Banking:**

Exchange of foreign currency is available at airports and at most hotels and banks throughout the city. International credit cards are accepted for payments in hotels, restaurants and shops. An increasing number of locations, especially small restaurants and food carts, are cashless.

**Electricity:**

The electricity voltage used in Europe is 220 volts with a frequency of 50 hertz. Any electrical device that indicates a maximum power of 240v 50/60 Hz in the plug, can be used in Europe.

**Shopping:**

Most stores in Barcelona are open from 10am to 9pm. A shopping center called [El Triangle](#) is located approximately 400 meters south-east of the main meeting location on the UB campus.

**Time Zone:**

Barcelona is on Center European time zone in July (GMT+2). During the meeting, sunrise will be around 6:30am and sunset will be around 9:30pm.

**Tipping:**

Tipping is not expected. In Barcelona you do not have to tip unless you want to. If you feel that you have been well looked after and appreciated as a client or guest a tip of 5 to 10% of check amount is appropriate. It is absolutely not necessary to leave a tip if you only have coffee or a snack.

**Weather:**

July is the one of the warmest months in Barcelona. The average high is around 30C (86F) and low around 18C (64F). Rain is relatively rare in July.

**Get Around:**

Barcelona and its metropolitan area have a wide range of public transport and sightseeing buses options. There are different ticket types so that you can get to where you want to go in Barcelona easily and conveniently.

**By Public Transportation:**

Public transport such as the metro, tram and FGC are the quickest, simplest and most convenient way of getting around Barcelona. You can choose from the different ticket types and travel cards.

**By Bike:**

Barcelona offers a large variety of rental companies with bikes located in various parts of the city. You can check the companies at this [link](#).

**By Car:**

In Barcelona the traffic is heavy and the public transportation system is great. If you decide to come by car, parking in Barcelona, as in all large cities, has many restrictions. Traveling by car during rush hour is not recommended.

**On Foot:**

Many fun activities, interesting sights, and local restaurants are within walking distance of the conference venue.

**Free Wifi:**

Wifi is provided at the meeting venue. Login information is available on the back of your nametag.

**Car Services:**

Barcelona has a service of 11,000 taxis which can be easily identified by their yellow and black livery. A green light on top of the taxi indicates its availability. There is also a service of taxis adapted for people with reduced mobility.

## Gala Dinner

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**Date:** Sunday, July 14, 2019

**Time:** 9:00pm

**Venue:** El Cangrejo Loco

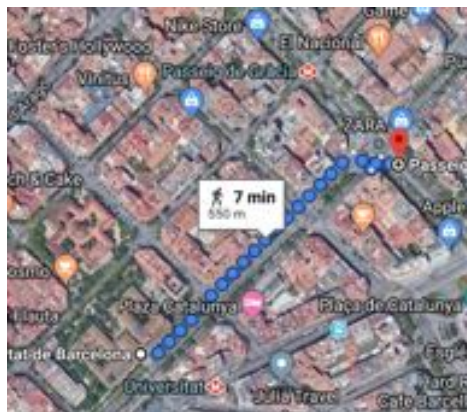
Port Olímpic, 30, Moll de Gregal, 29, 08005 Barcelona.

<http://www.elcangrejoloco.com>

**Recommended dress code:** Casual

**Food:** Vegetarian, vegan, and gluten free meals are available to those who ordered them at the time of purchasing banquet tickets. For other meals, the main course consists of fish.

**How to get there:** The best way to get to the El Cangrejo Loco restaurant from the meeting venue is by metro L4 or bus H16. Walk to the Passeig de Gràcia metro station and take the metro to the Ciutadella Vila Olímpica station. From there, there are no public transit routes that travel directly to the restaurant, but it is only 500 meters walk from there.



Top: From Universitat de Barcelona to Pg. de Gràcia. Bottom: From Ciutadella to El Cangrejo Loco.



## CNS Party

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**Date:** Monday, July 15, 2019

**Time:** 9:00pm until 1:30am

**Venue:** Bambú

Ronda Litoral, s/n 08005 Barcelona

<https://bambubeachbar.com/en/>

**Recommended dress code:** Casual

**How to get there:** The CNS Party will be held at the Bambú beach bar, inspired by the paradise of Southeast Asia, this bar is perfect to socialize and drink a cocktail.

It can be reached from the University of Barcelona by bus from Gran Via – Balmes to Diagonal-Agricultura (approximately 25min) and then walk 850 meters until Passeig Maritim.

It can also be reached by metro from Passeig de Gràcia station, L4 line, to Selva de Mar station. From there, there are two options; walking 15 minutes or taking the bus V29 until Av. Del Litoral-Platja de Llevant (2 stops).

**Return to UB area:** A bus service will be available at 1:00am and again at 1:30am from the party location to Plaça Catalunya, which is near the meeting location downtown.

**Recommendation:** Plan to eat dinner before the party, as only light refreshments and drinks will be provided. Recommended restaurants for dinner near the party are listed in the next link.



From Selva de Mar stop to Bambú.

## Restaurants

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Please find information about some restaurants near the University here:

[https://drive.google.com/open?id=1Ps52ETppskdD\\_8nKhd-2rFZm7yn6Mn3q&usp=sharing](https://drive.google.com/open?id=1Ps52ETppskdD_8nKhd-2rFZm7yn6Mn3q&usp=sharing).



Some nearby restaurants.

## Sights

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### **La Sagrada Família Basilica:**

This unique and breathtaking construction is Barcelona's most famous tourist attraction and the most visited attraction in Spain. It is like no other cathedral in the world and is rated as one of the world's top attractions by Tripadvisor users worldwide.



La Sagrada Família Basilica.

**La Font Màgica:**

The Magic fountain was built in 1929 as one of the main attractions for the 1929 Barcelona World Fair and the Font Màgica is still one of the most famous places in Barcelona with an estimated 2.5 million visitors annually.



La Font Màgica.

**Park Güell by Gaudi:**

Parc Güell is a UNESCO World Heritage Site and is considered to one of Gaudi's most artistic works. Parc Güell is a Barcelona top attraction and must-see. The park is on Carmel hill so seeing this attraction involves a 900m uphill walk if you take the hop-on-hop-off bus or arrive from metro station Vallcarca.



Park Güell.

**La Rambla Street:**

Also called Les Rambles because it consists of different sections. The Spanish poet Federico García Lorca said, “It is the only street in the world which I wish would never end” and it almost doesn’t because it now continues into Port Vell marina. La Rambla starts at central square Plaça Catalunya and ends at the Columbus monument at the Port Vell marina. La Rambla it is not a spectacular attraction in any way, but very pleasant to stroll down and feel the human heartbeat of Barcelona. La Rambla is also called Las Ramblas because different stretches of the street have different names. La Rambla is safe to visit, however, be careful of pickpockets on La Rambla and in nearby Metro stations.



La Rambla Street.

**Camp Nou Stadium and FCB Museum:**

Home of Barcelona football team, the Camp Nou stadium and FCB museum are among the most popular attractions in Barcelona attracting millions of visitors a year.



The Futbol Club Barcelona museum.

# Program

# Tutorials and Organizers

- T1 Introduction to the simulation of structurally detailed large-scale neuronal networks (NEST)**  
*Room B1, 13/07/2019, 09:30 - 17:40*  
**Alexander van Meegen**, Jülich Research Centre and JARA, Germany  
**Dennis Terhorst**, Jülich Research Centre and JARA, Germany
- T2 Building biophysically detailed neuronal models: from molecules to networks (NEURON and NetPyNE)**  
*Room B5, 13/07/2019, 09:30 - 17:40*  
**Robert McDougal**, Yale University, USA  
**Salvador Dura-Bernal**, SUNY Downstate, USA  
**William Lytton**, SUNY Downstate, USA
- T3 Model-based analysis of brain connectivity from neuroimaging data: estimation, analysis and classification**  
*Room B2, 13/07/2019, 09:30 - 17:40*  
**Andrea Insabato**, Universidad de Valencia, Spain  
**Adrià Trauste-Campo**, BarcelonaBeta, Spain  
**Matthieu Gilson**, Universitat Pompeu Fabra, Barcelona, Spain  
**Gorka Zamora-López**, Universitat Pompeu Fabra, Barcelona, Spain
- T4 Simulating Multiple Interacting Neural Populations using Population Density Techniques (using MIIND)**  
*Room B6, 13/07/2019, 09:30 - 17:40*  
**Hugh Osborne**, University of Leeds, UK  
**Marc De Kamps**, University of Leeds, UK  
**Lukas Deutz**, University of Leeds, UK
- T5 Simulating dendrites at different levels of abstraction**  
*Room B7, 13/07/2019, 09:30 - 17:40*  
**Everton J. Agnes**, University of Oxford, UK  
**Spyridon Chavlis**, FORTH, Greece  
**Athanasia Papoutsis**, FORTH, Greece  
**William F. Podlaski**, University of Oxford, UK
- T6 Field theory of neuronal networks**  
*Room B3, 13/07/2019, 09:30 - 17:40*  
**Moritz Helias**, Jülich Research Centre and JARA, Germany  
**David Dahmen**, Jülich Research Centre and JARA, Germany  
**Andrea Crisanti**, University La Sapienza, Italy

- T7 Introduction to high-performance neurocomputing**  
*Room T1, 13/07/2019, 09:30 - 17:40*  
**Tadashi Yamazaki**, RIKEN, Japan  
**Jun Igarashi**, RIKEN, Japan
- T8 Biophysical modeling of extracellular potentials (using LFPy)**  
*Room T2, 13/07/2019, 14:30 - 17:40*  
**Gaute T. Einevoll**, Norwegian University of Life Sciences & University of Oslo, Norway  
**Espen Hagen**, University of Oslo, Norway
- T9 Modeling neural systems in MATLAB using the DynaSim Toolbox**  
*Cancelled,*  
**Jason Sherfey**, MIT, USA
- T10 Design and sensitivity analysis of neural models (using PyRates and pygpc)**  
*Room S1, 13/07/2019, 9:30 - 12:40*  
**Richard Gast**, MPI for Human Cognitive and Brain Sciences, Germany  
**Konstantin Weise**, TU Ilmenau, Germany  
**Daniel Rose**, MPI for Human Cognitive and Brain Sciences, Germany  
**Thomas R. Knösche**, MPI for Human Cognitive and Brain Sciences and TU Ilmenau, Germany

# Meeting Schedule

## Saturday July 13

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### Tutorials

8:30 – 18:00	<b>Registration (Main Vestibule)</b>
9:30 – 10:40	<b>Tutorials (UB Meeting Rooms)</b>
10:40 – 11:10	<b>Break</b>
11:10 – 12:40	<b>Tutorials</b>
12:40 – 14:30	<b>Lunch Break</b>
14:30 – 16:00	<b>Tutorials</b>
16:00 – 16:30	<b>Break</b>
16:30 – 17:30	<b>Tutorials</b>

### Main Conference

17:50 – 18:00	<b>Welcome and Announcements (Paranymph)</b>
18:00 – 19:00 K1	<b>Keynote 1:</b> <i>Brain networks, adolescence and schizophrenia</i> Ed Bullmore
19:00 – 21:00	<b>Welcome Reception/Registration (Central Garden)</b>

## Sunday July 14

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### Main Conference

8:30 – 18:00	<b>Registration (Main Vestibule)</b>
9:30 – 9:40	<b>Announcements (Paranymph)</b>
9:40 – 10:40 K2	<b>Keynote 2:</b> <i>Neural Circuits for Mental Simulation</i> Kenji Doya
10:40 – 11:10	<b>Break</b>



### Oral Session I: Large Scale Networks

- 11:10 – 11:40 F1 **Featured Oral 1:**  
***The geometry of abstraction in hippocampus and pre-frontal cortex***  
Silvia Bernardi, Marcus K. Benna\*, Mattia Rigotti, Jérôme Munuera, Stefano Fusi, and C. Daniel Salzman
- 11:40 – 12:00 O1 ***Representations of Dissociated Shape and Category in Deep Convolutional Neural Networks and Human Visual Cortex***  
Astrid Zeman\*, J Brendan Ritchie, Stefania Bracci, and Hans Op De Beeck
- 12:00 – 12:20 O2 ***Discovering The Building Blocks of Hearing: A Data-Driven, Neuro-Inspired Approach***  
Lotte Weerts, Claudia Clopath, and Dan Goodman\*
- 12:20 – 12:40 O3 ***Modeling stroke and rehabilitation in mice using large-scale brain networks***  
Spase Petkoski\*, Anna Letizia Allegra Mascarò, Francesco Saverio Pavone, and Viktor Jirsa
- 12:40 – 14:30 **Lunch Break**

### Oral Session II: Network Structure and Dynamics

- 14:30 – 15:00 F2 **Featured Oral 1:**  
***Signatures of network structure in timescales of spontaneous activity***  
Roxana Zeraati\*, Nicholas Steinmetz, Tirin Moore, Tatiana Engel, and Anna Levina
- 15:00 – 15:20 O4 ***Self-Consistent Correlations of Randomly Coupled Rotators in the Asynchronous State***  
Alexander van Meegen\*, Benjamin Lindner
- 15:20 – 15:40 O5 ***Firing rate-dependent phase responses dynamically regulate Purkinje cell network oscillations***  
Yunliang Zang\*, Erik De Schutter
- 15:40 – 16:00 O6 ***Computational modeling of brainstem-spinal circuits controlling locomotor speed and gait***  
Ilya Rybak\*, Jessica Ausborn, Simon Danner, and Natalia Shevtsova
- 16:00 – 16:30 **Break**

### Oral Session III: Vision

- 16:30 – 16:50 O7 ***Co-refinement of network interactions and neural response properties in visual cortex***  
Sigrid Trägenap\*, Bettina Hein, David Whitney, Gordon Smith, David Fitzpatrick, and Matthias Kaschube
- 16:50 – 17:10 O8 ***Receptive Field Structure of Border Ownership-selective Cells in Response to Direction of Figure***  
Ko Sakai\*, Kazunao Tanaka, Rudiger von der Heydt, and Ernst Niebur
- 17:10 – 17:30 O9 ***Development of periodic and salt-and-pepper orientation maps from a common retinal origin***  
Min Song\*, Jaeson Jang, and Se-Bum Paik
- 17:30 – 20:20 **Poster Session 1 (Posters 1 – 120) (Main Vestibule)**

20:20 – 21:00	<b>Break (Time Allocated for Travel to Dinner)</b>
21:00 – 23:30	<b>CNS Banquet (El Cangrejo Loco, Port Olímpic, 30, Moll de Gregal, 29, 08005 Barcelona, Spain)</b>

## Monday July 15

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### Main Conference

8:30 – 18:00	<b>Registration (Main Vestibule)</b>
9:30 – 9:40	<b>Announcements (Paranymph)</b>
9:40 – 10:40 K3	<b>Keynote 3:</b> <i>One network, many states: varying the excitability of the cerebral cortex</i> Maria V. Sanchez-Vives
10:40 – 11:10	<b>Break</b>

### Oral Session IV: Cognition

11:10 – 11:40 F3	<b>Featured Oral 3:</b> <i>Internal bias controls phasic but not delay-period dopamine activity in a parametric working memory task</i> Néstor Parga*, Stefania Sarno, Manuel Beiran, José Vergara, Román Rossi-Pool, and Ranulfo Romo
11:40 – 12:00 O10	<i>Explaining the pitch of FM-sweeps with a predictive hierarchical model</i> Alejandro Tabas*, Katharina Von Kriegstein
12:00 – 12:20 O11	<i>Effects of anesthesia on coordinated neuronal activity and information processing in rat primary visual cortex</i> Heonsoo Lee*, Shiyong Wang, and Anthony Hudetz
12:20 – 12:40 O12	<i>Learning where to look: a foveated visuomotor control model</i> Emmanuel Daucé*, Pierre Albigès, and Laurent Perrinet
12:40 – 14:30	<b>Lunch Break</b>

### Oral Session V: Cells and circuits

14:30 – 14:50 O13	<i>A standardised formalism for voltage-gated ion channel models</i> Chaitanya Chintaluri, Bill Podlaski*, Pedro Goncalves, Jan-Matthis Lueckmann, Jakob H. Macke, and Tim P. Vogels
14:50 – 15:10 O14	<i>A priori identifiability of a binomial synapse</i> Camille Gontier*, Jean-Pascal Pfister
15:10 – 15:30 O15	<i>A flexible, fast and systematic method to obtain reduced compartmental models.</i> Willem Wybo*, Walter Senn

- 15:30 – 15:50 O16 ***An exact firing rate model reveals the differential effects of chemical versus electrical synapses in spiking networks***  
Ernest Montbriô, Alex Roxin\*, Federico Devalle, Bastian Pietras, and Andreas Daffertshofer
- 15:50 – 16:20 **Break**
- Oral Session VI: Data analysis**
- 16:20 – 16:40 O17 ***Graph-filtered temporal dictionary learning for calcium imaging analysis***  
Gal Mishne\*, Benjamin Scott, Stephan Thiberge, Nathan Cermak, Jackie Schiller, Carlos Brody, David W. Tank, and Adam Charles
- 16:40 – 17:00 O18 ***Drift-resistant, real-time spike sorting based on anatomical similarity for high channel-count silicon probes***  
James Jun\*, Jeremy Magland, Catalin Mitelut, and Alex Barnett
- 17:00 – 19:40 **Poster Session II (Posters 121 – 240) (Main Vestibule)**
- 19:40 – 21:00 **Break (Time Allocated for Dinner and Travel to Party)**
- 21:00 – 01:30 **CNS Party (Bambœ Beach Bar, Ronda Litoral, s/n, 08005 Barcelona, Spain)**

## Tuesday July 16

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### **Mixed Day**

- 8:30 – 18:00 **Registration (Main Vestibule)**
- 9:30 – 13:10 **Workshop Session 1 (UB Meeting Rooms)**
- 13:10 – 14:50 **Lunch Break**
- 14:50 – 15:50 K4 **Keynote 4: (Paranymph)**  
***Neural circuits for flexible memory and navigation***  
Ila Fiete
- 15:50 – 16:20 **Break**
- 16:20 – 17:20 **OCNS members' meeting**
- 17:20 – 20:00 **Poster Session III (Posters 241 – 360) (Main Vestibule)**

## Wednesday July 17

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### Workshops (UB Meeting Rooms)

8:30 – 18:00	<b>Registration (Main Vestibule)</b>
9:30 – 13:10	<b>Workshop Session 2 (UB Meeting Rooms)</b>
13:10 – 14:50	<b>Lunch Break</b>
14:50 – 18:40	<b>Workshop Session 3</b>

# Workshops and Organizers

- W1**    **Methods of Information Theory in Computational Neuroscience**  
*Paranymph, Tue 9:30 to 13:10 and Wed 9:30 to 18:30*  
**Lubomir Kostal**, Czech Academy of Sciences  
**Joseph T. Lizier**, The University of Sydney  
**Viola Priesemann**, Max Planck Institute for Dynamics & Self-organization, Goettingen  
**Justin Dauwels**, Nanyang Technological University  
**Taro Toyozumi**, RIKEN Center for Brain Science  
**Michael Wibral**, University of Goettingen  
**Adria Tauste**, BarcelonaBeta Brain Research Center
- W2**    **The dynamics and limitations of working memory**  
*Room B7, Tue 9:30 to 13:10 and Wed 9:30 to 18:30*  
**Zachary Kilpatrick**, University of Colorado Boulder  
**Albert Compte**, Institut d'investigacions Biomèdiques August Pi i Sunyer
- W3**    **Workshop on generative connectomics and plasticity**  
*Room S1 (Tue), Rooms S1 and S5 (Wed), Tue 9:30 to 13:10 and Wed 9:30 to 18:30*  
**Alexander Peyser**, Research Centre Jülich  
**Wouter Klijn**, Research Centre Jülich  
**Sandra Diaz**, Research Centre Jülich
- W4**    **Emergent Phenomena in Macroscopic Neural Networks**  
*Aula Magna, Tue 9:30 to 13:10 and Wed 9:30 to 18:30*  
**Joana Cabral**, Department of Psychiatry, University of Oxford  
**Jeremie Lefebvre**, Krembil Research Institute, Toronto
- W5**    **New Perspectives in Cortical Dynamics**  
*Room B5, Tue 9:30 to 13:10 and Wed 9:30 to 18:30*  
**David Hansel**, CNRS, France  
**Nicholas Priebe**, University of Texas at Austin  
**Carl van Vreeswijk**, CNRS, France
- W6**    **Neuronal Oscillations: mechanisms, computational properties and functionality**  
*Aula Capella, Wed 9:30 to 18:30*  
**Adrien Peyrache**, McGill University, Canada  
**Vassilis Cutsuridis**, University of Lincoln, UK  
**Horacio G. Rotstein**, NJIT / Rutgers University, USA

- W7 Dynamics of Rhythm Generation: Role of Ionic Pumps, Exchangers, and Ion Homeostasis**  
*Room B6 (Tue), Room B3 (Wed), Tue 9:30 to 13:10 and Wed 14:50 to 18:30*  
Ronald Calabrese, Emory University, Atlanta  
Gennady Cymbalyuk, Georgia State University, Atlanta
- W8 Modelling sequential biases in perceptual decisions**  
*Room S3, Wed 9:30 to 18:30*  
Alexandre Hyafil, Universitat Pompeu Fabra, Barcelona  
Jaime De La Rocha, Idibaps, Barcelona
- W9 Neural Multiplexed Coding, Coexistence of Multimodal Coding Strategies in Neural Systems**  
*Room S4, Wed 9:30 to 18:30*  
Milad Lankarany, Krembil Research Institute, Toronto  
Steven A. Prescott, The Hospital for Sick Children, Toronto
- W10 Olfaction – the complex sense**  
*Room S2, Tue 9:30 to 13:10 and Wed 9:30 to 13:10*  
Maxim Bazhenov, University of California, San Diego  
Mario Pannunzi, University of Sussex, UK
- W11 Dopaminergic Signaling Workshop**  
*Room B1, Tue 9:30 to 13:10 and Wed 9:30 to 13:10*  
Carmen Canavier, LSU Health Science Center, New Orleans
- W12 Diversity and function of interneurons**  
*Room T1 (Tue), Room T2 (Wed), Tue 9:30 to 13:10 and Wed 14:50 to 18:30*  
Luis Garcia Del Molino, New York University  
Jorge Jaramillo, New York University  
Jorge Mejias, University of Amsterdam
- W13 Integrative Theories of Cortical Function**  
*Room T1, Wed 9:30 to 18:30*  
Hamish Meffin, The University of Melbourne  
Anthony Burkitt, The University of Melbourne  
Ali Almasi, National Vision Research Institute of Australia
- W14 Graph modeling of macroscopic brain activity**  
*Room T2, Tue 9:30 to 13:10 and Wed 9:30 to 13:10*  
Ashish Raj, University of California San Francisco  
Eva Palacios, University of California San Francisco  
Pratik Mukherjee, University of California San Francisco

- W15 Manifolds for neural computation**  
*Room B3, Tue 9:30 to 13:10 and Wed 9:30 to 13:10*  
Matthew G. Perich, University of Geneva  
Juan A. Gallego, Spanish National Research Council (CSIC), Madrid  
Sara A. Solla, Northwestern University, Chicago
- W16 Functional network dynamics: Recent mathematical perspectives**  
*Room B2, Wed 9:30 to 18:30*  
Mathieu Gilson, Universitat Pompeu Fabra, Barcelona  
David Dahmen, Research Centre Jülich  
Moritz Helias, Research Centre Jülich
- W17 Computational modelling of brain networks in Electroencephalography**  
*Room B6, Wed 9:30 to 18:30*  
Benedetta Franceschiello, Lausanne University Hospital  
Katharina Glomb, Lausanne University Hospital
- W18 VirtualBrainCloud**  
*Room S3 (Tue), Room S2 (Wed), Tue 9:30 to 13:10 and Wed 14:50 to 18:30*  
Petra Ritter, Charité-Universitätsmedizin Berlin  
Julie Coutiol, Charité-Universitätsmedizin Berlin
- W19 Model-Driven Closed-Loop Technologies for Neuroscience Research**  
*Room S4 (Tue), Room B1 (Wed), Tue 9:30 to 13:10 and Wed 14:50 to 18:30*  
Pablo Varona, Universidad Autónoma de Madrid  
Thomas Nowotny, University of Sussex, UK
- W20 Phase Transitions in Brain Networks**  
*Room B2, Tue 9:30 to 13:10*  
Leonardo Gollo, QIMR Berghofer Medical Research Institute, Australia  
Linda Douw, Amsterdam UMC Medical Center
- W21 Modeling astrocyte functions: From ion channels to calcium dynamics and beyond**  
*Room S5, Tue 9:30 to 13:10*  
Marja-Leena Linne, Tampere University, Finland  
Predrag Janjic, Macedonian Academy of Sciences and Arts, Skopje
- W22 Student and Postdoc Career Development Workshop**  
*Aula Capella, Tue 9:30 to 13:10*  
Ankur Sinha, University of Hertfordshire, UK  
Anca Doloc-Mihu, Georgia Gwinnett College, USA  
Sharmila Venugopal, University of California Los Angeles

# **Abstracts**



# Tutorials

## T1 Introduction to the simulation of structurally detailed large-scale neuronal networks (NEST)

Room B1, 13/07/2019, 09:30 - 17:40

**Alexander van Meegen**, Jülich Research Centre and JARA, Germany

**Dennis Terhorst**, Jülich Research Centre and JARA, Germany

The tutorial starts with a brief demonstration of a real-world example, followed by two hands-on parts: the first introduces the respective software tools and the second combines them to cover major steps of the research process. The show case is the construction and simulation of a structurally detailed large-scale network model [1,2,3] in a collaborative and reproducible fashion. To this end, a simulation engine is combined with modern tools for the digital representation of workflows. The first hands-on part provides introductions to the tools used throughout the workflow, i.e. the NEural Simulation Toolkit NEST [4], the development platform GitHub in the context of modeling and the workflow management system snakemake [5]. The second part of the tutorial continues the hands-on work and brings the tools together to construct a simplified workflow following the introductory example. More explicitly, we will

- set up a snakemake-based workflow from the underlying anatomical data to visualizations of the simulation results.
- embed NEST into the workflow to enable large-scale simulations.
- prepare the workflow to be executed on a high performance computing system.

Finally, more advanced features of NEST are demonstrated: The NEST Modeling Language [6], rate-based neuron models [7] and recent advances in the simulation technology [8]. This video (<https://youtu.be/YsH3BcyZBcU>) gives an impression on what you will be able to do in your own research after attending the tutorial. The tutorial does not assume any prior knowledge of NEST, git or snakemake. For the hands-on parts, it is recommended that participants have a GitHub account and a Linux/Mac based environment available, ideally with a running NEST installation [9]. Nevertheless, participation is also possible without engaging in hands-on activities by following the live presentations only.

## References

- [1] Schmidt M, Bakker R, Hilgetag CC, Diesmann M, van Albada SJ (2018) Multi-scale account of the network structure of macaque visual cortex. *Brain Struct. Func.* 223(3):1409-1435
- [2] Schmidt M, Bakker R, Shen K, Bezgin G, Diesmann M, van Albada SJ (2018) A multi-scale layer-resolved spiking network model of resting-state dynamics in macaque visual cortical areas. *PLOS CB* 14(10):e1006359
- [3] <https://inm-6.github.io/multi-area-model/>
- [4] Linssen, Charl et al. (2018) NEST 2.16.0. Zenodo. <https://doi.org/10.5281/zenodo.1400174>
- [5] Köster J, Rahmann S (2012) Snakemake - A scalable bioinformatics workflow engine. *Bioinformatics* 28(19):2520-2522
- [6] Plotnikov D, Rumpel B, Blundell I, Ippen T, Eppler JM, Morrison A (2016) "NESTML: a modeling language for spiking neurons." In *Modellierung 2016*, March 2-4 2016, Karlsruhe, Germany. 93–108. doi:10.5281/zenodo.1412345
- [7] Hahne J, Dahmen D, Schuecker J, Frommer A, Bolten M, Helias M, Diesmann M (2017) Integration of continuous time dynamics in a spiking neural network simulator. *Front. Neuroinform* 11:34
- [8] Jordan J, Ippen T, Helias M, Kitayama I, Sato M, Igarashi J, Diesmann M, Kunkel S (2018) Extremely scalable spiking neuronal network simulation code: from laptops to exascale computers. *Front. Neuroinform* 12:2
- [9] <http://www.nest-simulator.org/installation/>

## **T2 Building biophysically detailed neuronal models: from molecules to networks (NEURON and NetPyNE)**

*Room B5, 13/07/2019, 09:30 - 17:40*

**Robert McDougal**, Yale University, USA

**Salvador Dura-Bernal**, SUNY Downstate, USA

**William Lytton**, SUNY Downstate, USA

This tutorial discusses implementing biophysically detailed models of neuronal processes across multiple spatial scales. We begin by exploring ModelDB ([modeldb.yale.edu](http://modeldb.yale.edu)), a discovery and exploration tool for computational neuroscience models, to see the breadth of existing models, to graphically explore their structure, to run models, and to extract components for reuse. We then introduce NEURON ([neuron.yale.edu](http://neuron.yale.edu)), a Python (e.g. [anaconda.com](http://anaconda.com)) scriptable neuroscience simulation environment.

The bulk of the tutorial consists of alternating periods of background, NEURON syntax, examples, and hands on exercises covering the implementation of models at four key scales: (1) intracellular dynamics (e.g. calcium buffering, protein interactions), (2) single neuron electrophysiology (e.g. action potential propagation), (3) neurons in extracellular space (e.g. spreading depression), and (4) networks of neurons. For network simulations, we will use NetPyNE ([netpyne.org](http://netpyne.org)), a high-level interface to NEURON supporting both programmatic and GUI specification that facilitates the development, parallel simulation, and analysis of biophysically detailed neuronal networks. We conclude with an example exploring the role of intracellular dynamics in shaping network activity.

Basic familiarity with Python is recommended. No prior knowledge of NEURON or NetPyNE is required, however participants are encouraged to download and install each of these packages prior to the tutorial.

### **References**

[1] NEURON: <https://neuron.yale.edu/>

[2] NetPyNE: [www.netpyne.org](http://www.netpyne.org)

[3] NetPyNE-UI: <https://github.com/MetaCell/NetPyNE-UI>

### **T3 Model-based analysis of brain connectivity from neuroimaging data: estimation, analysis and classification**

*Room B2, 13/07/2019, 09:30 - 17:40*

**Andrea Insabato**, Universidad de Valencia, Spain

**Adrià Trauste-Campo**, BarcelonaBeta, Spain

**Matthieu Gilson**, Universitat Pompeu Fabra, Barcelona, Spain

**Gorka Zamora-López**, Universitat Pompeu Fabra, Barcelona, Spain

Brain connectivity analysis has become central in nowadays neuroscience. We propose a systematic overview of the abundance of methods in this ever-growing field. This is necessary to answer questions like “how should I pick an appropriate connectivity measure for this type of experimental data?” or “how should I interpret the outcomes of my connectivity analysis?”, which are not usually addressed by textbooks or papers.

In this one-day tutorial we will offer a guide to navigate through the main concepts and methods of this field, including hands-on coding exercises. The morning session will be devoted to theory and concepts. We will focus on (i) time series analysis methods to estimate connectivity from BOLD fMRI data (extension to other types of data is possible), (ii) network theory to describe and analyze estimated networks and (iii) machine learning techniques to relate connectivity to cognitive states (e.g. tasks performed by subjects) or to pathological states (e.g. Alzheimer’s disease or MCI). Theory and concepts will be presented along with simple code examples. The afternoon session will comprise of a hands-on session, focusing on the applications of the reviewed connectivity methods to fMRI data. All code examples and exercises will be in Python using Jupyter notebooks, extending the existing framework [1] to incorporate recent developments [2].

#### **References**

- [1] [http://github.com/MatthieuGilson/WBLEC\\_toolbox](http://github.com/MatthieuGilson/WBLEC_toolbox)
- [2] Gilson M, Zamora-López G, Pallarés V, Adhikari MH, Senden M, Tauste Campo A, Mantini D, Corbetta M, Deco G, and Insabato A (bioRxiv) "MOU-EC: model-based whole-brain effective connectivity to extract biomarkers for brain dynamics from fMRI data and study distributed cognition"; doi:10.1101/531830
- [3] Lütkepohl, H. (2005). New introduction to multiple time series analysis. Springer Science and Business Media.
- [4] Murphy, K. P. (2012). Machine Learning: a Probabilistic Perspective. MIT Press.
- [5] Wasserman, S. and Faust, K. (1999). Social network analysis: Methods and Applications. Cambridge University Press.

## **T4 Simulating Multiple Interacting Neural Populations using Population Density Techniques (using MIIND)**

*Room B6, 13/07/2019, 09:30 - 17:40*

**Hugh Osborne**, University of Leeds, UK

**Marc De Kamps**, University of Leeds, UK

**Lukas Deutz**, University of Leeds, UK

Neural behaviour at the largest of scales is often modelled using mean rate based techniques which use a small number of variables and fitted parameters to capture the dynamics of a population of neurons. This is both time efficient and an appropriate level of complexity to answer many questions about brain dynamics. However, sometimes it is desirable to be able to relate the population behaviour to the behaviour of its constituent neurons and most rate based techniques do not do this rigorously. Population Density Techniques [1-3] are a rigorous method for taking an individual point neuron model and simulating the dynamics of a population, without the need to simulate individual cells. These methods have been shown to replicate firing rates accurately, compared to direct spike-based simulations, even for small populations [1,2]. In this tutorial we start with presenting the theory of PDTs, their strengths and weaknesses.

Then we present MIIND [4], a neural simulation platform designed for modelling the interactions between multiple populations of neurons. Unlike other PDT systems like DIPDE [5], MIIND uses a two dimensional geometric population density technique [6,7]. We will introduce this technique and guide participants through setting up individual neural populations. To solidify their understanding, they may then familiarise themselves with the simulation and analysis workflow and produce movies of each population as it develops over time in the neuron model's state space. This foundation will pave the way towards modelling a large scale network of populations using MIIND's XML style language. Such simulations can run on a single PC for smaller networks and for larger ones on a GPGPU device or a cluster. We will make an Ubuntu Docker available so that participants can follow the demonstration on their own laptop.

If you have a simulation you wish to try to adapt to a population density approach, we would be happy to give advice.

MIIND source code and documentation : <https://github.com/dekamps/miind>

MIIND prepackaged download and written tutorial : <http://miind.sourceforge.net/>

MIIND Docker Image (dockerhub) : [hughosborne/miind](https://hub.docker.com/r/hughosborne/miind)

Example population movie :

[https://drive.google.com/open?id=1CxXZwGbzysZDNMQVSzL\\_02PvsxetY4](https://drive.google.com/open?id=1CxXZwGbzysZDNMQVSzL_02PvsxetY4)

### **References**

- [1] Omurtag, A., Knight, B.W. and Sirovich, L., 2000. On the simulation of large populations of neurons. *Journal of computational neuroscience* , 8 (1), pp.51-63
- [2] de Kamps M (2003) A simple and stable numerical solution for the population density equation. *Neural Computation* , 15 (9), pp. 2129-2146
- [3] Baladron J, Fasoli D, Faugeras O, Touboul J. Mean-field description and propagation of chaos in networks of Hodgkin-Huxley and FitzHugh-Nagumo neurons. *The Journal of Mathematical Neuroscience*. 2012;2(1):10
- [4] de Kamps M, Baier V, Drever J, Dietz M, Mosenlechner L, and van der Velde F (2008) The state of MIIND. *NEURAL NETWORKS* , 21 (8), pp. 1164-1181
- [5] Website: © 2015 Allen Institute for Brain Science. DiPDE Simulator [Internet]. Available from: <https://github.com/AllenInstitute/dipde>
- [6] de Kamps, M., 2013. A generic approach to solving jump diffusion equations with applications to neural populations. arXiv preprint arXiv:1309.1654

[7] de Kamps, M., Elle Lepperød, M. and Lai, Y. M. 2019 Computational geometry for modeling neural populations: from visualization to simulation 2019, Accepted for publication by Plos CB, <https://www.biorxiv.org/content/10.1101/275412v5>

## **T5 Simulating dendrites at different levels of abstraction**

*Room B7, 13/07/2019, 09:30 - 17:40*

**Everton J. Agnes**, University of Oxford, UK

**Spyridon Chavlis**, FORTH, Greece

**Athanasia Papoutsis**, FORTH, Greece

**William F. Podlaski**, University of Oxford, UK

Dendritic computations are the result of the complex interactions between active ion channel conductances, morphology and synaptic dynamics. Although many of the functional properties of dendrites have been explored, their complete characterization is inaccessible with current experimental techniques. Complementary to experimental work, modeling tools can provide a framework for understanding the relationship between dendritic physiology and function at the single neuron and network level. In this tutorial, we will focus on the exploration of dendritic dynamics at different levels of abstraction. We will begin with detailed modeling, presenting the fundamentals of the passive and active properties of dendrites, and then move towards more phenomenological models which abstract away much of the detail while keeping the key features of dendritic processing intact. Throughout, we will make reference to relevant tools available in the field, including the ICGenealogy database for neuronal ion channel models, the NEURON simulator for detailed multi-compartmental modeling, and the BRIAN simulator for simulating abstract networks of neurons.

The proposed outline of the tutorial is as follows:

### 1 Details of dendritic computations

1a Passive properties, synaptic dynamics, and ion channels. Demonstration on how to model the kinetics of ion channels (e.g., Hodgkin-Huxley, other voltage-dependent and calcium-dependent currents, and AMPA and NMDA receptor dynamics), and fitting to experimental data. Demonstration of ICGenealogy as a tool for ion channel model discovery and comparison.

1b NEURON platform. Exploration of mod files; simulations that show basic dendritic computations. Brief discussion of model sharing platforms such as NeuroMorpho, ModelDB and OpenSourceBrain.

### 2 Simplifying dendritic dynamics

2a BRIAN platform. Implementation of dendritic compartments, ion channels (as 1a) and simulator functionality.

2b Simplified dendrites. Exploration of phenomenological single compartment dynamics that reproduce complex dendritic properties.

2c Networks of simplified neurons. Building computationally efficient networks with single neurons outlined in 1a, 1b, 2a, and 2b.

The tutorial will incorporate mathematical descriptions and hands-on simulations.

## **References**

- [1] Stuart, G, Spruston, N and Hausser, M (2008). Dendrites. Oxford Univ. Press
- [2] Gerstner, W, Kistler, W M, Naud, R and Paninski, L (2014). Neuronal dynamics: From single neurons to networks and models of cognition. Cambridge Univ. Press
- [3] ICGenealogy: <https://icg.neurotheory.ox.ac.uk/>
- [4] Python tutorial (basic) <https://docs.python.org/2/tutorial/>
- [5] BRIAN tutorial <https://brian.readthedocs.io/en/1.4.3/tutorials.html>
- [6] NEURON tutorial [http://web.mit.edu/neuron\\_v7.4/nrntuthtml/index.html](http://web.mit.edu/neuron_v7.4/nrntuthtml/index.html)

## T6 Field theory of neuronal networks

Room B3, 13/07/2019, 09:30 - 17:40

Moritz Helias, Jülich Research Centre and JARA, Germany

David Dahmen, Jülich Research Centre and JARA, Germany

Andrea Crisanti, University La Sapienza, Italy

Neural networks of the brain form one of the most complex systems we know. Many qualitative features of the emerging collective phenomena, such as correlated activity, stability, response to inputs, chaotic and regular behavior, can, however, be understood in simple models that are accessible with tools from statistical physics.

This tutorial is an introduction into the methods behind contemporary developments in the theory of large neural networks. Starting from very basic principles of moments and cumulants of scalar quantities and their generating functions, we introduce the notion of path integrals for dynamic variables and present systematic derivations of low-dimensional self-consistency equations for the statistics of activities in disordered neural networks. These methods not only reproduce results of heuristic mean-field approaches, but also yield systematic recipes to the analysis of stability and finite size corrections. We further show that the same field theoretical language allows systematic coarse-graining of neural network models in space and time to bridge multiple spatio-temporal scales. Finally, we turn the view from activities to connections and present Gardner's theory of connections that illustrates that the aforementioned techniques for network dynamics can be used to evaluate the functional performance of feed-forward neural networks in binary classification tasks.

Various techniques, such as path integrals, disorder averages, Lyapunov exponents, replica theory, renormalization group methods etc, are shown with example applications to combine the theory construct with modern neuroscientific questions on memory capacity, criticality and chaos, as well as diversity of dynamics.

This tutorial does not require background knowledge of statistical physics.

### References

- [1] Helias, Dahmen (2019) Statistical field theory for neural networks, arXiv <http://arxiv.org/abs/1901.10416>
- [2] Sompolinsky, Crisanti, Sommers (1988) Chaos in Random Neural Networks, Phys Rev Lett <https://link.aps.org/doi/10.1103/PhysRevLett.61.1318>
- [3] Crisanti, Sompolinsky (2018) Path Integral Approach to Random Neural Networks, Phys Rev E [10.1103/PhysRevE.98.062120](https://doi.org/10.1103/PhysRevE.98.062120)
- [4] Dahmen, Grün, Diesmann, Helias (2018) Two types of criticality in the brain, arXiv <https://arxiv.org/abs/1711.10930>

## **T7 Introduction to high-performance neurocomputing**

*Room T1, 13/07/2019, 09:30 - 17:40*

**Tadashi Yamazaki**, RIKEN, Japan

**Jun Igarashi**, RIKEN, Japan

Computational power of supercomputers is steadily increasing year by year, and is expected to reach at 1 exaflops in 202X. High-performance computing (HPC) is the use of supercomputers and parallel computing techniques to solve complex computational problems. Software tools in computational neuroscience such as NEURON and NEST simulators harness some of the unprecedented computational power of supercomputers. Nevertheless, it would still be desirable to have low-level programming skills in C language with the knowledge of parallel computing libraries such as OpenMP, MPI, and CUDA to customize existing tools for better performance and build new tools for novel purposes. Moreover, such skills will be useful for spike-based neuromorphic computing.

In this tutorial, we will introduce various parallel computing techniques for large-scale neural network simulations. We will start with a single spiking neuron simulation, and build a network of the neurons known as Brunel's balanced network. We will give a short lecture on numerical methods to solve ordinary differential equations as well. Then, we will parallelize the network simulations using various techniques including OpenMP, MPI, CUDA, and OpenCL. We will measure the computational time and confirm how these techniques accelerate the numerical simulations.

This is a hands-on tutorial. The audiences must bring their laptop computers to log into cluster machines in the lecturers' lab via ssh. Therefore, the audiences are expected to have basic programming skills in C and experience on Linux and ssh.

This tutorial is supported by MEXT Post-K Exploratory Challenge Number 4, MEXT Grant-in-Aid for High-Performance Computing with General Purpose Computers (Research and Development in the Next-Generation Area, Large-Scale Computational Sciences with Heterogeneous Many-Core Computers), and NEDO Next Generation AI and Robot Core Technology Development.

### **References**

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## **T8 Biophysical modeling of extracellular potentials (using LFPy)**

*Room T2, 13/07/2019, 14:30 - 17:40*

**Gaute T. Einevoll**, Norwegian University of Life Sciences & University of Oslo, Norway

**Espen Hagen**, University of Oslo, Norway

While extracellular electrical recordings have been one of the main workhorses in electrophysiology, the interpretation of such recordings is not trivial [1,2,3], as the measured signals result of both local and remote neuronal activity. The recorded extracellular potentials in general stem from a complicated sum of contributions from all transmembrane currents of the neurons in the vicinity of the electrode contact. The duration of spikes, the extracellular signatures of neuronal action potentials, is so short that the high-frequency part of the recorded signal, the multi-unit activity (MUA), often can be sorted into spiking contributions from the individual neurons surrounding the electrode [4]. No such simplifying feature aids us in the interpretation of the low-frequency part, the local field potential (LFP). To take a full advantage of the new generation of silicon-based multielectrodes recording from tens, hundreds or thousands of positions simultaneously, we thus need to develop new data analysis methods and models grounded in the biophysics of extracellular potentials [1,3]. This is the topic of the present tutorial.

In the tutorial we will go through the biophysics of extracellular recordings in the brain, a scheme for biophysically detailed modeling of extracellular potentials and the application to modeling single spikes [5], MUAs [6] and LFPs, both from single neurons [7] and populations of neurons [8], LFPy (LFPy.rtd.io) [9], a versatile tool based on Python and the NEURON simulation environment [10] ([www.neuron.yale.edu](http://www.neuron.yale.edu)) for calculation of extracellular potentials around neurons and networks of neurons, as well as corresponding electroencephalography (EEG) and magnetoencephalography (MEG) signals.

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- [10] ML Hines et al., Front Neuroinf 3:1 (2009)

## **T9 Modeling neural systems in MATLAB using the DynaSim Toolbox**

*Cancelled,*

**Jason Sherfey**, MIT, USA

This tutorial will help participants implement and explore neural models in MATLAB. It will include an introduction to neural modeling, hands-on exercises, and a hackathon where participants can work together with tool developers to implement models that are relevant to their research. The tutorial will focus on using DynaSim, which is an open-source MATLAB/GNU Octave Toolbox for rapid prototyping of neural models and batch simulation management. The tutorial will show how models can be built and explored using either MATLAB scripts or the DynaSim graphical interface, the latter being especially useful as a teaching tool and for those with limited experience with mathematics or programming. The hands-on exercises will demonstrate how DynaSim can be used to rapidly explore the dynamics of multi-compartment neurons, spike-timing-dependent plasticity in neural circuits, and systems of interacting networks during a simulated cognitive task. They will show further how to optimize simulations with DynaSim using a combination of code compilation and parallel computing. The exercises will be followed by a hackathon where participants will be able to further explore DynaSim features using models from the exercises or implement their custom models with assistance from the developers of DynaSim.

The tutorial does not assume any prior experience with DynaSim. However, it is recommended that participants install MATLAB on their laptops beforehand.

### **References**

[1] Software tools: <http://dynasimtoolbox.org>

[2] Sherfey, Jason S., et al. "DynaSim: A MATLAB Toolbox for Neural Modeling and Simulation." *Frontiers in Neuroinformatics* 12 (2018): 10

## T10 Design and sensitivity analysis of neural models (using PyRates and pygpc)

Room S1, 13/07/2019, 9:30 - 12:40

**Richard Gast**, MPI for Human Cognitive and Brain Sciences, Germany

**Konstantin Weise**, TU Ilmenau, Germany

**Daniel Rose**, MPI for Human Cognitive and Brain Sciences, Germany

**Thomas R. Knösche**, MPI for Human Cognitive and Brain Sciences and TU Ilmenau, Germany

Efficient software solutions for building and analyzing neural models are of tremendous value to the field of computational neuroscience. In this tutorial, we will introduce two open source Python tools that allow for a generic model definition, parallelized exploration of model parameter spaces and analysis of model uncertainties and sensitivities. On the one hand, PyRates [1] provides an intuitive user interface to define computational models at various spatial scales and simulate their behavior via a powerful, tensorflow-based backend [2]. On the other hand, Pygpc [3], allows for the quantification of model sensitivities and uncertainties to changes in their parameters via a non-intrusive generalized polynomial chaos (gPC) expansion [4]. Consequently, the tutorial will be split into two parts. We will start the first part by giving a theoretical introduction to neural population models. Next, we will teach participants how to implement such models in PyRates and extend them to neural networks with different spatial scales. We will then investigate the complex dependency of a models' behavior on its multidimensional parameter space and demonstrate the difficulty to analyze model sensitivities in such spaces. In the second part, we will introduce the gPC as an efficient solution for quantifying model sensitivities. We will showcase how the gPC can be coupled with the previously implemented population models and how it can be used to identify their most influential parameters. To this end, we will go through a hands-on example of a sensitivity analysis using PyRates and Pygpc. At the end of the tutorial, participants will have gained an understanding of a) neural population models, b) how to implement them in PyRates, c) how the complex relationship between model behavior and parametrization can be approximated via a GPC expansion and e) how a GPC-based model sensitivity analysis can be implemented in Pygpc.

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- [4] Saturnino, G. B., Thielscher, A., Madsen, K. H., Knoesche, T. R., and Weise, K. (2018). "A principled approach to conductivity uncertainty analysis in electric field calculations." NeuroImage (in press). DOI:10.1016/j.neuroimage.2018.12.053.



# Invited Presentations



**Ed Bullmore** *Professor of Neuroscience,  
Head of Department,  
Department of Psychiatry,  
Behavioural and Clinical Neuroscience Institute,  
University of Cambridge,  
Cambridge, UK*

## **K1 – Brain networks, adolescence and schizophrenia**

The adolescent transition from childhood to young adulthood is an important phase of human brain development and a period of increased risk for incidence of psychotic disorders. I will review some of the recent neuroimaging discoveries concerning adolescent development, focusing on an accelerated longitudinal study of 300 healthy young people (aged 14-25 years) each scanned twice using MRI. Structural MRI, including putative markers of myelination, indicates changes in local anatomy and connectivity of association cortical network hubs during adolescence. Functional MRI indicates strengthening of initially weak connectivity of subcortical nuclei and association cortex. I will also discuss the relationships between intra-cortical myelination, brain networks and anatomical patterns of expression of risk genes for schizophrenia.



**Kenji Doya** Professor,  
*Okinawa Institute of Science and Technology  
Graduate University,  
Okinawa, Japan*

## **K2 – Neural Circuits for Mental Simulation**

The basic process of decision making is often explained by learning of values of possible actions by reinforcement learning. In our daily life, however, we rarely rely on pure trial-and-error and utilize any prior knowledge about the world to imagine what situation will happen before taking an action. How such “mental simulation” is implemented by neural circuits and how they are regulated to avoid delusion are exciting new topics of neuroscience. Here I report our works with functional MRI in humans and two-photon imaging in mice to clarify how action-dependent state transition models are learned and utilized in the brain.



***Maria V. Sanchez-Vives*** *ICREA Research Professor,  
Institut d'Investigacions Biomediques  
August Pi i Sunyer (IDIBAPS),  
Universitat de Barcelona,  
Barcelona, Spain*

### **K3 – One network, many states: varying the excitability of the cerebral cortex**

In the transition from deep sleep, anesthesia or coma states to wakefulness, there are profound changes in cortical interactions both in the temporal and the spatial domains. In a state of low excitability, the cortical network, both in vivo and in vitro, expresses its “default activity pattern”, slow oscillations (Sanchez-Vives et al, Neuron, 94: 993, 2017), a state of low complexity and high synchronization. Understanding the multiscale mechanisms that enable the emergence of complex brain dynamics associated with wakefulness and cognition while departing from low-complexity, highly synchronized states such as sleep, is key to the development of reliable monitors of brain state transitions and consciousness levels during physiological and pathological states. In this presentation I will discuss different experimental and computational approaches aimed at unraveling how the complexity of activity patterns emerges in the cortical network as it transitions across different brain states. Strategies such as varying anesthesia levels or sleep/awake transitions in vivo, or progressive variations in excitability by variable ionic levels, GABAergic antagonists, potassium blockers or electric fields in vitro, reveal some of the common features of these different cortical states, the gradual or abrupt transitions between them, and the emergence of dynamical richness, providing hints as to the underlying mechanisms.



**Ila Fiete** *Associate Investigator, McGovern Institute  
Associate Professor, Brain and Cognitive Sciences  
MIT,  
Cambridge, MA, USA*

#### **K4 – Neural circuits for flexible memory and navigation**

I will discuss the problems of memory and navigation from a computational and functional perspective: What is difficult about these problems, which features of the neural circuit architecture and dynamics enable their solutions, and how the neural solutions are uniquely robust, flexible, and efficient.





# Contributed Talks

## **F1 The geometry of abstraction in hippocampus and pre-frontal cortex**

Silvia Bernardi, Marcus K. Benna\*, Mattia Rigotti, Jérôme Munuera, Stefano Fusi, and C. Daniel Salzman

Abstraction can be defined as a cognitive process that finds a common feature - an abstract variable, or concept - shared by a number of examples. Knowledge of an abstract variable enables generalization to new examples based upon old ones. Neuronal ensembles could represent abstract variables by discarding all information about specific examples, but this allows for representation of only one variable. Here we show how to construct neural representations that encode multiple abstract variables simultaneously, and we characterize their geometry. Representations conforming to this geometry were observed in dorsolateral pre-frontal cortex, anterior cingulate cortex, and the hippocampus in monkeys performing a serial reversal-learning task. These neural representations allow for generalization, a signature of abstraction, and similar representations are observed in a simulated multi-layer neural network trained with back-propagation. These findings provide a novel framework for characterizing how different brain areas represent abstract variables, which is critical for flexible conceptual generalization and deductive reasoning.

## F2 Signatures of network structure in timescales of spontaneous activity

Roxana Zeraati\*, Nicholas Steinmetz, Tirin Moore, Tatiana Engel, and Anna Levina

Cortical networks are spontaneously active. Timescales of these intrinsic fluctuations were suggested to reflect the network's specialization for task-relevant computations. However, how these timescales arise from the spatial network structure is unknown. Spontaneous cortical activity unfolds across different spatial scales. On a local scale of individual columns, ongoing activity spontaneously transitions between episodes of vigorous (On) and faint (Off) spiking, synchronously across cortical layers. On a wider spatial scale, activity propagates as cascades of elevated firing across many columns, characterized by the branching ratio defined as the average number of units activated by each active unit. We asked, to what extent the timescales of spontaneous activity reflect the dynamics on these two spatial scales and the underlying network structure. To this end, we developed a branching network model capable of capturing both the local On-Off dynamics and the global activity propagation. Each unit in the model represents a cortical column, which has spatially structured connections to other columns (Fig. 1A). The columns stochastically transition between On and Off states. Transitions to On-state are driven by stochastic external inputs and by excitatory inputs from the neighboring columns (horizontal recurrent input). An On state can persist due to a self-excitation representing strong recurrent connections within one column (vertical recurrent input). On and Off episode durations in our model follow exponential distributions, similar to the On-Off dynamics observed in single cortical columns (Fig. 1B). We fixed the statistics of On-Off transitions and the global propagation, and studied the dependence of intrinsic timescales on the network spatial structure. We found that the timescales of local dynamics reflect the spatial network structure. In the model, activity of single columns exhibits two distinct timescales: one induced by the recurrent excitation within the column and another induced by interactions between the columns (Fig. 1C). The first timescale dominates dynamics in networks with more dispersed connectivity (Fig. 1A, non-local; Fig. 1D), whereas the second timescale is prominent in networks with more local connectivity (Fig. 1A, local; Fig. 1D). Since neighboring columns share many of their recurrent inputs, the second timescale is also evident in cross-correlations (CC) between columns, and it becomes longer with increasing distance between columns.

To test the model predictions, we analyzed 16-channel microelectrode array recordings of spiking activity from single columns in the primate area V4. During spontaneous activity, we observed two distinct timescales in columnar On-Off fluctuations (Fig. 1E). Two timescales were also present in CCs of neural activity on different channels within the same column. To examine how timescales depend on horizontal cortical distance, we leveraged the fact that columnar recordings generally exhibit slight horizontal shifts due to variability in the penetration angle. As a surrogate for horizontal displacements between pairs of channels, we used distances between centers of their receptive fields (RF). As predicted by the model, the second timescale in CCs became longer with increasing RF-center distance. Our results suggest that timescales of local On-Off fluctuations in single cortical columns provide information about the underlying spatial network structure of the cortex.

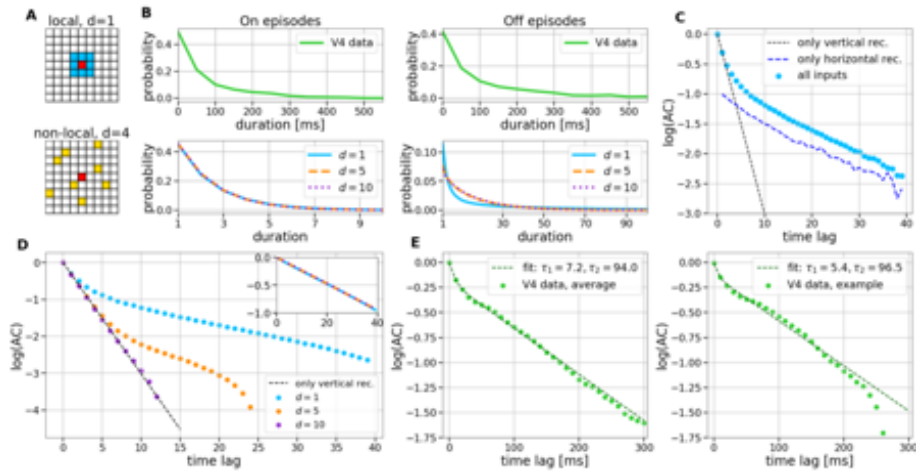


Figure 1: A) Schematic representation of the model local and non-local connectivity. B) Distributions of On-Off episode duration in V4 data and model. C) Representation of different timescales in single columns AC. D) Average AC of individual columns and the population activity (inset, with the same axes) for different network structures. E) V4 data AC averaged over all recordings, and an example recording.

### F3 Internal bias controls phasic but not delay-period dopamine activity in a parametric working memory task

Néstor Parga\*, Stefania Sarno, Manuel Beiran, José Vergara, Román Rossi-Pool, and Ranulfo Romo

Dopamine (DA) has been implied in coding reward prediction errors (RPEs) and in several other phenomena such as working memory and motivation to work for reward. Under uncertain stimulation conditions DA phasic responses to relevant task cues reflect cortical perceptual decision-making processes, such as the certainty about stimulus detection and evidence accumulation, in a way compatible with the RPE hypothesis [1,2]. This suggests that the midbrain DA system receives information from cortical circuits about decision formation and transforms it into a RPE signal. However, it is not clear how DA neurons behave when making a decision involves more demanding cognitive features, such as working memory and internal biases, or how they reflect motivation under uncertain conditions. To advance knowledge on these issues we have recorded and analyzed the firing activity of putatively midbrain DA neurons, while monkeys discriminated the frequencies of two vibrotactile stimuli delivered to one fingertip. This two-interval forced choice task, in which both stimuli were selected randomly in each trial, has been widely used to investigate perception, working memory and decision-making in sensory and frontal areas [3]; the current study adds to this scenario possible roles of midbrain DA neurons. We found that the DA responses to the stimuli were not monotonically tuned to their frequency values. Instead they were controlled by an internally generated bias (contraction bias). This bias induced a subjective difficulty that modulated those responses as well as the accuracy and the response times (RTs). A Bayesian model for the choice explained the bias and gave a measure of the animal's decision confidence, which also appeared modulated by the bias. We also found that the DA activity was above baseline throughout the delay (working memory) period. Interestingly, this activity was neither tuned to the first frequency nor controlled by the internal bias. While the phasic responses to the task events could be described by a reinforcement learning model based on belief states, the ramping behavior exhibited during the delay period could not be explained by standard models. Finally, the DA responses to the stimuli in short-RT trials and long-RTs trials were significantly different; interpreting the RTs as a measure of motivation, our analysis indicated that motivation affected strongly the responses to the task events but had only a weak influence on the DA activity during the delay interval. To summarize, our results show for the first time that an internal phenomenon (the bias) can control the DA phasic activity similar to the way physical differences in external stimuli do. We also encountered a ramping DA activity during the working memory period, independent of the memorized frequency value. Overall, our study supports the notion that delay and phasic DA activities accomplish quite different functions.

### References

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## O1 Representations of Dissociated Shape and Category in Deep Convolutional Neural Networks and Human Visual Cortex

Astrid Zeman\*, J Brendan Ritchie, Stefania Bracci, and Hans Op De Beeck

Deep Convolutional Neural Networks (CNNs) excel at object recognition and classification, with accuracy levels that now exceed humans [1]. In addition, CNNs also represent clusters of object similarity, such as the animate-inanimate division that is evident in object-selective areas of human visual cortex [2]. CNNs are trained using natural images, which contain shape and category information that is often highly correlated [3]. Due to this potential confound, it is therefore possible that CNNs rely upon shape information, rather than category, to classify objects. We investigate this possibility by quantifying the representational correlations of shape and category along the layers of multiple CNNs, with human behavioural ratings of these two factors, using two datasets that explicitly orthogonalise shape from category [3, 4]. We analyse shape and category representations along the human ventral pathway areas using fMRI and measure correlations between artificial with biological representations by comparing the output from CNN layers with fMRI activation in ventral areas.

First, we find that CNNs encode object category independently from shape, which peaks at the final fully connected layer for all network architectures. At the initial layer of all CNNs, shape is represented significantly above chance in the majority of cases (94%), whereas category is not. Category information only increases above the significance level in the final few layers of all networks, reaching a maximum at the final layer after remaining low for the majority of layers. Second, by using fMRI to analyse shape and category representations along the ventral pathway, we find that shape information decreases from early visual cortex (V1) to the anterior portion of ventral temporal cortex (VTC). Conversely, category information increases from low to high from V1 to anterior VTC. This two-way interaction is significant for both datasets, demonstrating that this effect is evident for both low-level (orientation dependent) and high-level (low vs high aspect ratio) definitions of shape. Third, comparing CNNs with brain areas, the highest correlation with anterior VTC occurs at the final layer of all networks. V1 correlations reach a maximum prior to fully connected layers, at early, mid or late layers, depending upon network depth. In all CNNs, the order of maximum correlations with neural data corresponds well with the flow of visual information along the visual pathway. Overall, our results suggest that CNNs represent category information independently from shape, similarly to human object recognition processing.

### References

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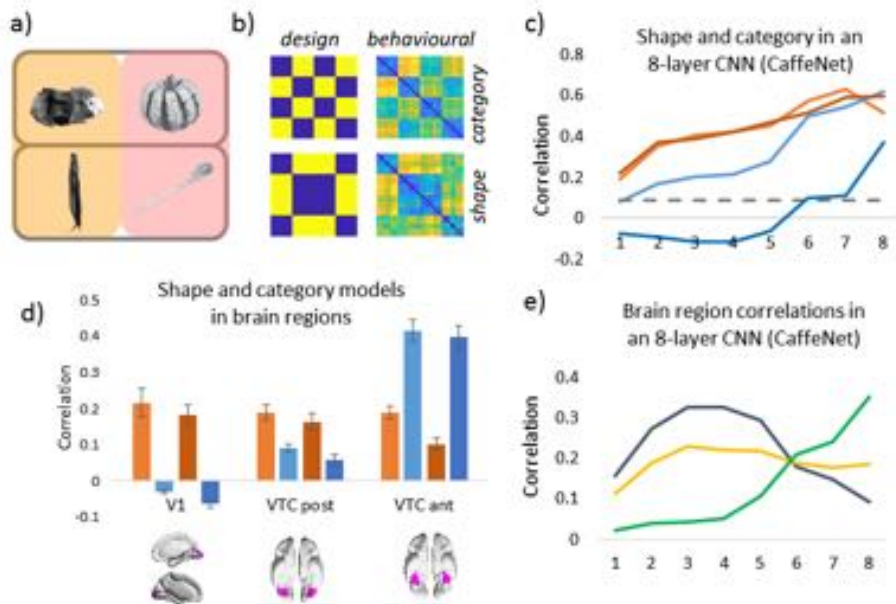


Figure 1: Figure 1. Shape and category models in CNNs vs the brain. a) Example stimuli. b) Design and behavioural models. c) Shape (orange) and category (blue) correlations in CNNs. Behavioural (darker) and design (lighter) models. Only one CNN shown. d) Shape (orange) and category (blue) correlations in ventral brain regions. e) V1 (blue), posterior (yellow) and anterior (green) VTC correlated with CNN layers.

## O2 Discovering The Building Blocks of Hearing: A Data-Driven, Neuro-Inspired Approach

Lotte Weerts, Claudia Clopath, and Dan Goodman\*

Our understanding of hearing and speech recognition rests on controlled experiments requiring simple stimuli. However, these stimuli often lack the variability and complexity characteristic of complex sounds such as speech. We propose an approach that combines neural modelling with data-driven machine learning to determine auditory features that are both theoretically powerful and can be extracted by networks that are compatible with known auditory physiology. Our approach bridges the gap between detailed neuronal models that capture specific auditory responses, and research on the statistics of real-world speech data and its relationship to speech recognition. Importantly, our model can capture a wide variety of well studied features using specific parameter choices, and allows us to unify several concepts from different areas of hearing research.

We introduce a feature detection model with a modest number of parameters that is compatible with auditory physiology. We show that this model is capable of detecting a range of features such as amplitude modulations (AMs) and onsets. In order to objectively determine relevant feature detectors within our model parameter space, we use a simple classifier that approximates the information bottleneck, a principle grounded in information theory that can be used to define which features are “useful”. By analysing the performance in a classification task, our framework allows us to determine the best model parameters and their neurophysiological implications and relate those to psychoacoustic findings. We analyse the performance of a range of model variants in a phoneme classification task (Fig 1). Some variants improve accuracy compared to using the original signal, indicating that our feature detection model extracts useful information. By analysing the properties of high performing variants, we rediscover several proposed mechanisms for robust speech processing. Firstly, our result suggest that model variants that can detect and distinguish between formants are important for phoneme recognition. Secondly, we rediscover the importance of AM sensitivity for consonant recognition, which is in line with several experimental studies that show that consonant recognition is degraded when certain amplitude modulations are removed. Besides confirming well-known mechanisms, our analysis hints at other less-established ideas, such as the importance of onset suppression. Our results indicate that onset suppression can improve phoneme recognition, which is in line with the hypothesis that the suppression of onset noise (or “spectral splatter”), as observed in the mammalian auditory brainstem, can improve the clarity of a neural harmonic representation. We also discover

model variants that are responsive to more complex features, such as combined onset and AM sensitivity. Finally, we show how our approach lends itself to be extended to more complex environments, by distorting the clean speech signal with noise.

Our approach has various potential applications. Firstly, it could lead to new, testable experimental hypotheses for understanding hearing. Moreover, promising features could be directly applied as a new acoustic front-end for speech recognition systems.

**Acknowledgments** This work was partly supported by a Titan Xp donated by the NVIDIA Corporation, The Royal Society grant RG170298 and the Engineering and Physical Sciences Research Council (grant number EP/L016737/1).

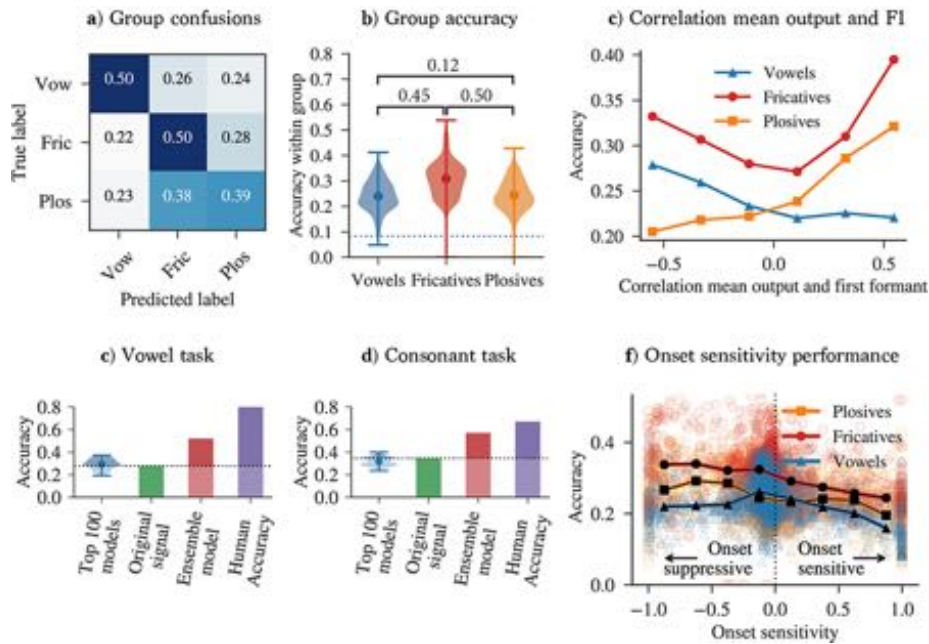


Figure 1: a) between-group confusion matrix for best parameters. b) distribution of within-group accuracies and between-group accuracy correlations. c) Within-group accuracy and correlation of model output and spectral peaks. d,e) accuracy achieved with model variants, the original filtered signal, and ensemble models on a vowel (d) and consonant (e) task. f) Within-group accuracy versus onset strength.



### O3 Modeling stroke and rehabilitation in mice using large-scale brain networks

Spase Petkoski\*, Anna Letizia Allegra Mascaro, Francesco Saverio Pavone, and Viktor Jirsa

Individualized large-scale computational modeling of the dynamics associated with the brain pathologies [1] is an emerging approach in the clinical applications, which gets validation through animal models. A good candidate for confirmation of brain network causality is stroke and the subsequent recovery, which alter brain's structural connectivity, and this is then reflected on functional and behavioral level. In this study we use large-scale brain network model (BNM) to computationally validate the structural changes due to stroke and recovery in mice, and their impact on the resting state functional connectivity (FC), as captured by wide-field calcium imaging. We built our BNM based on the detailed Allen Mouse (AM) connectome that is implemented in The Virtual Mouse Brain [2]. It dictates the strength of the couplings between distant brain regions based on tracer data. The homogeneous local connectivity is absorbed into the neuronal mass model that is generally derived from mean activity of populations of spiking neurons, Fig. 1, and is here represented by the Kuramoto oscillators [3], as canonical model for network synchronization due to weak interactions. The photothrombotic focal stroke affects the right primary motor cortex (rM1). The injured forelimb is daily trained on a custom designed robotic device (M-Platform, [4,5]) from 5 days after the stroke for a total of 4 weeks. The stroke is modeled by different levels of damage of the links connecting rM1, while the recovery is represented by reinforcing of alternative connections of the nodes initially linked to it [6]. We systematically simulate various impacts of stroke and recovery, to find the best match with the coactivation patterns in the data, where the FC is characterized with the phase coherence calculated for the phases of Hilbert transformed delta frequency activity of pixels within separate regions [6]. Statistically significant changes within the FC of 5 animals are obtained for transitions between the three conditions: healthy, stroke and rehabilitation after 4 weeks of training, and these are compared with the best fits for each condition of the model in the parameter space of the global coupling strength and stroke impact and rewiring. This approach uncovers recovery paths in the parameter space of the dynamical system that can be related to neurophysiological quantities such as the white matter tracts. This can lead to better strategies for rehabilitation, such as stimulation or inhibition of certain regions and links that have a critical role on the dynamics of the recovery.

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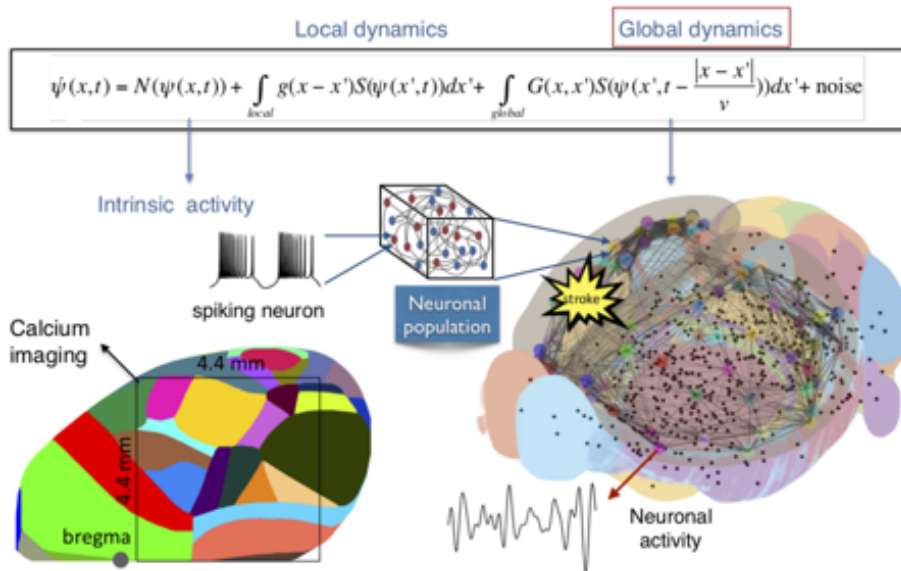


Figure 1: The equation of the mouse BNM shows that the spatiotemporal dynamics is shaped by the connectivity. The brain network (right) is reconstructed from the AMA, showing the centers of sub cortical (small black dots) and cortical (colored circles) regions. On the left, the field of view during the recordings is overlaid on the reconstructed brain, and different colors represent the cortical regions.

#### O4 Self-Consistent Correlations of Randomly Coupled Rotators in the Asynchronous State

Alexander van Meegen\*, Benjamin Lindner

Spiking activity of cortical neurons in behaving animals is highly irregular and asynchronous. The quasi stochastic activity (the network noise) does not seem to root in the comparatively weak intrinsic noise sources but is most likely due to the nonlinear chaotic interactions in the network. Consequently, simple models of spiking neurons display similar states, the theoretical description of which has turned out to be notoriously difficult. In particular, calculating the neuron's correlation function is still an open problem. One classical approach pioneered in the seminal work of Sompolinsky et al. [1] used analytically tractable rate units to obtain a self-consistent theory of the network fluctuations and the correlation function of the single unit in the asynchronous irregular state. Recently, the original model attracted renewed interest, leading to substantial extensions and a wide range of novel results [2-5].

Here, we develop a theory for a heterogeneous random network of unidirectionally coupled phase oscillators [6]. Similar to Sompolinsky's rate-unit model, the system can attain an asynchronous state with pronounced temporal autocorrelations of the units. The model can be examined analytically and even allows for closed-form solutions in simple cases. Furthermore, with a small extension, it can mimic mean-driven networks of spiking neurons and the theory can be extended to this case accordingly.

Specifically, we derived a differential equation for the self-consistent autocorrelation function of the network noise and of the single oscillators. Its numerical solution has been confirmed by simulations of sparsely connected networks (Fig. 1). Explicit expressions for correlation functions and power spectra for the case of a homogeneous network (identical oscillators) can be obtained in the limits of weak or strong coupling strength. To apply the model to networks of sparsely coupled excitatory and inhibitory exponential integrate-and-fire (IF) neurons, we extended the coupling function and derived a second differential equation for the self-consistent autocorrelations. Deep in the mean-driven regime of the spiking network, our theory is in excellent agreement with simulations results of the sparse network.

This work paves the way for more detailed studies of how the statistics of connection strength, the heterogeneity of network parameters, and the form of the interaction function shape the network noise and the autocorrelations

of the single element in asynchronous irregular state.

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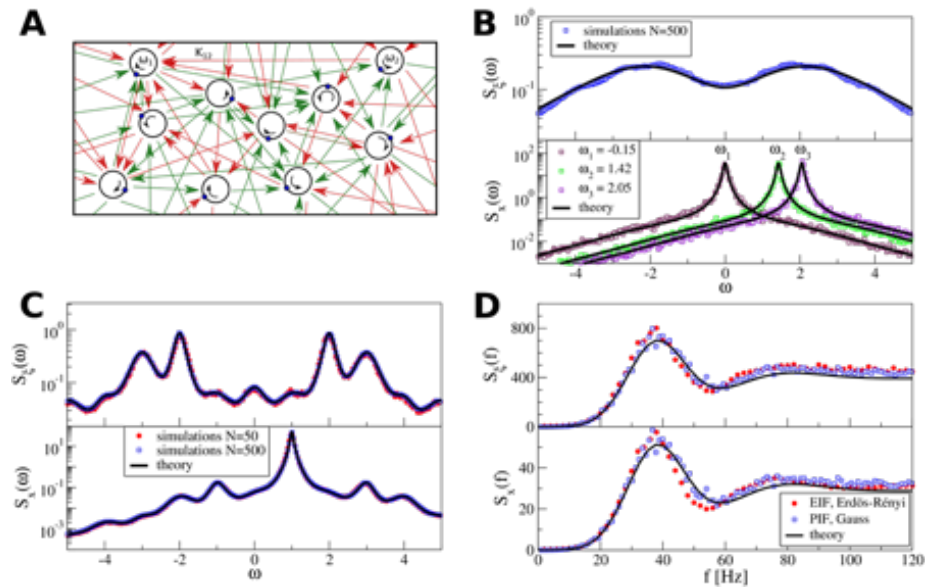


Figure 1: Sketch of a random network of phase oscillators (A). Self-consistent power spectra of network noise and single units (B-D, upper and lower plots respectively) obtained from simulations (colored symbols) compared with the theory (black lines): Heterogeneous (B) and homogeneous (C) networks of phase oscillators, and sparsely coupled IF networks (D). Panels B-D adapted and modified from [6].

## O5 Firing rate-dependent phase responses dynamically regulate Purkinje cell network oscillations

Yunliang Zang\*, Erik De Schutter

Phase response curves (PRCs) have been defined to quantify how a weak stimulus shift the next spike timing in regular firing neurons. However, the biophysical mechanisms that shape the PRC profiles are poorly understood. The PRCs in Purkinje cells (PCs) show firing rate (FR) adaptation. At low FRs, the responses are small and phase independent. At high FRs, the responses become phase dependent at later phases, with their onset phases gradually left-shifted and peaks gradually increased, due to an unknown mechanism [1, 2]. Using our recently developed compartment-based PC model [3], we reproduced the FR-dependence of PRCs and identified the depolarized interspike membrane potential as the mechanism underlying the transition from phase-independent responses at low FRs to the gradually left-shifted phase-dependent responses at high FRs. We also demonstrated this mechanism plays a general role in shaping PRC profiles in other neurons. PC axon collaterals have been proposed to correlate temporal spiking in PC ensembles [4, 5], but whether and how they interact with the FR-dependent PRCs to regulate PC output remains unexplored. We built a recurrent inhibitory PC-to-PC network model to examine how FR-dependent PRCs regulate the synchrony of high frequency (160 Hz) oscillations observed in vivo [4]. We find the synchrony of these oscillations increases with FR due to larger and broader PRCs at high FRs. This increased synchrony still holds when the network incorporates dynamically and heterogeneously changing cellular FRs. Our work implies that FR-dependent PRCs may be a critical property of the cerebellar cortex in combining rate- and synchrony-coding to dynamically organize its temporal output.

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## O6 Computational modeling of brainstem-spinal circuits controlling locomotor speed and gait

Ilya Rybak\*, Jessica Ausborn, Simon Danner, and Natalia Shevtsova

Locomotion is an essential motor activity allowing animals to survive in complex environments. Depending on the environmental context and current needs quadruped animals can switch locomotor behavior from slow left-right alternating gaits, such as walk and trot (typical for exploration), to higher-speed synchronous gaits, such as gallop and bound (specific for escape behavior). At the spinal cord level, the locomotor gait is controlled by interactions between four central rhythm generators (RGs) located on the left and right sides of the lumbar and cervical enlargements of the cord, each producing rhythmic activity controlling one limb. The activities of the RGs are coordinated by commissural interneurons (CINs), projecting across the midline to the contralateral side of the cord, and long propriospinal neurons (LPNs), connecting the cervical and lumbar circuits. At the brainstem level, locomotor behavior and gaits are controlled by two major brainstem nuclei: the cuneiform (CnF) and the pedunculopontine (PPN) nuclei [1]. Glutamatergic neurons in both nuclei contribute to the control of slow alternating-gait movements, whereas only activation of CnF can elicit high-speed synchronous-gait locomotion. Neurons from both regions project to the spinal cord via descending reticulospinal tracts from the lateral paragigantocellular nuclei (LPGi) [2].

To investigate the brainstem control of spinal circuits involved in the slow exploratory and fast escape locomotion, we built a computational model of the brainstem-spinal circuits controlling these locomotor behaviors. The spinal cord circuits in the model included four RGs (one per limb) interacting via cervical and lumbar CINs and LPNs. The brainstem model incorporated bilaterally interacting CnF and PPN circuits projecting to the LPGi nuclei that mediated the descending pathways to the spinal cord. These pathways provided excitation of all RGs to control locomotor frequency and inhibited selected CINs and LPNs, which allowed the model to reproduce the speed-dependent gait transitions observed in intact mice and the loss of particular gaits in mutants lacking some genetically identified CINs [3]. The proposed structure of synaptic inputs of the descending (LPGi) pathways to the spinal CINs and LPNs allowed the model to reproduce the experimentally observed effects of stimulation of excitatory and inhibitory neurons within CnF, PPN, and LPGi. This suggests explanations for (a) the speed-dependent expression of different locomotor gaits and the role of different CINs and LPNs in gait transitions, (b) the involvement of the CnF and PPN nuclei in the control of low-speed alternating-gait locomotion and the specific role of the CnF in the control of high-speed synchronous-gait locomotion, and (c) the role of inhibitory neurons in these areas in slowing down and stopping locomotion. The model provides important insights into the brainstem-spinal cord interactions and the brainstem control of locomotor speed and gaits.

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## **O7 Co-refinement of network interactions and neural response properties in visual cortex**

Sigrid Trägenap\*, Bettina Hein, David Whitney, Gordon Smith, David Fitzpatrick, and Matthias Kaschube

In the mature visual cortex, local tuning properties are linked through distributed network interactions with a remarkable degree of specificity [1]. However, it remains unknown whether the tight linkage between functional tuning and network structure is an intrinsic feature of cortical circuits, or instead gradually emerges in development. Combining virally-mediated expression of GCAMP6s in pyramidal neurons with wide-field epifluorescence imaging in ferret visual cortex, we longitudinally monitored the spontaneous activity correlation structure - our proxy for intrinsic network interactions - and the emergence of orientation tuning around eye-opening. We find that prior to eye-opening, the layout of emerging iso-orientation domains is only weakly similar to the spontaneous correlation structure. Nonetheless within one week of visual experience, the layout of iso-orientation domains and the spontaneous correlation structure become rapidly matched. Motivated by these observations, we developed dynamical equations to describe how tuning and network correlations co-refine to become matched with age. Here we propose an objective function capturing the degree of consistency between orientation tuning and network correlations. Then by gradient descent of this objective function, we derive dynamical equations that predict an interdependent refinement of orientation tuning and network correlations. To first approximation, these equations predict that correlated neurons become more similar in orientation tuning over time, while network correlations follow a relaxation process increasing the degree of self-consistency in their link to tuning properties. Empirically, we indeed observe a refinement with age in both orientation tuning and spontaneous correlations. Furthermore, we find that this framework can utilize early measurements of orientation tuning and correlation structure to predict aspects of the future refinement in orientation tuning and spontaneous correlations. We conclude that visual response properties and network interactions show a considerable degree of coordinated and interdependent refinement towards a self-consistent configuration in the developing visual cortex.

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## O8 Receptive Field Structure of Border Ownership-selective Cells in Response to Direction of Figure

Ko Sakai\*, Kazunao Tanaka, Rudiger von der Heydt, and Ernst Niebur

The responses of border ownership-selective cells (BOCs) have been reported to signal the direction of figure (DOF) along the contours in natural images with a variety of shapes and textures [1]. We examined the spatial structure of the optimal stimuli for BOCs in monkey visual cortical area V2 to determine the structure of the receptive field. We computed the spike triggered average (STA) from responses of the BOCs to natural images (JHU archive, <http://dx.doi.org/10.7281/T1C8276W>). To estimate the STA in response to figure-ground organization of natural images, we tagged figure regions with luminance contrast. The left panel in Figure 1 illustrates the procedure for STA computation. We first aligned all images to a given cell's preferred orientation and preferred direction of figure. We then grouped the images based on the luminance contrast of their figure regions with respect to their ground regions, and averaged them separately for each group. By averaging the bright-figure stimuli with weights based on each cell's spike count, we were able to observe the optimal figure and ground sub-regions as brighter and darker regions, respectively. By averaging the dark-figure stimuli, we obtained the reverse. We then generated the STA by subtracting the average of the dark-figure stimuli from that of the bright-figure stimuli. This subtraction canceled out the dependence of response to contrast. We compensated for the bias due to the non-uniformity of luminance in the natural images by subtracting the simple ensemble average of the stimuli (equivalent to weight=1 for all stimuli) from the weighted average. The mean STA across 22 BOCs showed facilitated and suppressed sub-regions in response to the figure towards the preferred and non-preferred DOFs, respectively (Figure 1, the right panel). The structure was shown more clearly when figure and ground were replaced by a binary mask. The result demonstrates, for the first time, the antagonistic spatial structure in the receptive field of BOCs in response to figure-ground organization.

### Acknowledgment

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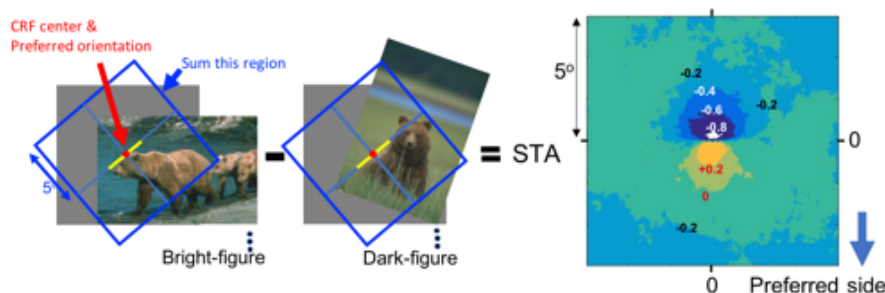


Figure 1: (Left) We tagged figure regions with luminance contrast to compute the STA in response to figure-ground organization. Natural images with bright foreground were weighted by the cell's spike counts and summed. The analogue was computed for scenes with dark foregrounds and the difference taken. (Right) The computed STA across 22 cells revealed antagonistic sub-regions.

## O9 Development of periodic and salt-and-pepper orientation maps from a common retinal origin

Min Song\*, Jaeson Jang, and Se-Bum Paik

Spatial organization of orientation tuning in the primary visual cortex (V1) is arranged in different forms across mammalian species. In some species (e.g. monkeys or cats), the preferred orientation continuously changes across the cortical surface (columnar orientation map), while other species (e.g. mice or rats) have a random-like distribution of orientation preference, termed salt-and-pepper organization. However, it still remains unclear why the organization of the cortical circuit develops differently across species. Previously, it was suggested that each type of circuit might be a result of wiring optimization under different conditions of evolution (Kaschube, 2014), but the developmental mechanism of each organization of orientation tuning still remains unclear. In this study, we propose that the structural variations between cortical circuits across species simply arise from the differences in physical constraints of the visual system – the size of the retina and V1. By expanding the statistical wiring model proposing that the orientation tuning of a V1 neuron is restricted by the local arrangement of ON and OFF retinal ganglion cells (RGCs) (Ringach, 2004, 2007), we suggest that the number of V1 neurons sampling a given RGC (sampling ratio) is a crucial factor in determining the continuity of orientation tuning in V1. Our simulation results show that as the sampling ratio increases, neighboring V1 neurons receive similar retinal inputs, resulting in continuous changes in orientation tuning. To validate our prediction, we estimated the sampling ratio of each species from the physical size of the retina and V1 and compared with the organization of orientation tuning. As predicted, this ratio could successfully distinguish diverse mammalian species into two groups according to the organization of orientation tuning, even though the organization has not been clearly predicted by considering only a single factor in the visual system (e.g. V1 size or visual acuity; Van Hooser et al., 2005). Our results suggest a common retinal origin of orientation preference across diverse mammalian species, while its spatial organization can vary depending on the physical constraints of the visual system.

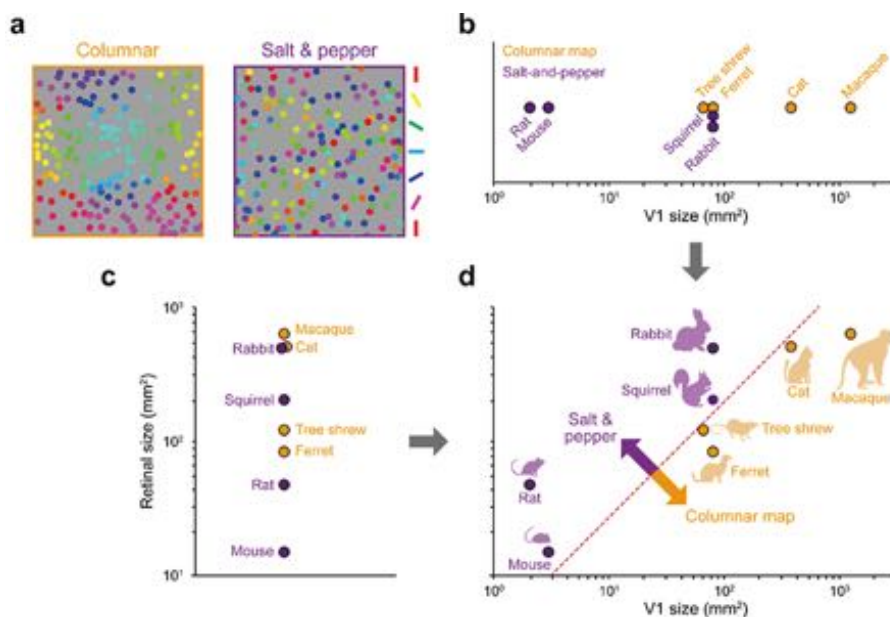


Figure 1: Organization of orientation tuning in a species could be predicted by V1/retinal size



## O10 Explaining the pitch of FM-sweeps with a predictive hierarchical model

Alejandro Tabas\*, Katharina Von Kriegstein

Frequency modulation (FM) is a basic constituent of vocalisation. FM-sweeps in the frequency range and modulation rates of speech have been shown to elicit a pitch percept that consistently deviates from the sweep average frequency [1]. Here, we use this perceptual effect to inform a model characterising the neural encoding of FM.

First, we performed a perceptual experiment where participants were asked to match the pitch of 30 sweeps with probe sinusoids of the same duration. The elicited pitch systematically deviated from the average frequency of the sweep by an amount that depended linearly on the modulation slope. Previous studies [2] have proposed that the deviance might be due to a fixed-sized-window integration process that fosters frequencies present at the end of the stimulus. To test this hypothesis, we conducted a second perceptual experiment considering the pitch elicited by continuous trains of five concatenated sweeps. As before, participants were asked to match the pitch of the sweep trains with probe sinusoids. Our results showed that the pitch deviance from the mean observed in sweeps was severely reduced in the train stimuli, in direct contradiction with the fixed-sized-integration-window hypothesis.

The perceptual effects may also stem from unexpected interactions between the frequencies spanned in the stimuli during pitch processing. We studied this possibility in two well-established families of mechanistic models of pitch. First, we considered a general spectral model that computes pitch as the expected value of the activity distribution across the cochlear decomposition. Due to adaptation effects, this model fostered the spectral range present at the beginning of the sweep: the exact opposite of what we observed in the experimental data. Second, we considered the predictions of the summary autocorrelation function (SACF) [3], a prototypical model of temporal pitch processing that considers the temporal structure of the auditory nerve activity. The SACF was unable to integrate temporal pitch information quickly enough to keep track of the modulation rate, yielding inconsistent pitch predictions that deviated stochastically from the average frequency.

Here, we introduce an alternative hypothesis based on top-down facilitation. Top-down efferents constitute an important fraction of the fibres in the auditory nerve; moreover, top-down predictive facilitation may reduce the metabolic cost and increase the speed of the neural encoding of expected inputs. Our model incorporates a second layer of neurons encoding FM direction that, after detecting that the incoming inputs are consistent with a rising (falling) sweep, anticipate that neurons encoding immediately higher (lower) frequencies will activate next. This prediction is propagated downwards to neurons encoding such frequencies, increasing their readiness and effectively inflating their weight during pitch temporal integration.

The described mechanism fully reproduces our and previously published experimental results (Fig 1). We conclude that top-down predictive modulation plays an important role in the neural encoding of frequency modulation even at early stages of the processing hierarchy.

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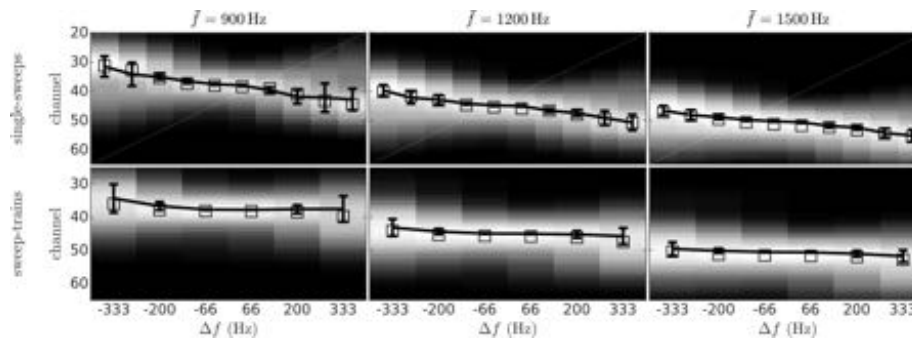


Figure 1: Heatmaps show the distribution of the activation across channels (y-axis) for different sweep frequency gaps (x-axis). Squares printed over the distributions mark the expected value with respect to the distribution. Solid error bars are estimations of the experimental results in the channel space.

## O11 Effects of anesthesia on coordinated neuronal activity and information processing in rat primary visual cortex

Heonsoo Lee\*, Shiyong Wang, and Anthony Hudetz

**Introduction** Understanding of how anesthesia affects neural activity is important to reveal the mechanism of loss and recovery of consciousness. Despite numerous studies during the past decade, how anesthesia alters spiking activity of different types of neurons and information processing within an intact neural network is not fully understood. Based on prior *in vitro* studies we hypothesized that excitatory and inhibitory neurons in neocortex are differentially affected by anesthetic. We also predicted that individual neurons are constrained to population activity, leading to impaired information processing within a neural network.

**Methods** We implanted sixty-four-contact microelectrode arrays in primary visual cortex (layer 5/6, contacts spanning 800  $\mu\text{m}$  depth and 1600  $\mu\text{m}$  width; Fig. 1B) for recording of extracellular unit activity at three steady-state levels of anesthesia (6, 4 and 2% desflurane) and wakefulness (Fig. 1A; number of rats = 8). Single unit activities were extracted and putative excitatory and inhibitory neurons were identified based on their spike waveforms and autocorrelogram characteristics (number of neurons = 210; Fig. 1C). Neuronal features such as firing rate, interspike interval (ISI), bimodality, and monosynaptic spike transmission probabilities were investigated. Normalized mutual information and transfer entropy were also applied to investigate the interaction between spike trains and population activity (local field potential; LFP).

**Results** First, anesthesia significantly altered characteristics of individual neurons. Firing rate of most neurons was reduced; this effect was more pronounced in inhibitory neurons. Excitatory neurons showed enhanced bursting activity ( $\text{ISI} < 9$  ms) and silent periods (hundreds of milliseconds), which resulted in a bimodal ISI distribution (Fig. 1D-E). Second, anesthesia disrupted information processing within a neural network. Neurons shared the silent periods, resulting in synchronous population activity (neural oscillations), despite of the suppressed monosynaptic connectivity (Fig. 1F). The population activity (LFP) showed reduced information content (entropy), and was easily predicted by individual neurons; that is, shared information between individual neurons and population activity was significantly increased (Fig. 1G). Transfer entropy analysis revealed a strong directional influence from LFP to individual neurons, suggesting that neuronal activity is constrained to the synchronous population activity (Fig. 1I).

**Conclusions** This study reveals how excitatory and inhibitory neurons are differentially affected by anesthetic, leading to synchronous population activity and impaired information processing. These findings provide an integrated understanding of anesthetic effects on neuronal activity and information processing. Further study of stimulus evoked activity and computational modeling will provide a more detailed mechanism of how anesthesia alters neural activity and disrupts information processing.

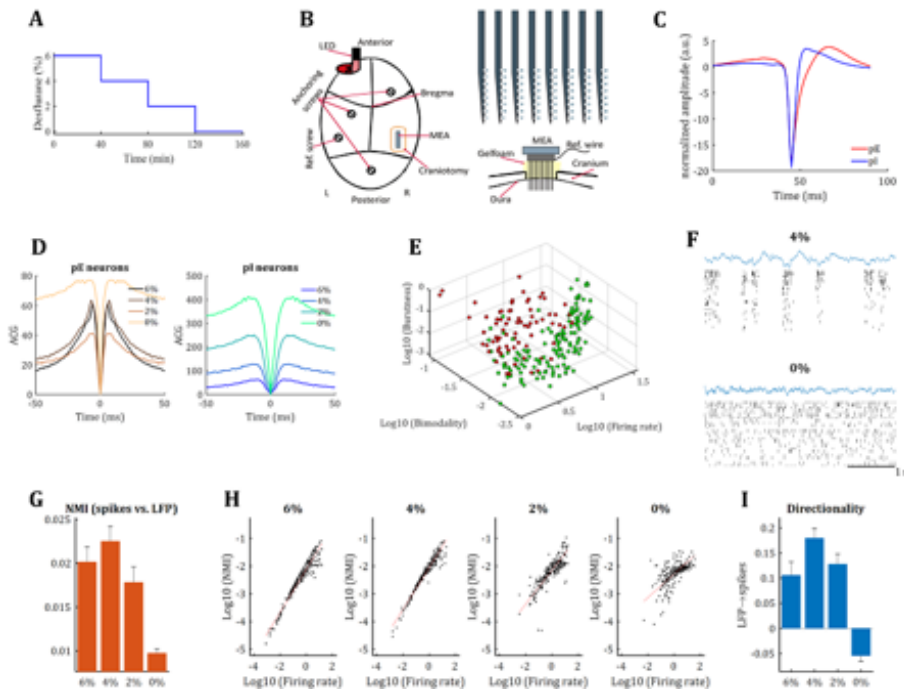


Figure 1: Fig. 1 (A) Experimental protocol (B) Microelectrode array implantation (C) Spike waveforms (D) Auto-correlograms (E) Three neuronal characteristics in anesthesia (red) and wakefulness (green) (F) Examples of LFP and spiking activity (G) Normalized mutual information (NMI) between individual spiking activity and LFP (H) Correlation between NMI and firing rate (I) Directionality of transfer entropy

## O12 Learning where to look: a foveated visuomotor control model

Emmanuel Dacé\*, Pierre Albigès, and Laurent Perrinet

We emulate a model of active vision which aims at finding a visual target whose position and identity are unknown. This generic visual search problem is of broad interest to machine learning, computer vision and robotics, but also to neuroscience, as it speaks to the mechanisms underlying foveation and more generally to low-level attention mechanisms. From a computer vision perspective, the problem is generally addressed by processing the different hypothesis (categories) at all possible spatial configuration through dedicated parallel hardware. The human visual system, however, seems to employ a different strategy, through a combination of a foveated sensor with the capacity of rapidly moving the center of fixation using saccades. Visual processing is done through fast and specialized pathways, one of which mainly conveying information about target position and speed in the peripheral space (the “where” pathway), the other mainly conveying information about the identity of the target (the “what” pathway). The combination of the two pathways is expected to provide most of the useful knowledge about the external visual scene. Still, it is unknown why such a separation exists. Active vision methods provide the ground principles of saccadic exploration, assuming the existence of a generative model from which both the target position and identity can be inferred through active sampling. Taking for granted that (i) the position and category of objects are independent and (ii) the visual sensor is foveated, we consider how to minimize the overall computational cost of finding a target. This justifies the design of two complementary processing pathways: first a classical image classifier, assuming that the gaze is on the object, and second a peripheral processing pathway learning to identify the position of a target in retinotopic coordinates. This framework was tested on a simple task of finding digits in a large, cluttered image (see figure 1). Results demonstrate the benefit of specifically learning where to look, and this before actually identifying the target category (with cluttered noise ensuring the category is not readable in the periphery). In the “what” pathway, the accuracy drops to the baseline at mere 5 pixels away from the center of fixation, while issuing a saccade is beneficial in up to 26 pixels around, allowing a much wider covering of the image. The difference between the two distributions forms an “accuracy gain”, that quantifies the benefit of issuing a saccade with respect to a central prior. Until the central classifier is confident, the system should thus perform a saccade to the most likely target position. The different accuracy predictions, such as the

ones done in the “what” and the “where” pathway, may also explain more elaborate decision making, such as the inhibition of return. The approach is also energy-efficient as it includes the strong compression rate performed by retina and V1 encoding, which is preserved up to the action selection level. The computational cost of this active inference strategy may thus be way less than that of a brute force framework. This provides evidence of the importance of identifying “putative interesting targets” first, and we highlight some possible extensions of our model both in computer vision and modeling.

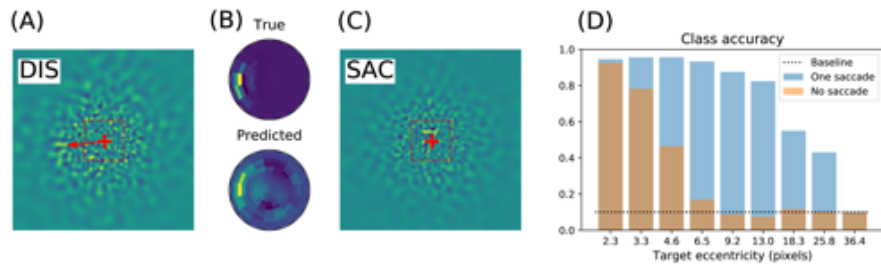


Figure 1: Simulated active vision agent: (A) Example retinotopic input. (B) Example network output (Predicted) compared with ground truth (True). (C) Accuracy estimation after saccade decision. (D) Orange bars: accuracy of a central classifier with respect to target eccentricity; Blue bars: classification rate after one saccade (1000 trials average per eccentricity scale).

### **O13 A standardised formalism for voltage-gated ion channel models**

Chaitanya Chintaluri, Bill Podlaski\*, Pedro Goncalves, Jan-Matthis Lueckmann, Jakob H. Macke, and Tim P. Vogels

Biophysical neuron modelling has become widespread in neuroscience research, with the combination of diverse ion channel kinetics and morphologies being used to explain various single-neuron properties. However, there is no standard by which ion channel models are constructed, making it very difficult to relate models to each other and to experimental data. The complexity and scale of these models also makes them especially susceptible to problems with reproducibility and reusability, especially when translating between different simulators. To address these issues, we revive the idea of a standardised model for ion channels based on a thermodynamic interpretation of the Hodgkin-Huxley formalism, and apply it to a recently curated database of approximately 2500 published ion channel models (ICGenealogy). We show that a standard formulation fits the steady-state and time-constant curves of nearly all voltage-gated models found in the database, and reproduces responses to voltage-clamp protocols with high fidelity, thus serving as a functional translation of the original models. We further test the correspondence of the standardised models in a realistic physiological setting by simulating the complex spiking behaviour of multi-compartmental single-neuron models in which one or several of the ion channel models are replaced by the corresponding best-fit standardised model. These simulations result in qualitatively similar behaviour, often nearly identical to the original models. Notably, when differences do arise, they likely reflect the fact that many of the models are very finely tuned. Overall, this standard formulation facilitates better understanding and comparisons among ion channel models, as well as reusability of models through easy functional translation between simulation languages. Additionally, our analysis allows for a direct comparison of models based on parameter settings, and can be used to make new observations about the space of ion channel kinetics across different ion channel subtypes, neuron types and species.

## O14 A priori identifiability of a binomial synapse

Camille Gontier\*, Jean-Pascal Pfister

Synapses are highly stochastic transmission units. A classical model describing this transmission is called the binomial model [1], which assumes that there are  $N$  independent release sites, each having the same release probability  $p$ ; and that each vesicle release gives rise to a quantal current  $q$ . The parameters of the binomial model ( $N$ ,  $p$ ,  $q$ , and the recording noise) can be estimated from postsynaptic responses, either by following a maximum-likelihood approach [2] or by computing the posterior distribution over the parameters [3]. But these estimates might be subject to parameter identifiability issues. This uncertainty of the parameter estimates is usually assessed a posteriori from recorded data, for instance by using re-sampling procedure such as parametric bootstrap. Here, we propose a methodology for a priori quantifying the structural identifiability of the parameters. A lower bound on the error of parameter estimates can be obtained analytically using the Cramer-Rao bound. Instead of simply assessing a posteriori the validity of their parameter estimates, it is thus possible for experimentalists to select a priori a lower bound on the standard deviation of the estimates and to select the number of data points and to tune the level of noise accordingly. Besides parameter identifiability, another critical issue is the so-called model identifiability, i.e. the possibility, given a certain number of data points  $T$  and a certain level of measurement noise, to find the model of synapse that fits our data the best. For instance, when observing discrete peaks on the histogram of post-synaptic currents, one might be tempted to conclude that the binomial model ("multi-quantal hypothesis") is the best one to fit the data. However, these peaks might actually be artifacts due to noisy or scarce data points, and data might be best explained by a simpler Gaussian distribution ("uni-quantal hypothesis"). Model selection tools are classically used to determine a posteriori which model is the best one to fit a data set, but little is known on the a priori possibility (in terms of number of data points or recording noise) to discriminate the binomial model against a simpler distribution. We compute an analytical identifiability domain for which the binomial model is correctly identified (Fig. 1), and we verify it by simulations. Our proposed methodology can be further extended and applied to other models of synaptic transmission, allowing to define and quantitatively assess a priori the experimental conditions to reliably fit the model parameters as well as to test hypotheses on the desired model compared to simpler versions. In conclusion, our approach aims at providing experimentalists objectives for experimental design on the required number of data points and on the maximally acceptable recording noise. This approach allows to optimize experimental design, draw more robust conclusions on the validity of the parameter estimates, and correctly validate hypotheses on the binomial model.

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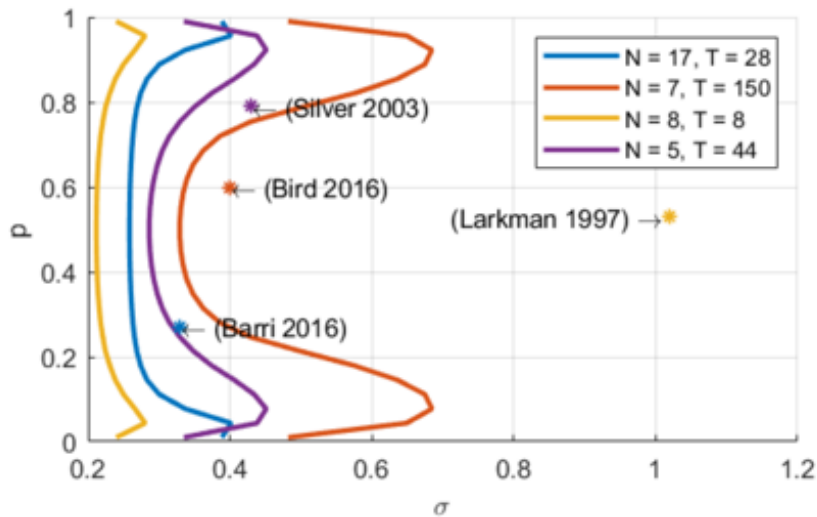


Figure 1: Published estimates of binomial parameters (dots), and corresponding identifiability domains (solid lines: the model is identifiable if, for a given release probability  $p$ , the recording noise does not exceed  $\sigma$ ). Applying our analysis to fitted parameters of the binomial model found in previous studies, we find that none of them are in the parameter range that would make the model identifiable.

## O15 A flexible, fast and systematic method to obtain reduced compartmental models.

Willem Wybo\*, Walter Senn

Most input signals received by neurons in the brain impinge on their dendritic trees. Before being transmitted downstream as action potential (AP) output, the dendritic tree performs a variety of computations on these signals that are vital to normal behavioural function (Cichon and Gan 2015; Takahashi et al. 2016). In most modelling studies however, dendrites are omitted due to the cost associated with simulating them. Biophysical neuron models can contain thousands of compartments, rendering it infeasible to employ these models in meaningful computational tasks. Thus, to understand the role of dendritic computations in networks of neurons, it is necessary to simplify biophysical neuron models. Previous work has either explored advanced mathematical reduction techniques (Kellems et al. 2010; Wybo et al. 2015) or has relied on ad-hoc simplifications to reduce compartment numbers (Traub et al. 2005). Both of these approaches have inherent difficulties that prevent widespread adoption: advanced mathematical techniques cannot be implemented with standard simulation tools such as NEURON (Carnevale and Hines, 2004) or BRIAN (Goodman and Brette, 2009), whereas ad-hoc methods are tailored to the problem at hand and generalize poorly. Here, we present an approach that overcomes both of these hurdles: First, our method simply outputs standard compartmental models (Fig 1A). The models can thus be simulated with standard tools. Second, our method is systematic, as the parameters of the reduced compartmental models are optimized with a linear least squares fitting procedure to reproduce the impedance matrix of the biophysical model (Fig 1B). This matrix relates input current to voltage, and thus determines the response properties of the neuron (Wybo et al. 2019). By fitting a reduced model to this matrix, we obtain the response properties of the full model at a vastly reduced computational cost. Furthermore, since we are solving a linear least squares problem, the fitting procedure is well-defined – as there is a single minimum to the error function – and computationally efficient. Our method is not constrained to passive neuron models. By linearizing ion channels around wisely chosen sets of expansion points, we can extend the fitting procedure to yield appropriately rescaled maximal conductances for these ion channels (Fig 1C). With these conductances, voltage and spike output can be predicted accurately (Fig 1D, E). Since our reduced models reproduce the response properties of the biophysical models, non-linear synaptic currents, such as NMDA, are also integrated correctly. Our models thus reproduce dendritic NMDA spikes (Fig 1F). Our method is also flexible, as any dendritic computation (that can be implemented in a biophysical model) can be reproduced by choosing an appropriate set of locations on the morphology at which to fit the impedance matrix. Direction selectivity (Branco et al., 2010) for instance, can be implemented by fitting a reduced model to a set of locations distributed on a linear branch, whereas

independent subunits (Hausser and Mel, 2003) can be implemented by choosing locations on separate dendritic subtrees. In conclusion, we have created a flexible linear fitting method to reduce non-linear biophysical models. To streamline the process of obtaining these reduced compartmental models, work is underway on a toolbox (<https://github.com/WillemWybo/NEAT>) that automatizes the impedance matrix calculation and fitting process.

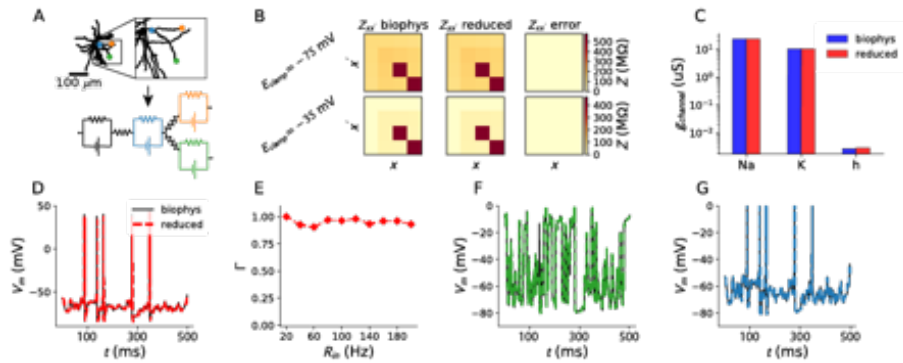


Figure 1: A: Reduction of branch of stellate cell with compartments at 4 locations. B: Biophysical (left) and reduced (middle) impedance matrices and error (right) at two holding potentials (top and bottom). C: Somatic conductances. D: Somatic voltage. E Spike coincidence factor between both models (1: perfect coincidence, 0: no coincidence with 4 ms window). F res. G: Same as D, but for green resp. blue site.



## **O16 An exact firing rate model reveals the differential effects of chemical versus electrical synapses in spiking networks**

Ernest Montbri , Alex Roxin\*, Federico Devalle, Bastian Pietras, and Andreas Daffertshofer

Chemical and electrical synapses shape the collective dynamics of neuronal networks. Numerous theoretical studies have investigated how, separately, each of these type of synapses contributes to the generation of neuronal oscillations, but their combined effect is less understood. In part this is due to the impossibility of traditional neuronal firing rate models to include electrical synapses.

Here we perform a comparative analysis of the dynamics of heterogeneous populations of integrate-and-fire neurons with chemical, electrical, and both chemical and electrical coupling. In the thermodynamic limit, we show that the population's mean-field dynamics is exactly described by a system of two ordinary differential equations for the center and the width of the distribution of membrane potentials –or, equivalently, for the population-mean membrane potential and firing rate. These firing rate equations exactly describe, in a unified framework, the collective dynamics of the ensemble of spiking neurons, and reveal that both chemical and electrical coupling are mediated by the population firing rate. Moreover, while chemical coupling shifts the center of the distribution of membrane potentials, electrical coupling tends to reduce the width of this distribution promoting the emergence of synchronization.

The firing rate equations are highly amenable to analysis, and allow us to obtain exact formulas for all the fixed points and their bifurcations. We find that the phase diagram for networks with instantaneous chemical synapses are characterized by a codimension-two Cusp point, and by the presence of persistent states for strong excitatory coupling. In contrast, phase diagrams for electrically coupled networks is determined by a Takens-Bogdanov codimension-two point, which entails the presence of oscillations and greatly reduces the presence of persistent states. Oscillations arise either via a Saddle-Node-Invariant-Circle bifurcation, or through a supercritical Hopf bifurcation. Near the Hopf bifurcation the frequency of the emerging oscillations coincides with the most likely firing frequency of the network. Only the presence of chemical coupling allows to shift (increase for excitation, and decrease for inhibition) the frequency of these oscillations. Finally, we show that the Takens-Bogdanov bifurcation scenario is generically present in networks with both chemical and electrical coupling.

We acknowledge support by the European Union's Horizon 2020 research and innovation programme under the Marie Sk odowska-Curie grant agreement No. 642563.

## O17 Graph-filtered temporal dictionary learning for calcium imaging analysis

Gal Mishne\*, Benjamin Scott, Stephan Thiberge, Nathan Cermak, Jackie Schiller, Carlos Brody, David W. Tank, and Adam Charles

Optical calcium imaging is a versatile imaging modality that permits the recording of neural activity, including single dendrites and spines, deep neural populations using two-photon microscopy, and wide-field recordings of entire cortical surfaces. To utilize calcium imaging, the temporal fluorescence fluctuations of each component (e.g., spines, neurons or brain regions) must be extracted from the full video. Traditional segmentation methods used spatial information to extract regions of interest (ROIs), and then projected the data onto the ROIs to calculate the time-traces[1]. Current methods typically use a combination of both a-priori spatial and temporal statistics to isolate each fluorescing source in the data, along with the corresponding time-traces[2,3]. Such methods often rely on strong spatial regularization and temporal priors that can bias time-trace estimation and that do not translate well across imaging scales. We propose to instead model how the time-traces generate the data, using only weak spatial information to relate per-pixel generative models across a field-of-view. Our method, based on spatially-filtered Laplacian-scale mixture models[4,5], introduces a novel non-local spatial smoothing and additional regularization to the dictionary learning framework, where the learned dictionary consists of the fluorescing components' time-traces.

We demonstrate on synthetic and real calcium imaging data at different scales that our solution has advantages regarding initialization, implicitly inferring number of neurons and simultaneously detecting different neuronal types (Fig. 1). For population data, we compare our method to a current state-of-the-art algorithm, Suite2p, on the publicly available Neurofinder dataset (Fig. 1C). The lack of strong spatial contiguity constraints allows our model to isolate both disconnected portions of the same neuron, as well as small components that would otherwise be over-shadowed by larger components. In the latter case, this is important as such configurations can easily cause false transients which can be scientifically misleading. On dendritic data our method isolates spines and dendritic firing modes (Fig. 1D). Finally, our method can partition widefield data [6] in to a small number of components that capture the scientifically relevant neural activity (Fig. 1E-F).

**Acknowledgments:** GM is supported by NIH NIBIB and NINDS (grant R01EB026936).

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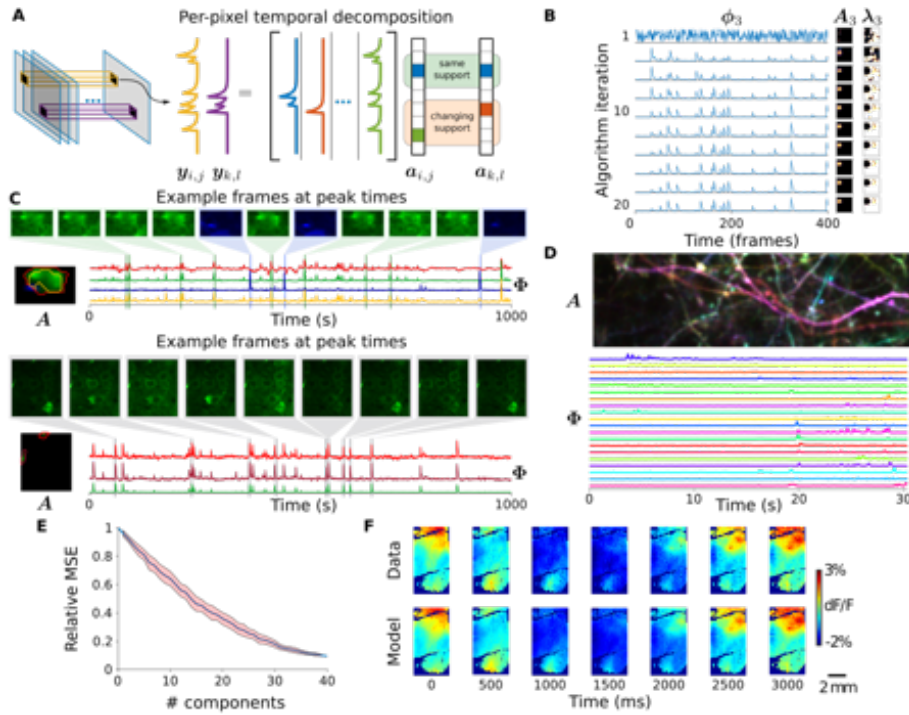


Figure 1: Temporal dictionary-learning (A). Simulations: our method converges from random initialization to true time-traces (B). Neurofinder: comparing to Suite2p reveals our method better detects apical and discontinuous components (C). Tuft dendrites: decomposing into dendritic and spine components (D). Widefield data: 40 components sufficiently capture important behaviorally-relevant dynamics (E,F).

## O18 Drift-resistant, real-time spike sorting based on anatomical similarity for high channel-count silicon probes

James Jun\*, Jeremy Magland, Catalin Mitelut, and Alex Barnett

Extracellular electrophysiology records a mixture of neural population activity at a single spike resolution. In order to resolve individual cellular activities, a spike-sorting operation groups together similar spike waveforms distributed at a subset of electrodes adjacent to each neuron. Penetrating micro-electrode arrays are widely used to measure the spiking activities from behaving animals, but silicon probes can be drifted in the brain due to animal movements or tissue relaxation following a probe penetration. The probe drift issue results in errors in conventional spike sorting operations that assumes stationarity in spike waveforms and amplitudes. Some of the latest silicon probes [1] offer a whole-shank coverage of closely-spaced electrode arrays, which can continually capture the spikes generated by neurons moving along the probe axis. We introduce a drift-resistant spike sorting algorithm for high channel-count, high-density silicon probe, which is designed to handle gradual and rapid random probe movements. IronClust takes advantage of the fact that a drifting probe revisits the same anatomical locations at various times. We apply a density-based clustering by grouping a temporal subset of the spiking events where the probe occupied similar anatomical locations. Anatomical similarities between a disjoint set of time bins are determined by calculating the activity histograms, which capture the spatial structures in the spike amplitude distribution based on the peak spike amplitudes on each electrode. For each spiking event, the clustering algorithm (DPCLUS [2]) computes the distances to a subset of its neighbors selected by their peak channel locations and the anatomical similarity. Based on the  $k$ -nearest neighbors [3], the clustering algorithm finds the density peaks based on the local density values and the nearest distances to the higher-density neighbors, and recursively propagates the cluster memberships toward a decreasing density gradient. The accuracy of our algorithm was evaluated using validation datasets generated using a biophysically detailed neural network simulator (BioNet [4]), which generated three scenarios including stationary, slow monotonic drift, and fast random drift cases. IronClust achieved 8% error on the stationary dataset, and 10% error on the gradual or random drift datasets, which significantly outperformed existing algorithms (Fig. 1). We also found

that additional columns of electrodes improve the sorting accuracy in all cases. IronClust achieved over 11x of the real-time speed using GPU, and over twice faster than other leading algorithm. In conclusion, we realized an accurate and scalable spike sorting operation resistant to probe drift by taking advantage of an anatomically-aware clustering and parallel computing.

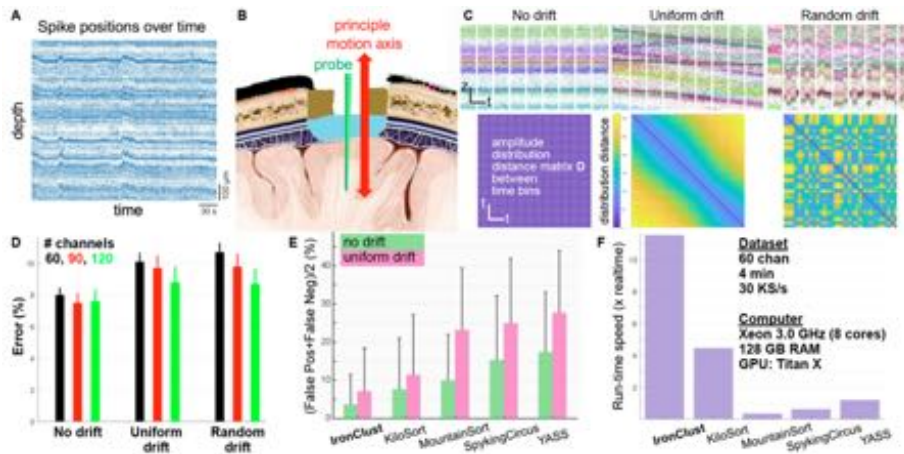


Figure 1: A: Probe drift causes coherent shifts in the spike positions preserving the anatomical structure. B: Principal probe movement occurs along the probe axis. C: Three drift scenarios and the anatomical similarity matrices between time bins. D: Clustering errors for various drift scenarios and electrode layouts. E: Accuracy comparison. F: Speed comparison between multiple sorters.



# Workshops

## **W1 Methods of Information Theory in Computational Neuroscience**

*Paranymph, Tue 9:30 to 13:10 and Wed 9:30 to 18:30*

**Lubomir Kostal**, Czech Academy of Sciences

**Joseph T. Lizier**, The University of Sydney

**Viola Priesemann**, Max Planck Institute for Dynamics & Self-organization, Goettingen

**Justin Dauwels**, Nanyang Technological University

**Taro Toyozumi**, RIKEN Center for Brain Science

**Michael Wibral**, University of Goettingen

**Adria Tauste**, BarcelonaBeta Brain Research Center

Methods originally developed in Information Theory have found wide applicability in computational neuroscience. Beyond these original methods there is a need to develop novel tools and approaches that are driven by problems arising in neuroscience.

A number of researchers in computational/systems neuroscience and in information/communication theory are investigating problems of information representation and processing. While the goals are often the same, these researchers bring different perspectives and points of view to a common set of neuroscience problems. Often they participate in different fora and their interaction is limited.

The goal of the workshop is to bring some of these researchers together to discuss challenges posed by neuroscience and to exchange ideas and present their latest work.

The workshop is targeted towards computational and systems neuroscientists with interest in methods of information theory as well as information/communication theorists with interest in neuroscience. Potential topics for talks include, but are not limited to: spike coding and modelling, characterising information processing, testing coding hypotheses, and information dynamics and computation.

Please see our website <http://www.biomed.cas.cz/~kostal/CNS2019-ITW/> for full abstracts, schedule and additional contributed talks.

### **Speakers:**

- Michael Wibral (Georg-August University, Goettingen) “Applying point-wise partial information decomposition to stimulus representations in prefrontal cortex”
- Renaud Jolivet (University of Geneva) “Combining information theory and energetics into a coherent framework to study the brain’s heterocellular circuits”
- Julijana Gjorgjieva (Max Planck Institute for Brain Research, Frankfurt) “Functional diversity among sensory neurons from efficient coding principles”
- Takyua Isomura (RIKEN Center for Brain Science) TBA
- Adria Tauste (BarcelonaBeta Brain Research Center) “Relating neural coding and communication: Evidences from thalamo-cortical spike-train data during stimulus perception”
- Wiktor Mlynarski (Institute of Science and Technology Austria, Vienna) “Adaptability and efficiency in neural coding”
- David Kappel (Georg-August University, Goettingen) “An information theoretic account of sequence learning: From prediction errors to transfer entropy”
- Raoul Vicente (Institute of Computer Science, University of Tartu) “Using information theoretic functionals to guide deep reinforcement learning agents”
- David Shorten (The University of Sydney) “Estimation of Transfer Entropy for Spike Trains in Continuous-Time”
- Jaroslav Hlinka (Institute of Computer Science CAS, Prague) “Network Inference and Maximum Entropy Estimation on Information Diagrams”
- Praveen Venkatesh (Carnegie Mellon University) “Revealing Information Paths in the Brain using Synergistic Information”

- Rodrigo Cofre Torres (University of Valparaiso) “Exploring information-theoretic high-order effects of LSD in a Whole-Brain Model”
- Massimiliano Zanin (Technical University of Madrid) “Time irreversibility of resting brain activity in the healthy brain and pathology”
- Lubomir Kostal (Institute of Physiology CAS, Prague) “Critical size of neural population for reliable information transmission”

## **W2 The dynamics and limitations of working memory**

*Room B7, Tue 9:30 to 13:10 and Wed 9:30 to 18:30*

**Zachary Kilpatrick**, University of Colorado Boulder

**Albert Compte**, Institut d'investigacions Biomèdiques August Pi i Sunyer

We use working memory (WM) to hold and manipulate information when making decisions, solving problems, and guiding behavior. Experiments often require subjects to store items in WM for a few seconds, and use this information to make a decision. Since non-human primates and rodents can be trained on such tasks, it has been possible to record some of the neural substrates of working memory during this delay period. Controversy remains as to how items are represented in the brain, and the effect this has on time and resource limitations of WM. Are memoranda represented with stable and persistent activity or dynamic activity? Are WM resources distributed to minimize error or maximize reward? Combined experimental and computational approaches are needed to resolve these current conflicts, and this workshop will discuss open questions and current approaches to answering them. Approaches include data-driven models, human psychophysics, imaging, and neural activity recordings during working memory delay periods.

Please see our website <http://www.math.utah.edu/~kilpatri/cns19.html> for full abstracts and schedule.

### **Speakers:**

- Tim Buschman (Princeton University, USA) "Neural dynamics improve working memory "
- Rosanne Rademaker (University of California San Diego, USA) "Representations in visual cortex during changing memory and sensory demands"
- Dante Wasmuht (University of Oxford, UK) "Active and latent working memories in prefrontal cortex"
- Klaus Wimmer (Centre de Recerca Matemàtica, Barcelona, Spain) "Circuit mechanisms underlying task-triggered changes in population codes in spatial working memory "
- Paul Bays (University of Cambridge, UK) "Stochastic sampling: A unifying framework for working memory limits "
- Aspen Yoo (New York University, USA) "The effect of behavioral relevance on working memory representations"
- Georgia Gregoriou (University of Crete, Greece) "Encoding and retention of spatial and non-spatial information in the parietal and prefrontal cortices"
- Albert Compte (Institut d'Investigacions Biomèdiques August Pi i Sunyer) "Reactivation of prefrontal cortex representations boost serial biases in working memory"
- Zachary Kilpatrick (University of Colorado Boulder, USA) "Analyzing neural and synaptic mechanisms of interference in working memory"
- Athena Akrami (University College London, UK) "Demarcation of working memory - what's the timescale and content of working memory?"
- Ila Fiete (Massachusetts Institute of Technology, Cambridge, USA) TBA



### **W3 Workshop on generative connectomics and plasticity**

*Room S1 (Tue), Rooms S1 and S5 (Wed), Tue 9:30 to 13:10 and Wed 9:30 to 18:30*

**Alexander Peyser**, Research Centre Jülich

**Wouter Klijin**, Research Centre Jülich

**Sandra Diaz**, Research Centre Jülich

The generation and evolution of connectivity in simulations has only recently become computationally tractable, and is the focus of several research programs (e.g. HBP, DFG priority program).

In this event, we will cover the state-of-the-art research in simulation and modeling of generative connectomics and structural plasticity, as well as future directions. We will discuss modeling and simulation of connectivity generation from two perspectives: 1. Neural development and structural plasticity in biological neural networks 2. Generation of connectivity for biological and artificial neural networks

The workshop will have both a theoretical and a practical part. We will have two sessions with presentations with generous time for open discussion on the current state of the art. The third session will focus on practical and future applications in two parallel groups: one group on design and implementation of a stand-alone structural plasticity module compatible with several simulators / emulators (NEST, Arbor, TVB, Neuron, SpiNNaker, BrainScales, etc.) and a second group focusing on the preparation of a perspectives and architecture paper on future directions for generative and developmental simulation.

Please see our website [http://www.fz-juelich.de/ias/jsc/EN/Expertise/SimLab/slns/news\\_events/2019/ocns-ws-2019.html](http://www.fz-juelich.de/ias/jsc/EN/Expertise/SimLab/slns/news_events/2019/ocns-ws-2019.html) for full abstracts and schedule.

#### **Speakers:**

- Markus Axer (Forschungszentrum Jülich, Jülich, Germany) “Polarized Light Imaging of the brain’s fiber architecture”
- Claudia Casellato and Alice Geminiani (University of Pavia, Pavia, Italy) “Reconstruction and simulations of cerebellar networks with plasticity”
- Rodrigo Suarez (The University of Queensland, Brisbane, Australia) “Conservation and change of organizational features during the evolution of neocortical circuits in mammals”
- Johanna Senk (Forschungszentrum Jülich, Jülich Germany) “Towards Reproducible Generation and Description of Network Connectivity”
- Christian Pehle (Heidelberg University, Heidelberg, Germany) “ Connectivity generation in the BrainScales system ”
- Han Lu (University of Freiburg, Freiburg, Germany) “Network remodeling and cell assembly formation may contribute to the aftereffects of tDCS, suggested by a homeostatic structural plasticity mode”
- Felix Wolf (Technical University of Darmstadt, Darmstadt, Germany) “A Scalable Algorithm for Simulating the Structural Plasticity of the Brain”
- Óscar David Robles Sánchez (Universidad Rey Juan Carlos, Madrid, Spain) “Visualization tools for the analysis of neuronal connectivity and activity”

## **W4 Emergent Phenomena in Macroscopic Neural Networks**

*Aula Magna, Tue 9:30 to 13:10 and Wed 9:30 to 18:30*

**Joana Cabral**, Department of Psychiatry, University of Oxford

**Jeremie Lefebvre**, Krembil Research Institute, Toronto

Composed of  $\sim 100$  billion interconnected neurons, the human brain is one of the most complex networks in Nature, exhibiting a rich repertoire of non-trivial spatiotemporal patterns spanning multiple spatial and temporal scales. At the macroscopic level, patterns with well-established behavioural correlates emerge from the collective behaviour of neuronal systems coupled through a complex wiring structure. Yet, the mechanisms underlying the formation and stability of these patterns, and which role they play in neural computation, brain health and disease, remain poorly understood.

Understanding the fundamental principles governing the macroscopic dynamics of coupled neuronal populations will provide unprecedented insights to address key questions about brain dynamics across scales.

In this workshop, we will bring together both junior and senior researchers in computational and systems neuroscience who use approaches from theoretical physics, mathematical analysis, dimensionality-reduction techniques and biologically-informed numerical simulations, to reflect and debate on the principles underlying macroscopic brain network dynamics in space, time and frequency domains, how they can be controlled, and their implications for information processing.

Please see our website <http://sites.google.com/view/brainnet-cns2019/home> for full abstracts and schedule.

### **Speakers:**

- Demian Battaglia (CNRS Institute for Systems Neuroscience, Marseille, France) "Oscillations: computing, beyond routing?"
- Selen Atasoy (Department of Psychiatry, University of Oxford, UK) "Connectome-specific Harmonic Waves"
- Daniel Margulies (CNRS Brain and Spine Institute, Paris, France) "Gradients in large-scale Cortical Organization"
- Jan Fousek (Institute for Systems Neuroscience, Aix-Marseille University, France) "From Neurons to Dynamical Networks"
- John Griffiths (Krembil Center for Neuroinformatics, CAMH Toronto, Canada) "Spatiotemporal dynamics in large-scale neural systems"
- Morten Kringelbach (Head of the Hedonia Transnational Research Group, University of Oxford, UK) "Driving transitions in metastable subspace"
- Josephine Cruzat (Center for Brain and Cognition, Universitat Pompeu Fabra, Barcelona, Spain) "In-silico modulation of whole-brain dynamics"
- Patricio Orio (Centro Interdisciplinario de Neurociencias de Valparaíso, Chile) "Drivers of Multi-stability in Neural Networks"
- James Roberts (QIMR Berghofer Medical Research Institute, Brisbane, Australia) "Metastable Brain Waves"
- Fatihcan Atay (Department of Mathematics at Bilkent University, Turkey) "Collective dynamics in networks with time delays"
- Leonardo Gollo (QIMR Berghofer Medical Research Institute, Brisbane, Australia) "Long-range synchrony with time-delays"
- Jérémie Lefebvre (Research Institute, Department of Mathematics, University of Toronto, Canada) "Electromagnetic Stimulation of oscillatory patterns"
- Joana Cabral (Department of Psychiatry, University of Oxford, UK) "Collective oscillatory modes in the Connectome"

## **W5 New Perspectives in Cortical Dynamics**

*Room B5, Tue 9:30 to 13:10 and Wed 9:30 to 18:30*

**David Hansel**, CNRS, France

**Nicholas Priebe**, University of Texas at Austin

**Carl van Vreeswijk**, CNRS, France

The two major paradigms for our current understanding of cortical dynamics are the theories of balanced networks and of stabilized supra-linear networks. These related theories differ in their assumptions on the synaptic strengths and on the importance of neuronal input-output nonlinearities. Which of these two theories is more appropriate could depend on the species, cortical area or even the cortical layer. Up to now these theories have mostly been applied to highly simplified model networks consisting of one excitatory and one inhibitory neuronal population with purely random connectivity. It is now well established, however, that cortical circuitry is much more complex. In particular, there is a diverse population of inhibitory neurons with distinct connectivity profiles, nonlinearities and synaptic dynamics. Furthermore, the connectivity in cortex deviates significantly from a purely random one. The feed-forward and feedback interactions between layers add an additional level of complexity. We will compare experimental findings with the current theories and we will discuss how failures of these might be resolved by incorporating complexity into our models.

Please see our website <http://clm.utexas.edu/PriebeLab/cns-2019-workshop/> for schedule.

### **Speakers:**

- Yashar Ahmadian (University of Oregon, Eugene, USA) “Loose balance in spiking networks”
- Nicolas Brunel (Duke University, Durham, USA) “Nonlinearities in network transfer function: Networks of spiking neurons vs supralinear stabilized network”
- Ran Darshan (Janelia Research Campus, Ashburn, USA) “Sub-threshold fluctuations in mouse cortex: data and theory”
- David Golomb (Ben Gurion University of the Negev, Beer-sheva, Israel) “Dynamics of layer-4 barrel cortical circuits with SOM inhibitory interneurons”
- David Hansel and Carl van Vreeswijk (CNRS, Paris, France) “The Balance network model and the cortical operating regime”
- Andrea Hasenstaub (UCSF, USA) “Paradoxes and dynamics of cortical inhibition”
- Mark Histed (NIH, Bethesda, USA) “Inhibition stabilization is a widespread property of cortical networks”
- Ilan Lampl (The Weizmann Institute, Rehovot, Israel) “The role of the corpus callosum in interhemispheric synaptic correlations across behavioral states”
- Ken Miller (Columbia University New York, USA) “The stabilized supralinear network model and the cortical operating regime”
- Gianluigi Mongillo (CNRS, Paris, France) “Inhibitory connectivity defines the realm of excitatory plasticity”
- Eli Nelken (Hebrew University, Jerusalem, Israel) “Time course of adaptation of excitatory and inhibitory neurons in the superficial layers of auditory cortex”
- Jagruti Pattadkal (University of Texas at Austin, USA) “Fluctuations in network state in awake primate sensory cortex”
- Nicholas Priebe (University of Texas at Austin, USA) “Switching between balanced and unbalanced modes in the sensory neocortex”
- Alfonso Renart (Champalimaud Foundation, Lisbon, Portugal) “Low dimensional competitive dynamics during cortical desynchronization”
- Alex Reyes (New York University, USA) “Rate propagation in a multilayer network of cultured neurons”
- Alex Roxin (Universitat Pompeu Fabra, Barcelona, Catalonia, Spain) “A network model of place-cell turnover in CA1”
- Maria Victoria Sanchez-Vives (IDIPAPS, Barcelona, Catalonia, Spain) “Synaptic and non-synaptic modulation of cortical activity and synchronization”
- Tatjana Tchumatchenko (Max Planck, Frankfurt, Germany) “Recurrent neural networks with finite number of neurons”

## **W6 Neuronal Oscillations: mechanisms, computational properties and functionality**

*Aula Capella, Wed 9:30 to 18:30*

**Adrien Peyrache**, McGill University, Canada

**Vassilis Cutsuridis**, University of Lincoln, UK

**Horacio G. Rotstein**, NJIT / Rutgers University, USA

Oscillations at various frequency ranges have been observed in several brain structures (hippocampus, entorhinal cortex, olfactory bulb and others). They are believed to be important for cognitive functions such as learning, memory, navigation and attention. 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 in a given brain region, and at higher levels of organization involving several of these regions. Recent advances in this field have benefited from the interaction between experiment and theory, and models with varying levels of detail.

The 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.

Following the tradition of this workshop we have reserved 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 will be happy to include additional contributed talks from scientists not included in this list. This year we will incorporate a new modality of participation by calling for a spontaneous five minutes long data blitz where interesting students and postdocs can briefly present their work and contribute to the discussion.

Please see our website <http://www.vassiliscutsuridis.org/workshops/CNS2019/CNS2019web.htm> for full abstracts, schedule and additional contributed talks (to be announced).

### **Speakers:**

- Nikolai Axmacher (Ruhr-Universität, Bochum, Germany) "Oscillations as an interface between single cells and networks: the case of grid representations"
- Karim Benchenane (ESPCI/CNRS, Paris, France) "Dissociation of fear initiation and maintenance by breathing-driven prefrontal oscillations"
- John White (Boston University, MA, USA) "The Biophysical Bases and Consequences of Correlated Activity in Hippocampus"
- Jozsef Csicsvari (IST, Austria) "Assembly reactivation dynamics are governed by ripple and gamma oscillations"
- Wilten Nicola (Imperial College London, UK) "The rhythms of the hippocampus can be functionally interpreted as the operations of a Hard Disk Drive"
- Alexandra Chatzikalymniou (University of Toronto, Canada) "Linking abstract computational models of theta rhythms with biologically sophisticated models, guided by a common experimental foundation"
- Adrien Peyrache (McGill University, Montreal, Canada) "A link between dynamics and function in the anterior thalamus"
- Dan Levenstein (NYU, New York, USA) "Excitable dynamics of NREM sleep"
- Imre Vida (Charité, Berlin, Germany) "Perisomatic and dendritic inhibitory mechanisms in gamma and fast oscillations in hippocampal networks"
- Bijan Pesaran (NYU, New York, USA) "Dynamic modulation of network excitability mediates multiregional communication in the primate brain"
- Farzan Nadim (NJIT/Rutgers, Newark, USA) "Distinct mechanisms underlie electrical coupling resonance and membrane potential resonance"

- Horacio G. Rotstein (New Jersey Institute of Technology, Newark, USA) “Resonance-based mechanisms of generation of oscillations in networks of non-oscillatory neurons”
- Carmen Canavier (Louisiana State University, USA) “Mechanisms of Inhibitory Interneuronal Network Synchrony for Type 1 versus Type 2 Excitability”

## **W7 Dynamics of Rhythm Generation: Role of Ionic Pumps, Exchangers, and Ion Homeostasis**

*Room B6 (Tue), Room B3 (Wed), Tue 9:30 to 13:10 and Wed 14:50 to 18:30*

**Ronald Calabrese**, Emory University, Atlanta

**Gennady Cymbalyuk**, Georgia State University, Atlanta

The ability of distinct circuits to generate patterns of rhythmic activity is widespread among vertebrate and invertebrate species. These patterns correspond to different functions like control of different rhythmic movements and pathological events like seizure episodes. The dynamics of the circuits producing such patterns are based on the basic principles conserved across phyla. This workshop will investigate roles of interactions of processes on different time and space scales in attaining the robustness and flexibility, characteristic of living circuits.

We will focus on the roles played by Na<sup>+</sup>/K<sup>+</sup> pump, Ca<sup>2+</sup> pumps, and ion exchangers in generation of functional and dysfunctional rhythms. We would like to bring together experts applying experimental approaches and the computational neuroscience methods developed in the neuroscience, neuro-biophysics, neuro-informatics, neuroethology, and bifurcation theory to determine the basic principles of the transient, intermittent, and steady dynamics of rhythm generation from different phyla.

Please see our website <https://labs.ni.gsu.edu/gcymbalyuk/WorkshopCNS2019.htm> for full abstracts, schedule and additional contributed talks (to be announced).

### **Speakers:**

- Gennady Cymbalyuk (GSU, Atlanta, USA) “Contribution of the Na/K pump current to dynamics of robust and intermittent bursting patterns”
- Maxim Bazhenov (University of California San Diego, Department of Medicine, La Jolla, USA) “Ionic homeostasis and epileptogenesis”
- Boris Gutkin (Ecole Normale Supérieure PSL University, Paris, France) “Modelling the Role of Chloride homeostasis pathology in epileptogenesis”
- Ryan Phillips (University of Pittsburgh, Pittsburgh, USA) “Effects of short-term ionic plasticity of GABAergic synapses in the basal ganglia and brainstem respiratory circuits”
- Laurence Picton (Karolinska Institutet, Stockholm, Sweden) “Roles of the sodium pump in the spinal locomotor circuits of *Xenopus* tadpoles and mice”
- Ghanim Ullah (University of South Florida, Tampa, USA) “The role of glutamate and GABA in neuronal ion homeostasis: Implications for spreading depolarization and rhythms”
- Plus additional contributed talks ...

## **W8 Modelling sequential biases in perceptual decisions**

*Room S3, Wed 9:30 to 18:30*

**Alexandre Hyafil**, Universitat Pompeu Fabra, Barcelona

**Jaime De La Rocha**, Idibaps, Barcelona

The workshop will gather scientists with different perspectives on the subject of serial perceptual biases with a focus on either modelling biases (at different levels) or developing theoretical accounts that might explain them, from normative accounts to physiological mechanisms. The existence of such biases has been known for decades but up to few years ago, their analysis was confined to a small psychology community. In the last 2-3 years, there has been a surge of studies from neuroscientists over various specialties. We now realize that sequential decision biases are more complex and ubiquitous as previously thought, and that they offer a window into cognitive mechanisms at the interface of perceptual-based and value-based decision-making. The workshop will provide an enriching mix of experimental models (healthy humans, human patients, primates, rodents), modalities/systems (vision, audition, working memory) and modelling scales (spiking networks, latent variable models, Bayesian models).

Please see our website <https://sites.google.com/view/cns-2019-serial-workshop> for full information.

### **Speakers:**

- Vincent Adam (Prowler.io, Cambridge, UK) “Normative models and Statistical methods to study the effect of sensory history in perception in discrimination tasks”
- Athena Akrami (University College, London) “Timescales of neuronal sensory representation in decision making and working memory tasks”
- Guido Marco Cicchini (Institute of Neuroscience, Pisa) “Serial effects reflect an optimizing mechanism and can occur in perception”
- Ainhoa Hermoso-Mendizabal (Idibaps, Barcelona) “The neural circuitry of history dependent choice biases in rat perceptual decisions”
- Matthias Fristche (Donders Institute, Nijmegen) “Opposite effects of recent history on perception and decision and their modulation by attention”
- Yonatan Loewenstein (Hebrew University, Jerusalem) “Dissecting the roles of supervised and unsupervised learning in perceptual discrimination judgments”
- Florent Meyniel (CEA, Paris) “Neuro-computational origins of sequential effects in predictions”
- Gabriela Mochol (Universitat Pompeu Fabra, Barcelona) “Representation of choice bias in the activity of prearcuate gyrus during perceptual decision making”
- Heike Stein (Idibaps, Barcelona) “The influence of NMDA receptor dysfunction on serial biases in (human) working memory”
- Anke Braun (University Medical Center, Hamburg) “Adaptive History Biases Result from Confidence-Weighted Accumulation of past Choices”

## **W9 Neural Multiplexed Coding, Coexistence of Multimodal Coding Strategies in Neural Systems**

*Room S4, Wed 9:30 to 18:30*

**Milad Lankarany**, Krembil Research Institute, Toronto

**Steven A. Prescott**, The Hospital for Sick Children, Toronto

The brain processes phenomenal amounts of information despite biological constraints on their maximal firing rate, network size, etc. (Laughlin and Sejnowski, 2003). Such constraints necessitate efficient neural coding strategies. In telecommunication systems, coding efficiency is increased by sending multiple messages simultaneously over a single communication channel, the so-called multiplexing. Emerging evidence suggests that brain can also multiplex. Understanding mechanisms underlying which neurons encode and decode multiple information simultaneously is a hot topic in both Neuroscience.

Neural systems, specifically, sensory systems, which process continual streams of input comprising multiple features, could especially benefit from multiplexing. Stimulus features evoke distinct “coding patterns”, thus information about each feature could be reconstructed (decoded) from spikes associated with the respective coding pattern. These spikes could conceivably be distinguished by (i) their patterning within a neuron, (ii) their differential association with network oscillations, or (iii) their stimulus-induced correlation across neurons. Therefore, multiplexing suggests that more than one coding strategy can simultaneously be performed to decode different features of the stimulus.

The main objective of this workshop is to explore the possibility of coexistence of distinct neural coding strategies – neural multiplexed coding – in different levels, ranging from single neurons to neuronal networks. Due to tremendous attraction into this topic over last five years, we believe that this workshop will address an overarching insight on how brain multiplexes, and discuss the latest findings in this domain from experimental, methodological and modeling perspectives. Our workshop is intended for a broad audience and will ideally attract audience members from diverse backgrounds. We have the opportunity of hosting leading scientists in both computational and experimental fields to address various aspects of multiplexing – from single neurons to network level. The workshop will finish with an open forum aimed at integrating the core concepts underlying neural multiplexed coding in different levels.

Please see our website <https://sites.google.com/view/cns-workshop-on-neural-mux/home> for full abstracts, schedule and additional contributed talks (to be announced).

### **Speakers:**

- Mark Diesmann (Institute of Neuroscience and Medicine (INM-6) - Computational and Systems Neuroscience, Jülich, Germany) “Open cortical multi-area model at cellular resolution”
- Steve Prescott (The Hospital for Sick Children - University of Toronto, Toronto, Canada) “TBA”
- Sungho Hong (Okinawa Institute of Technology, Okinawa, Japan) “TBA”
- Arvind Kumar (KTH Royal Institute of Technology, Stockholm, Sweden) “Synaptic constrains on neural code”
- Milad Lankarany (The Krembil Brain Institute - University of Toronto, Toronto, Canada) “Synchrony-Division Multiplexing; Neuronal Multiplexed Coding through Synchronous and Asynchronous spikes”
- Plus additional contributed talks ...



## W10 Olfaction – the complex sense

Room S2, Tue 9:30 to 13:10 and Wed 9:30 to 13:10

**Maxim Bazhenov**, University of California, San Diego

**Mario Pannunzi**, University of Sussex, UK

Olfaction could be called ‘the complex sense’. It has no well-defined organizing property analogous to the wavelength of light in vision or the pitch of sounds in audition. While the properties of the stimuli in other sensory modalities can be tightly measured and controlled, we still do not even know the relevant time scales of olfactory stimuli, nor the speed of the olfactory system. To map the complex olfactory stimulus space to unique and reliable neuronal responses, the olfactory system has to be a complex machine, yet even tiny insects with relatively simple neural systems can solve very complex olfactory tasks [1]. While we have 3 types of visual receptors, *Drosophila* has more than 50 olfactory receptor types and rats have more than 1000, fueling fierce debates on the dimensionality of the odour space [2].

The goal of computational/theoretical research in olfaction is to formulate a theory that captures the fundamental mechanisms behind this ‘complex sense’ without needing to know all the details of how the olfactory system is implemented in particular species [3]. However, we do not yet understand the olfactory system well enough to know which details are critical and which are insignificant [1]. Any model of a highly complex system risks being useless if one tries to include too many details and it therefore becomes under-constrained. This is an extremely common problem in Computational Neuroscience and, in this workshop, we will examine it in the light of the latest experimental results in olfaction.

### References

1. Slankster et al., (2019) Strength in diversity: functional diversity among olfactory neurons of the same type, *Journal of bioenergetics and biomembranes*.
2. Meister, (2015) On the dimensionality of odor space, *eLife*; Bushdid et al. (2014) Humans can discriminate more than 1 trillion olfactory stimuli, *Science*.
3. Abbott (2008) Theoretical neuroscience rising, *Neuron*.

For full abstracts and schedule visit, please visit our website <http://odor-objects.inf.sussex.ac.uk/wordpress/index.php/2019/02/21/workshop-olfaction-the-complex-sense-at-cns2019-barcelona/>.

### Speakers:

- Mario Pannunzi (University of Sussex, Brighton, UK) “Odor stimuli: not just chemical identity”
- Mark Stopfer (NICHD, Rockville, MD, USA) “Modeling a giant neuron that shapes neural codes for odors”
- Maxim Bazhenov (University of California, San Diego, CA, USA) “Adaptive neural dynamics for detecting salient features of olfactory stimuli”
- Brian Smith (Arizona State University, Phoenix, AZ, USA) “Novelty detection in early olfactory processing”
- James Bennett (University of Sussex, Brighton, UK) “Plasticity at recurrent inhibitory synapses outperforms alternative sparse coding mechanisms in a model of the *Drosophila* mushroom body”
- Aurel Lazar (Columbia University, New York, NY, USA) “Predictive Coding in the *Drosophila* Antennal Lobe”
- Martin Nawrot (University of Cologne, Cologne, Germany) “Transfer learning for predicting sensory evidence in the insect mushroom body”
- Alex Koulakov (Cold Spring Harbor Laboratory, New York, NY, USA) “Neural networks that sample the space of molecules”

## **W11 Dopaminergic Signaling Workshop**

*Room B1, Tue 9:30 to 13:10 and Wed 9:30 to 13:10*

**Carmen Canavier**, LSU Health Science Center, New Orleans

This workshop will examine dopaminergic signaling from the perspective of the afferent inputs to dopamine neurons, to plasticity of afferent synapses onto dopamine neurons, to the dynamic diversity of dopamine neuron subpopulations, to plasticity and other forms of dopaminergic signaling in the SNc and VTA as well as in projection areas such as the striatum and prefrontal cortex, with reference to depression, schizophrenia, Parkinson's and addiction. This work is timely in that the diversity of dopaminergic populations is beginning to be appreciated and significant because of the cognitive, motor and motivational functional circuits that rely on dopaminergic signaling.

Please see our website [https://www.medschool.lsuhscc.edu/cell\\_biology/2019\\_cns\\_meeting.aspx](https://www.medschool.lsuhscc.edu/cell_biology/2019_cns_meeting.aspx) for full abstracts and schedule.

### **Speakers:**

- Joshua Berke (UCSF, San Francisco, USA) "Dissociable dopamine dynamics for learning and motivation"
- Avrama Blackwell (George Mason University, Washington DC, USA) "The role of dopamine and post-synaptic signaling molecules in synaptic plasticity and relapse to alcohol use"
- Carmen Canavier (Louisiana State University Health Sciences Center, New Orleans, USA) "Dynamic diversity underlying pauses and bursting in SNc dopamine neurons"
- Kenji Doya (Okinawa Institute of Science and Technology Okinawa, Japan) "Possible roles of dopamine in model-free and model-based decision and learning"
- Rebekah Evans (NIH, Bethesda, USA) "A dendrite-specific striatonigral circuit facilitates dopamine rebound"
- Arif Hamid (Brown University, Providence, USA) "Wave-like spatio-temporal patterns organize dopamine transients into compartmentalized decision-signals"
- Eleonora Russo (Central Institute of Mental Health, Mannheim, Germany) "Effects of phasic dopamine in sensory representations and their perceived salience"
- Laurent Venance (Center for Interdisciplinary research in Biology, Collège de France, Paris, France) "Dopamine-endocannabinoid interactions mediate bidirectional spike timing dependent plasticity in the striatum"
- Martin Vinck (Ernst Struengmann Institute for Neuroscience in Cooperation with Max Planck Society, Frankfurt, Germany) "Tuning of neuronal interactions in the lateral Ventral Tegmental Area by dopamine sensitivity"
- Jeff Wickens (Okinawa Institute of Science and Technology, Okinawa, Japan) "Timing of dopamine directs synaptic plasticity"
- Denis Zakharov (Higher School of Economics, Moscow, Russia) "Role of VTA GABAergic neurons in high-frequency firing of dopaminergic neuron"
- Larry Zweifel (University of Washington, Seattle, USA) "Specialized dopamine projection neurons work cooperatively to maximize reward reinforcement"

## **W12 Diversity and function of interneurons**

*Room T1 (Tue), Room T2 (Wed), Tue 9:30 to 13:10 and Wed 14:50 to 18:30*

**Luis Garcia Del Molino**, New York University

**Jorge Jaramillo**, New York University

**Jorge Mejias**, University of Amsterdam

Inhibitory interneurons exhibit much more variability than excitatory neurons in terms of morphology, electrophysiology, and connectivity. Advanced experimental techniques, such as optogenetics, have allowed to better classify neuronal activity by neuron type providing new insight into cortical dynamics. Early models of neuronal networks relied on the presence of a homogeneous inhibitory population, but these models cannot account for many novel experimental observations. Updated circuit models that include interneuron heterogeneity expose the potential roles of different interneuron types.

The aim of this workshop is to provide an overview of recent developments in the field focusing on functional approaches to interneuron modeling.

Please see our website <https://sites.google.com/view/cns19interneuron/home> for full abstracts and schedule.

### **Speakers:**

- Hanna Bos (University of Pittsburg) “Arousal unlocks interneuron heterogeneity in olfactory codes”
- Conrado Bosman (Universiteit van Amsterdam) “Pre-stimulus arousal states modulate stimulus evoked pupil responses and neural dynamics in awake ferrets”
- Angus Chadwick (University College London) “Data driven modelling of excitatory-inhibitory cortical dynamics”
- Mario Dipoppa (Columbia University) “Mean-field model of a cortical microcircuit in mouse V1”
- Shirin Dora (Universiteit van Amsterdam) TBA
- Luis Garcia del Molino (New York University) “Paradoxical response reversal of top-down modulation in cortical circuits with three interneuron types”
- Boris Gutkin (Ecole Normale Supérieure de Paris) “Cholinergic modulation of hierarchical inhibitory circuitry in the prefrontal cortex controls resting state activity”
- Jorge Jaramillo (New York University) “Engagement of the thalamic reticular nucleus in decision confidence computations”
- Stefan Mihalas (Allen Institute) “Exploring the role of inhibitory cell types in artificial neural networks using matrix factorization”
- Horacio Rotstein (New Jersey Institute of Technology) “Post-inhibitory rebound interacts with preventing or deleting mechanisms to generate theta spiking resonance in hippocampal CA1 pyramidal cells”
- Katharina Wilmes (Imperial College London) “Interneuron circuits for guiding local plasticity based on top-down signals”

## **W13 Integrative Theories of Cortical Function**

*Room T1, Wed 9:30 to 18:30*

**Hamish Meffin**, The University of Melbourne

**Anthony Burkitt**, The University of Melbourne

**Ali Almasi**, National Vision Research Institute of Australia

Understanding how our brain computes and analyses sensory inputs from our external environment whilst enabling us to experience such rich and varied mental lives is one of the great scientific challenges of the 21st century. An attempt to understand the underlying integrative principles of cortical functions have led to appealing computational theories. In concert with these theories, multiple models have been developed that are implementing cortical computations as diverse as sensory perception, control of voluntary motor activity and high-level cognitive functions. This workshop aims to look at some of the recent advances in development of theories governing these cortical computations, the models implementing those computations, and the experimental evidence that is used to differentiate between models.

The goal of the workshop is to bring together and foster a dialogue between theoreticians, modelers and experimentalists. The workshop is targeted towards both computational and experimental neuroscientists with interest in understanding the computations that are carried out in the cortex.

For an up to date list of talks and schedule please see the workshop website.

### **Speakers** (alphabetical order):

- Sacha van Albada (Jülich Research Centre, Germany) “Bringing together cortical structure and dynamics in large-scaling spiking network models”
- Ali Almasi (University of Melbourne and National Vision Research Institute, Australia) “Feature selectivity and invariance in primary visual cortex”
- Anthony N. Burkitt (Biomedical Engineering, University of Melbourne, Australia) “Predictive coding through time: Real-time temporal alignment of neural activity in neural circuits”
- Yves Fregnac (CNRS-UNIC - Unité de Neurosciences, Information et Complexité, Gif-sur-Yvette, France) “Role of Horizontal connectivity in contour co-linearity and filling-in prediction in the Primary Visual Cortex”
- Anna Levina (University of Tübingen, Germany) “Optimization of computational capabilities by poisoning neuronal systems close to criticality”
- Max Nolte (Blue Brain Project, EPFL, Switzerland) “Cortical reliability amid noise and chaos”
- Thomas Parr (Wellcome Centre for Human Neuroimaging, Institute of Neurology, UCL, UK) “The anatomy of (active) inference”
- Alex Reyes (Center for Neural Science, New York University, USA) “Mathematical structures and operations for representing sound frequency and intensity”

## **W14 Graph modeling of macroscopic brain activity**

*Room T2, Tue 9:30 to 13:10 and Wed 9:30 to 13:10*

**Ashish Raj**, University of California San Francisco

**Eva Palacios**, University of California San Francisco

**Pratik Mukherjee**, University of California San Francisco

One of the most important questions in computational neuroscience is how the brain's structural wiring gives rise to its function and its patterns of activity. Although numerical models of single neurons and local microscopic neuronal assemblies, ranging from simple integrate-and-fire neurons to detailed multi-compartment and multi-channel models have been proposed, it is unclear if these models can explain structure-function coupling at meso- or macroscopic scales. Therefore, there is a need for more direct models of structural network-induced neural activity patterns and a need for collecting various modeling efforts together in one place, in order to catalyze discussion of how these approaches can be combined to produce new models that are more effective than their individual constituent elements. In this workshop we have put together recent modeling efforts aimed towards filling the chasm between neuron-level and whole brain activity modeling. We focus largely but not exclusively on graph models for this purpose, since at the macroscopic scale, brain regions interact with each other via long range projection fibers – a network organization that is best addressed using graph theory. Graph theory will play an increasingly important role in attempts to understand the massive amounts of data generated by large collaborative projects such as the Human Connectome Project.

### **Speakers:**

- Bill Lytton (SUNY Downstate Medical Center, New York, USA) “Biomimesis for computer simulation: multi-scale modeling to connect micro, meso, and macro”
- Willem de Haan (VUmc, Amsterdam, Netherlands) “Connectome-coupled neural mass model of macroscopic brain activity: the essential tool for activity-targeting treatment development in Alzheimer's disease?”
- Prejaas Tewarie (University of Nottingham, United Kingdom; VU University Amsterdam, Netherlands) “Explaining frequency specific spatiotemporal patterns of electrophysiological networks”
- Pratik Mukherjee (University of California, San Francisco, USA) “How white matter microstructure & connectivity can inform graph models of brain activity”
- Ashish Raj (University of California, San Francisco, USA) “A linear spectral graph model of brain activity”
- Sebastien Naze (BM Research, USA) “Sensitivity analysis of the connectome harmonics framework and its application to neurodegenerative disorders”
- Alex Leow (University of Illinois, Chicago, USA) “Can we vectorize the resting state and compute the speed of mind? Embedding brain dynamics using manifold learning and spectral graph theory with applications to fMRI and EEG”
- Roser Sala-Llonch (University of Barcelona, Barcelona) “Methodological choices related to the estimation of brain Functional Connectivity signals”
- Gorka Zamora-López (Pompeu Fabra University, Barcelona, Spain) “Model-based graph theory to the rescue: a new framework to interpret the relation between structural connectivity and function”
- Adeel Razi (Monash University, Melbourne, Australia) “Dynamic causal modelling (DCM) of the resting brain”
- Martijn van den Heuvel (VU Amsterdam, Netherlands) “Computational models of disconnectivity in disease”

## **W15 Manifolds for neural computation**

*Room B3, Tue 9:30 to 13:10 and Wed 9:30 to 13:10*

**Matthew G. Perich**, University of Geneva

**Juan A. Gallego**, Spanish National Research Council (CSIC), Madrid

**Sara A. Solla**, Northwestern University, Chicago

In recent years, the neural manifold framework has spurred numerous advances in our understanding of cortical function. This framework proposes that the building blocks of neural computation are population-wide patterns of neuronal covariation, rather than the independent modulation of single neurons. Our workshop will bring together a diverse panel to discuss new advances and unanswered questions related to the identification and computational role of neural manifolds. The workshop will be split into two sessions. In the first, we will focus on theoretical and experimental work exploring the role of manifolds in neural computation. In the second session we will begin to merge the theory with mathematical and methodological considerations. We will explore the implications of linear vs nonlinear manifold estimation and statistical vs dynamical characterization of manifold activity. Each speaker will give a short talk, followed by a lengthy moderated discussion. This workshop is designed to inspire future work towards understanding manifold neural computation through experiments, theory, and computational techniques.

Please see our website <https://mperi.ch/ocns2019.htm> for full abstracts and the schedule.

### **Speakers:**

- Matthew Perich (University of Geneva, Geneva, Switzerland) “Long-term stability of the low-dimensional dynamics of neural population activity associated with consistent behavior”
- Devika Narain (Erasmus Medical Center, Rotterdam, Netherlands) “Flexible timing through recurrent cortical dynamics”
- Emily Oby (University of Pittsburgh, Pittsburgh, USA) “New neural activity patterns emerge with long-term learning”
- Srdjan Ostojic (École Normale Supérieure, Paris, France) “Shaping slow activity manifolds in recurrent neural networks”
- Benjamin Dann (German Primate Center (DPZ), Goettingen, Germany) “Neural manifold contributions do not reflect the network communication structure in monkey frontoparietal areas”
- Ila Fiete (Massachusetts Institute of Technology, Boston, USA) “TBD”
- Cengiz Pehlevan (Harvard University, Boston, USA) “Hebbian learning of manifolds”
- Gal Mishne (Yale University, New Haven, USA) “Manifold learning for unsupervised analysis of neuronal activity tensors”
- Allan Mancoo (Champalimau, Lisbon, Portugal) “Why higher order principal components may be irrelevant”

## **W16 Functional network dynamics: Recent mathematical perspectives**

*Room B2, Wed 9:30 to 18:30*

**Matthieu Gilson**, Universitat Pompeu Fabra, Barcelona

**David Dahmen**, Research Centre Jülich

**Moritz Helias**, Research Centre Jülich

This workshop focuses on functional aspects of collective dynamical phenomena in neuronal networks. It gathers a series of speakers who have studied biological neuronal networks with the aim of relating structure and dynamics to functions. The goal is to combine (computational) neuroscience with machine learning, statistical mechanics, information theory and graph analysis. It will be of great interest for the traditional audience of CNS.

In practice, we want to present progress in various exciting directions, such as low-dimensional dynamical manifolds, geometrical aspects of learning and representations, classification on data manifolds, learning in dynamic and spiking systems, and correlated activity as distributed representations.

The workshop is timely because recent experimental progress in simultaneous recordings of many neurons (e.g. dense electrode arrays) requires advances in mathematical neuroscience to interpret the coming data. We aim to review new perspectives for network-oriented analyses of neuronal activity by leading young researchers in the field.

Please see our website [http://matthieugilson.eu/events/workshop\\_CNS2019.html](http://matthieugilson.eu/events/workshop_CNS2019.html) for full abstracts.

### **Speakers:**

- SueYeon Chung (MIT, Cambridge, USA) “Processing of Object Manifolds in Deep Networks and the Brain”
- Ran Darshan (Janelia Research Campus, Ashburn, Virginia, USA) “Spatiotemporal correlations emerge from feedforward structures in balanced networks”
- Stefano Fusi (Columbia University, New York, USA) TBA
- Julia Gallinaro and Stefan Rotter (BCCN Freiburg, Germany) “Associative properties of structural plasticity based on firing rate homeostasis in recurrent neuronal networks”
- Leonidas Richter and Julijana Gjorgjieva (Max Planck Institute for Brain Research and Technical University of Munich, Germany) “Linking cortical plasticity and activity changes following monocular deprivation in model networks of visual cortical circuits”
- Raoul-Martin Memmesheimer (University of Bonn, Germany) “Dynamical learning of dynamics”
- Taro Toyozumi (Riken BSI, Wako-shi, Japan) “Intrinsic spine dynamics are critical for recurrent network learning in models with and without autism spectrum disorder”
- Friedemann Zenke (Friedrich Miescher Institute, Basel, Switzerland) “Building functional spiking neural networks using surrogate gradients”

## **W17 Computational modelling of brain networks in Electroencephalography**

*Room B6, Wed 9:30 to 18:30*

**Benedetta Franceschiello**, Lausanne University Hospital

**Katharina Glomb**, Lausanne University Hospital

Electroencephalography (EEG) is a non-invasive neuroimaging technique. It records the scalp voltage potentials resulting from current flow in and around neurons, providing a direct measure of brain activity. EEG has an excellent temporal resolution, its affordability and portability contribute to its huge potential for research and clinical applications. Nevertheless it lacks spatial resolution and recordings suffer from the effects of instantaneous field spread. These problems are mathematically underdetermined, therefore it has been proposed to use computational models to circumvent them. Computational models allow experimenters to simulate phenomena and interactions beyond what could be physiologically tested and observed in the real world. We believe that the use of computational modelling of brain networks could greatly help to overcome the limitations of EEG recordings, while at the same time computational models would benefit from real-time recordings. The aim of this workshop is to gather together experts of both communities to bridge these subjects.

Please see our website <https://sites.google.com/view/ocns-2019-eeg-comp-model> for full abstracts and schedule.

### **Speakers:**

- Joana Cabral (Life and Health Sciences Research Institute, University of Minho, Portugal) “Emergence of frequency-specific long-range coherence in the neuroanatomical Connectome”
- Ashish Raj (School of Medicine, UCSF, San Francisco, US) “Eigenmodes of the brain: a graph spectral theory of brain activity”
- Anna Cattani (Department of Biomedical and Clinical Sciences “Luigi Sacco”, Milan, Italy) “A modelling approach for describing stimulation and electrophysiological recording of unconscious and conscious brain states”
- Alberto Mazzoni (BioRobotics Institute, Scuola Superiore Sant’Anna, Pisa, Italy) “Thalamocortical connectivity models account for functional interplay between spectra of extracellular activity in the two areas”
- Alain Destexhe (Paris-Saclay Institute of Neuroscience, CNRS, Gif sur Yvette, France) “Do local field potentials and the EEG primarily reflect inhibitory processes?”
- Benedetta Franceschiello and Katharina Glomb (CHUV, Lausanne, Switzerland) “Computational model of EEG: why we should be bothered”



## W18 VirtualBrainCloud

Room S3 (Tue), Room S2 (Wed), Tue 9:30 to 13:10 and Wed 14:50 to 18:30

**Petra Ritter**, Charité-Universitätsmedizin Berlin

**Julie Courtiol**, Charité-Universitätsmedizin Berlin

We present the *VirtualBrainCloud*—a EU project—that merges existing software tools and platforms to provide access to high quality clinical multi-disciplinary data in order to integrate them via computational modeling, and make them useful in clinical practice.

Central to this project is the large-scale simulation platform *The Virtual Brain (TVB)*. This simulation environment allows the biologically realistic modeling of network dynamics of human and mouse brain using connectome-based approaches across different brain scales: from cellular to whole-brain level. This computational modeling system is tailored to the individual, and bridges multiple scales to identify key mechanisms that predict disease progression and serves as Precision Decision Support System.

The workshop provides insight in the interdisciplinary work and related challenges that range from computational and clinical neuroscience to infrastructure, and legal and ethical matters. Our international speakers team, from EU and Canada, comprises a balanced composition of genders and seniority levels.

Please see our event webpage [http://bit.ly/CNS2019\\_VBC](http://bit.ly/CNS2019_VBC) for program, full abstracts, and additional information.

### Speakers:

- Hannelore Aerts (Ghent University, Belgium) "Modeling brain dynamics in brain tumor patients"
- Anastasia Brovkin (University Medical Center Hamburg-Eppendorf, Germany) "Interfacing TVB with a digital atlas"
- Julie Courtiol (Charité-Universitätsmedizin Berlin, Germany) "The Virtual Epileptic Patient"
- Nikolaus Forgo (University of Vienna, Austria) "Ethical and legal aspects of personalized brain simulation and data sharing"
- Sumit Madan (Fraunhofer SCAI, Germany) "Terminologies, ontologies and data curation"
- Randy McIntosh (University of Toronto, Canada) "The Neurodegenerative Virtual Brain"
- Alexander Peyser (Forschungszentrum Jülich, Germany) "Cloud and HPC solutions"
- Oleksandr Popovych (Forschungszentrum Jülich, Germany) "Enriching big data analytics by computational modeling"
- Petra Ritter (Charité-Universitätsmedizin Berlin, Germany) "The Virtual Brain Simulation Platform and VirtualBrainCloud"
- Gianluca Susi (Technical University of Madrid, Spain and University of Rome "Tor Vergata") "Linking spiking neural networks to TVB"
- Bertrand Thirion (Paris-Saclay University, Inria-CEA, Paris, France) "Machine-learning tools for large-scale data"
- Riccardo Zucca (Institute for Bioengineering of Catalonia, Barcelona, Spain) "BrainX3: a tool for multi-modal data integration, analysis, visualization and interaction"

## **W19 Model-Driven Closed-Loop Technologies for Neuroscience Research**

*Room S4 (Tue), Room B1 (Wed), Tue 9:30 to 13:10 and Wed 14:50 to 18:30*

**Pablo Varona**, Universidad Autónoma de Madrid

**Thomas Nowotny**, University of Sussex, UK

Experimental neuroscience research faces the fundamental problem that the nervous system is only partially observable. Neural information processing occurs on many different interacting spatial and temporal scales and this is not fully reflected in the time series of a single or a few recording modalities. Moreover, spatial and temporal resolution and coverage are not the only aspects that limit insights into the information dynamics in the nervous system. Most experimental protocols in neuroscience research are based on recordings of spontaneous activity or on classical stimulus-response paradigms, where the nervous system under observation is stimulated and the response is then analyzed offline. Temporal aspects of input signals are often investigated by delivering stimuli prepared a priori, with a pre-determined temporal structure. However, neural activity is mostly transient and nonstationary and hence the associated information processing is history-dependent, contextual and involves sequential activations in feedback computations, which adds to the inherent observation intricacy.

In this context, closed-loop technologies allow designing novel experimental protocols to address the nature of partial observations in experimental neuroscience research. In addition, closed-loop methodologies can be used to deal with the transient nature of neural activity by exploring neural dynamics through online interaction. They allow to build more accurate models and bridge between disparate levels of analysis, including the study of the interplay between different spatial and temporal scales in neural computation, even when addressing just a single observation modality.

In this workshop we address the current state-of-the-art of closed-loop approaches in neuroscience and, in particular, the use of models to drive such interactions: from in vitro protocols all the way-up to behavioral and human closed-loop fMRI and neurorehabilitation protocols. The discussion will touch upon the important fact that these protocols are not easy to design and implement and that novel theoretical and technical approaches are needed.

This workshop is intended to gather researchers from computational and experimental neuroscience who are currently working on the theoretical design and practical implementation of closed-loop schemes for neuroscience research. We also target the computational neuroscience community more widely, who seek ways to constrain their models' parameter spaces, while sustaining a wide reproducibility of dynamics as revealed by closed-loop interactions. Methods originally developed in Information Theory have found wide applicability in computational neuroscience. Beyond these original methods there is a need to develop novel tools and approaches that are driven by problems arising in neuroscience.

Please see our website <http://www.ii.uam.es/~gnb/CNSclosedloop.html> for full information and additional contributed talks (to be announced).

### **Speakers:**

- Pablo Varona (Universidad Autónoma de Madrid, Spain) "On the need for multiscale closed-loops in neuroscience research"
- Thomas Nowotny (University of Sussex, UK) "Closed-loop electrophysiology for single cell investigations"
- Daniele Linaro (Leuven Center for Brain and Disease Research, Belgium) "Real-time closed-loop electrophysiology to investigate correlation transfer in cortical neurons"
- Attila Szücs (University of California San Diego, US) "Differential and frequency-dependent regulation of intrinsic excitability by voltage-dependent membrane currents"
- Mel Stater (Universitat de Barcelona, Spain) "Virtual reality in closed-loop learning"
- Plus additional contributed talks and interactive software demos ...

## **W20 Phase Transitions in Brain Networks**

*Room B2, Tue 9:30 to 13:10*

**Leonardo Gollo**, QIMR Berghofer Medical Research Institute, Australia

**Linda Douw**, Amsterdam UMC Medical Center

Phase transitions occur in a variety of physical and biological systems, including brain networks. They are characterized by instabilities that generate special dynamical properties, which are associated with dynamical and functional benefits. Phase transition is also an appealing framework that has been utilised to explain pathological brain activity. Historically, the idea of phase transitions in the brain is not new and has sparked some controversy over the years. In this half-day workshop, a number of current world-class experts will revisit the possible roles of phase transitions in the brain. They will discuss the recent progress in the field and the relevance and limitations of this framework to computational neuroscience. In order to further exploit and explicitize contemporary viewpoints on the promises and pitfalls of phase transitions in the brain, we will end this workshop with a roundtable discussion in which the speakers and the audience will be invited to participate.

Please see our website <http://www.sng.org.au/cns-2019-workshop> for full abstracts, and schedule.

### **Speakers:**

- Anna Levina (MPI) “Influence of spatial structure on data processing and phase transitions in neuronal networks”
- Serena di Santo (Universidad de Granada) “Building a Landau-Ginzburg theory of the brain”
- Jonathan Touboul (Brandeis University) “The statistical mechanics of noise-induced phase transitions”
- Fernando Santos (UFPE) “Topological phase transitions in functional brain networks”
- James Roberts (QIMRB) “Geometry and fragility of the human connectome”
- Linda Douw (Amsterdam UMC) “A historical perspective on phase transitions in the brain”

## **W21 Modeling astrocyte functions: From ion channels to calcium dynamics and beyond**

*Room S5, Tue 9:30 to 13:10*

**Marja-Leena Linne**, Tampere University, Finland

**Predrag Janjic**, Macedonian Academy of Sciences and Arts, Skopje

A fundamental question in neuroscience is how different mechanisms of glial cell function, particularly the astrocytes, are linked with cognitive functions and behavior in mammals, as well as in mechanisms of brain disease. Various evidence has accumulated on the roles of astrocytes in neuronal excitability, synaptic transmission, plasticity, and in higher cognitive functions. It is a disturbing reality that most of computational cellular neuroscience concentrates on modeling of the neuronal functions only, largely ignoring other brain cells in the models of neural circuits. Their roles in electrical, neuromodulatory and metabolic signaling is being elucidated daily, and their quantitative properties slowly emerge. The goal of the workshop is to present the state-of-the-art in quantitative aspects of astrocytic function and computational modeling of astrocytes in order to facilitate better understanding of the functions and dynamics of brain circuits. We concentrate on single astrocyte and small astrocyte networks, with an emphasis on methodological issues and principal difficulties for bridging the gap between the models and experimental studies.

Please see our website <https://sites.tuni.fi/cns2019-w21astro/> for full abstracts and schedule.

### **Speakers:**

- Short introduction by the organizers: "Why is glioscience modeling neglected within the field of computational neuroscience? "
- Marja-Leena Linne (Tampere University, Tampere, Finland), "Understanding the role of glial cells in brain functions through in vivo, in vitro and in silico approaches"
- Corrado Cali (King Abdullah University of Science and Technology, Thuwal, Saudi Arabia), "Morphological basis of brain energy metabolism in the mammalian brain: focus on astrocytes"
- Tiina Manninen (Tampere University, Finland and Stanford University, USA), "Computational models of astrocyte calcium dynamics and astrocyte-neuron interactions"
- Predrag Janjic (Macedonian Academy of Sciences and Arts, Skopje, North Macedonia), "Quantitative description of potassium transport in astrocytes: Are the dynamical models in reach?"
- Leonid Savtchenko (University College London, London, UK), "ASTRO: A Cloud-computing model builder to explore realistically morphed astrocytes in silico"
- Gaute Einevoll (University of Oslo, Oslo, Norway), "Modeling astrocytic regulation of extracellular ion concentrations and extracellular fields"
- Discussion and wrap-up, 15 min.

## **W22 Student and Postdoc Career Development Workshop**

*Aula Capella, Tue 9:30 to 13:10*

**Ankur Sinha**, University of Hertfordshire, UK

**Anca Doloc-Mihu**, Georgia Gwinnett College, USA

**Sharmila Venugopal**, University of California Los Angeles

The Computational Neuroscience community is a diverse, international, and interdisciplinary community allowing for various successful career paths, each with their own requirements. Students and postdocs in the community are similarly presented with a diverse range of challenges, and excellent mentorship from current leaders in the CNS community is an invaluable resource for the development of future leaders in research or industry.

This workshop will provide CNS students and postdocs the opportunity to learn about successful career paths and strategies from a panel of established computational neuroscientists. Participants will hear from a range of professionals, from junior faculty having recently transitioned from postdoc status, researchers working outside of their home countries, to senior faculty who are involved in reviewing journals, grants, and making academic hirings. The panellists will discuss their current roles, their duties, their career paths, and the skills necessary to navigate them. The workshop will focus on providing suggestions, advice, tips, tricks, do's and don'ts on developing these skills with the goal of preparing the attendees for their professional journeys.

Postdocs and students are encouraged to ask questions to the speakers and participate in the discussion of topics of universal interest or specific concerns. To further foster communication in the group and address more specific questions, attendees will be invited to go out for lunch together with the organisers and panellists after the workshop.

The organisers are in the process of preparing a dossier of information that will be disseminated to the research community after the workshop. This will include information gathered from a questionnaire, along with salient points filtered from the discussion and Q and A sessions that will be held at the workshop.

Please see our web page at <http://biocomputation.herts.ac.uk/pages/2019-cns-workshop.html> for more information and the link to the survey.



# Posters

# Poster Listing

## Sunday Posters Posters P1 – P120

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**P1 Promoting community processes and actions to make neuroscience FAIR**

Malin Sandström\*, Mathew Abrams

*INCF, INCF Secretariat, Stockholm, Sweden*

**P2 Ring integrator model of the head direction cells**

Anu Aggarwal\*

*Grand Valley State University, Electrical and Computer Engineering, Grand Rapids, MI, United States of America*

**P3 Parametric modulation of distractor filtering in visuospatial working memory.**

Davd Bestue<sup>1\*</sup>, Albert Compte<sup>2</sup>, Torkel Klingberg<sup>3</sup>, and Rita Almeida<sup>4</sup>

<sup>1</sup>*IDIBAPS, Barcelona, Spain*

<sup>2</sup>*IDIBAPS, Systems Neuroscience, Barcelona, Spain*

<sup>3</sup>*Karolinska Institutet, Stockholm, Sweden*

<sup>4</sup>*Stockholm University, Stockholm, Sweden*

**P4 Dynamical phase transitions study in simulations of finite neurons network**

Cecilia Romaro<sup>1\*</sup>, Fernando Najman<sup>2</sup>, and Morgan Andre<sup>2</sup>

<sup>1</sup>*University of São Paulo, Department of Physics, Ribeirão Preto, Brazil*

<sup>2</sup>*University of São Paulo, Institute of Mathematics and Statistics, São Paulo, Brazil*

**P5 Computational modeling of genetic contributions to excitability and neural coding in layer V pyramidal cells: applications to schizophrenia pathology**

Tuomo Mäki-Marttunen<sup>1\*</sup>, Gaute Einevoll<sup>2</sup>, Anna Devor<sup>3</sup>, William A. Phillips<sup>4</sup>, Anders M. Dale<sup>3</sup>, and Ole A. Andreassen<sup>5</sup>

<sup>1</sup>*Simula Research Laboratory, Oslo, Norway*

<sup>2</sup>*Norwegian University of Life Sciences, Faculty of Science and Technology, Aas, Norway*

<sup>3</sup>*University of California, San Diego, Department of Neurosciences, La Jolla, United States of America*

<sup>4</sup>*University of Stirling, Psychology, Faculty of Natural Sciences, Stirling, United Kingdom*

<sup>5</sup>*University of Oslo, NORMENT, KG Jebsen Centre for Psychosis Research, Division of Mental Health and Addiction, Oslo, Norway*



- P6 Spatiotemporal dynamics underlying successful cognitive therapy for posttraumatic stress disorder**  
 Marina Charquero<sup>1\*</sup>, Morten L Kringelbach<sup>1</sup>, Birgit Kleim<sup>2</sup>, Christian Ruff<sup>3</sup>, Steven C.r Williams<sup>4</sup>, Mark Woolrich<sup>5</sup>, Vidaurre Diego<sup>5</sup>, and Ehlers Anke<sup>6</sup>  
<sup>1</sup>University of Oxford, Department of Psychiatry, Oxford, United Kingdom  
<sup>2</sup>University of Zurich, Psychotherapy and Psychosomatics, Zurich, Switzerland  
<sup>3</sup>University of Zurich, Zurich Center for Neuroeconomics (ZNE), Department of Economics, Zurich, Switzerland  
<sup>4</sup>King's College London, Neuroimaging Department, London, United Kingdom  
<sup>5</sup>University of Oxford, Wellcome Trust Centre for Integrative NeuroImaging, Oxford Centre for Human Brain Activity (OHBA), Oxford, United Kingdom  
<sup>6</sup>University of Oxford, Oxford Centre for Anxiety Disorders and Trauma, Department of Experimental Psychology, Oxford, United Kingdom
- P7 Experiments and modeling of NMDA plateau potentials in cortical pyramidal neurons**  
 Peng Gao<sup>1</sup>, Joe Graham<sup>2\*</sup>, Wen-Liang Zhou<sup>1</sup>, Jinyoung Jang<sup>1</sup>, Sergio Angulo<sup>2</sup>, Salvador Dura-Bernal<sup>2</sup>, Michael Hines<sup>3</sup>, William W Lytton<sup>2</sup>, and Srdjan Antic<sup>1</sup>  
<sup>1</sup>University of Connecticut Health Center, Department of Neuroscience, Farmington, CT, United States of America  
<sup>2</sup>SUNY Downstate Medical Center, Department of Physiology and Pharmacology, Brooklyn, NY, United States of America  
<sup>3</sup>Yale University, Department of Neuroscience, CT, United States of America
- P8 Systematic automated validation of detailed models of hippocampal neurons against electrophysiological data**  
 Sára Sáráy<sup>1\*</sup>, Christian A Rössert<sup>2</sup>, Andrew Davison<sup>3</sup>, Eilif Muller<sup>2</sup>, Tamas Freund<sup>4</sup>, Szabolcs Kali<sup>4</sup>, and Shailesh Appukuttan<sup>3</sup>  
<sup>1</sup>Faculty of Information Technology and Bionics, Pázmány Péter Catholic University, Hungary  
<sup>2</sup>École Polytechnique Fédérale de Lausanne, Blue Brain Project, Lausanne, Switzerland  
<sup>3</sup>Centre National de la Recherche Scientifique, Université Paris-Sud, Paris-Saclay Institute of Neuroscience, Gif-sur-Yvette, France  
<sup>4</sup>Institute of Experimental Medicine, Hungarian Academy of Sciences, Budapest, Hungary
- P9 Systematic integration of experimental data in biologically realistic models of the mouse primary visual cortex: Insights and predictions**  
 Yazan Billeh<sup>1\*</sup>, Binghuang Cai<sup>2</sup>, Sergey Gratiy<sup>1</sup>, Kael Dai<sup>1</sup>, Ramakrishnan Iyer<sup>1</sup>, Nathan Gouwens<sup>1</sup>, Reza Abbasi-Asl<sup>2</sup>, Xiaoxuan Jia<sup>3</sup>, Joshua Siegle<sup>1</sup>, Shawn Olsen<sup>1</sup>, Christof Koch<sup>1</sup>, Stefan Mihalas<sup>1</sup>, and Anton Arkhipov<sup>1</sup>  
<sup>1</sup>Allen Institute for Brain Science, Modelling, Analysis and Theory, Seattle, WA, United States of America  
<sup>2</sup>Allen Institute for Brain Science, Seattle, WA, United States of America  
<sup>3</sup>Allen Institute for Brain Science, Neural Coding, Seattle, WA, United States of America
- P10 Small-world networks enhance the inter-brain synchronization**  
 Kentaro Suzuki<sup>1\*</sup>, Jihoon Park<sup>2</sup>, Yuji Kawai<sup>2</sup>, and Minoru Asada<sup>2</sup>  
<sup>1</sup>Osaka University, Graduate School of Engineering, Minoh City, Japan  
<sup>2</sup>Osaka University, Suita, Osaka, Japan

- P11 A potential mechanism for phase shifts in grid cells: leveraging place cell remapping to introduce grid shifts**  
 Zachary Sheldon<sup>1\*</sup>, Ronald Ditullio<sup>2</sup>, and Vijay Balasubramanian<sup>2</sup>  
<sup>1</sup>University of Pennsylvania, Philadelphia, PA, United States of America  
<sup>2</sup>University of Pennsylvania, Computational Neuroscience Initiative, Philadelphia, United States of America
- P12 Computational modeling of seizure spread on a cortical surface explains the theta-alpha electrographic pattern**  
 Viktor Sip<sup>1\*</sup>, Viktor Jirsa<sup>1</sup>, Maxime Guye<sup>2</sup>, and Fabrice Bartolomei<sup>3</sup>  
<sup>1</sup>Aix-Marseille Université, Institute de Neurosciences, Marseille, France  
<sup>2</sup>Aix-Marseille Université, Centre de Résonance Magnétique Biologique et Médicale, Marseille, France  
<sup>3</sup>Assistance Publique - Hôpitaux de Marseille, Service de Neurophysiologie Clinique, Marseille, France
- P13 Bistable firing patterns: one way to understand how epileptic seizures are triggered**  
 Fernando Borges<sup>1\*</sup>, Paulo Protachevicz<sup>2</sup>, Ewandson Luiz Lameu<sup>3</sup>, Kelly Cristiane Iarosz<sup>4</sup>, Iberê Caldas<sup>4</sup>, Alexandre Kihara<sup>1</sup>, and Antonio Marcos Batista<sup>5</sup>  
<sup>1</sup>Federal University of ABC, Center for Mathematics, Computation, and Cognition., São Bernardo do Campo, Brazil  
<sup>2</sup>State University of Ponta Grossa, Graduate in Science Program, Ponta Grossa, Brazil  
<sup>3</sup>National Institute for Space Research (INPE), LAC, São José dos Campos, Brazil  
<sup>4</sup>University of São Paulo, Institute of Physics, São Paulo, Brazil  
<sup>5</sup>State University of Ponta Grossa, Program of Post-graduation in Science, Ponta Grossa, Brazil
- P14 Can sleep protect memories from catastrophic forgetting?**  
 Oscar Gonzalez<sup>1\*</sup>, Yury Sokolov<sup>2</sup>, Giri Krishnan<sup>2</sup>, and Maxim Bazhenov<sup>2</sup>  
<sup>1</sup>University of California, San Diego, Neurosciences, La Jolla, CA, United States of America  
<sup>2</sup>University of California, San Diego, Medicine, La Jolla, United States of America
- P15 Predicting the distribution of ion-channels in single neurons using compartmental models.**  
 Roy Ben-Shalom<sup>1\*</sup>, Kyung Geun Kim<sup>2</sup>, Matthew Sit<sup>3</sup>, Henry Kyoung<sup>3</sup>, David Mao<sup>3</sup>, and Kevin Bender<sup>1</sup>  
<sup>1</sup>University of California, San-Francisco, Neurology, San-Francisco, CA, United States of America  
<sup>2</sup>University of California, Berkeley, EE/CS, Berkeley, CA, United States of America  
<sup>3</sup>University of California, Berkeley, Computer Science, Berkeley, United States of America
- P16 The contribution of dendritic spines to synaptic integration and plasticity in hippocampal pyramidal neurons**  
 Luca Tar<sup>1\*</sup>, Sára Sárny<sup>2</sup>, Tamas Freund<sup>1</sup>, Szabolcs Kali<sup>1</sup>, and Zsuzsanna Bengery<sup>2</sup>  
<sup>1</sup>Institute of Experimental Medicine, Hungarian Academy of Sciences, Budapest, Hungary  
<sup>2</sup>Faculty of Information Technology and Bionics, Pázmány Péter Catholic University, Hungary
- P17 Modelling the dynamics of optogenetic stimulation at the whole-brain level**  
 Giovanni Rabuffo<sup>\*</sup>, Viktor Jirsa, Francesca Melozzi, and Christophe Bernard  
 Aix-Marseille Université, Institut de Neurosciences des Systèmes, Marseille, France

- P18 Investigating the effect of the nanoscale architecture of astrocytic processes on the propagation of calcium signals**  
 Audrey Denizot<sup>1\*</sup>, Misa Arizono<sup>2</sup>, Weiliang Chen<sup>3</sup>, Iain Hepburn<sup>3</sup>, Hédi Soula<sup>4</sup>, U. Valentin Nägerl<sup>2</sup>, Erik De Schutter<sup>3</sup>, and Hugues Berry<sup>5</sup>  
<sup>1</sup>INSA Lyon, Villeurbanne, France  
<sup>2</sup>Université de Bordeaux, Interdisciplinary Institute for Neuroscience, Bordeaux, France  
<sup>3</sup>Okinawa Institute of Science and Technology, Computational Neuroscience Unit, Onna-Son, Japan  
<sup>4</sup>University of Pierre and Marie Curie, INSERM UMRS 1138, Paris, France  
<sup>5</sup>INRIA, Lyon, France
- P19 Neural mass modeling of the Ponto-Geniculo-Occipital wave and its neuromodulation**  
 Kaidi Shao\*, Nikos Logothetis, and Michel Besserve  
 MPI for Biological Cybernetics, Department for Physiology of Cognitive Processes, Tübingen, Germany
- P20 Oscillations in working memory and neural binding: a mechanism for multiple memories and their interactions**  
 Jason Pina<sup>1\*</sup>, G. Bard Ermentrout<sup>2</sup>, and Mark Bodner<sup>3</sup>  
<sup>1</sup>York University, Physics and Astronomy, Toronto, Canada  
<sup>2</sup>University of Pittsburgh, Department of Mathematics, Pittsburgh, PA, United States of America  
<sup>3</sup>Mind Research Institute, Irvine, United States of America
- P21 DeNSE: modeling neuronal morphology and network structure in silico**  
 Tanguy Fardet<sup>1\*</sup>, Alessio Quaresima<sup>2</sup>, and Samuel Bottani<sup>2</sup>  
<sup>1</sup>University of Tübingen, Computer Science Department - Max Planck Institute for Biological Cybernetics, Tübingen, Germany  
<sup>2</sup>Université Paris Diderot, Laboratoire Matière et Systèmes Complexes, Paris, France
- P22 Sponge astrocyte model: volume effects in a 2D model space simplification**  
 Darya Vervevko<sup>1\*</sup>, Andrey Verisokin<sup>1</sup>, Dmitry Postnov<sup>2</sup>, and Alexey R. Brazhe<sup>3</sup>  
<sup>1</sup>Kursk State University, Department of Theoretical Physics, Kursk, Russia  
<sup>2</sup>Saratov State University, Institute for Physics, Saratov, Russia  
<sup>3</sup>Lomonosov Moscow State University, Department of Biophysics, Moscow, Russia
- P23 Sodium-calcium exchangers modulate excitability of spatially distributed astrocyte networks**  
 Andrey Verisokin<sup>1\*</sup>, Darya Vervevko<sup>1</sup>, Dmitry Postnov<sup>2</sup>, and Alexey R. Brazhe<sup>3</sup>  
<sup>1</sup>Kursk State University, Department of Theoretical Physics, Kursk, Russia  
<sup>2</sup>Saratov State University, Institute for Physics, Saratov, Russia  
<sup>3</sup>Lomonosov Moscow State University, Department of Biophysics, Moscow, Russia
- P24 Building a computational model of aging in visual cortex**  
 Seth Talyansky<sup>1\*</sup>, Braden Brinkman<sup>2</sup>  
<sup>1</sup>Catlin Gabel School, Portland, OR, United States of America  
<sup>2</sup>Stony Brook University, Department of Neurobiology and Behavior, Stony Brook, NY, United States of America

- P25 Toward a non-perturbative renormalization group analysis of the statistical dynamics of spiking neural populations**  
Braden Brinkman\*  
*Stony Brook University, Department of Neurobiology and Behavior, Stony Brook, NY, United States of America*
- P26 Sensorimotor strategies and neuronal representations of whisker-based object recognition in mice barrel cortex**  
Ramon Nogueira<sup>1\*</sup>, Chris Rodgers<sup>1</sup>, Stefano Fusi<sup>2</sup>, and Randy Bruno<sup>1</sup>  
<sup>1</sup>*Columbia University, Center for Theoretical Neuroscience, New York, NY, United States of America*  
<sup>2</sup>*Columbia University, Zuckerman Mind Brain Behavior Institute, New York, United States of America*
- P27 Identifying the neural circuits underlying optomotor control in larval zebrafish**  
Winnie Lai<sup>1\*</sup>, John Holman<sup>1</sup>, Paul Pichler<sup>1</sup>, Daniel Saska<sup>2</sup>, Leon Lagnado<sup>2</sup>, and Christopher Buckley<sup>3</sup>  
<sup>1</sup>*University of Sussex, Department of Informatics, Brighton, United Kingdom*  
<sup>2</sup>*University of Sussex, Department of Neuroscience, Brighton, United Kingdom*  
<sup>3</sup>*University of Sussex, Falmer, United Kingdom*
- P28 A novel learning mechanism for interval timing based on time cells of hippocampus**  
Sorinel Oprisan<sup>1\*</sup>, Tristan Aft<sup>1</sup>, Mona Buhusi<sup>2</sup>, and Catalin Buhusi<sup>2</sup>  
<sup>1</sup>*College of Charleston, Department of Physics and Astronomy, Charleston, SC, United States of America*  
<sup>2</sup>*Utah State University, Department of Psychology, Logan, UT, United States of America*
- P29 Learning the receptive field properties of complex cells in V1**  
Yanbo Lian<sup>1</sup>, Hamish Meffin<sup>2</sup>, David Grayden<sup>1</sup>, Tatiana Kameneva<sup>3</sup>, and Anthony Burkitt<sup>1\*</sup>  
<sup>1</sup>*University of Melbourne, Department of Biomedical Engineering, Melbourne, Australia*  
<sup>2</sup>*University of Melbourne, Department of Optometry and Visual Science, Melbourne, Australia*  
<sup>3</sup>*Swinburne University of Technology, Telecommunication Electrical Robotics and Biomedical Engineering, Hawthorn, Australia*
- P30 Bursting mechanisms based on interplay of the Na/K pump and persistent sodium current**  
Gennady Cymbalyuk<sup>1\*</sup>, Christian Erxleben<sup>2</sup>, Angela Wenning-Erxleben<sup>2</sup>, and Ronald Calabrese<sup>2</sup>  
<sup>1</sup>*Georgia State University, Neuroscience Institute, Atlanta, GA, United States of America*  
<sup>2</sup>*Emory University, Department of Biology, Atlanta, GA, United States of America*
- P31 Balanced synaptic strength regulates thalamocortical transmission of informative frequency bands**  
Alberto Mazzoni<sup>1\*</sup>, Matteo Saponati<sup>2</sup>, Jordi Garcia-Ojalvo<sup>3</sup>, and Enrico Cataldo<sup>2</sup>  
<sup>1</sup>*Scuola Superiore Sant'Anna Pisa, The Biorobotics Institute, Pisa, Italy*  
<sup>2</sup>*University of Pisa, Department of Physics, Pisa, Italy*  
<sup>3</sup>*Universitat Pompeu Fabra, Department of Experimental and Health Sciences, Barcelona, Spain*

- P32 Modeling gephyrin dependent synaptic transmission pathways to understand how gephyrin regulates GABAergic synaptic transmission**  
 Carmen Alina Lupascu<sup>1\*</sup>, Michele Migliore<sup>1</sup>, Annunziato Morabito<sup>2</sup>, Federica Ruggeri<sup>2</sup>, Chiara Parisi<sup>2</sup>, Domenico Pimpinella<sup>2</sup>, Rocco Pizzarelli<sup>2</sup>, Giovanni Meli<sup>2</sup>, Silvia Marinelli<sup>2</sup>, Enrico Cherubini<sup>2</sup>, and Antonino Cattaneo<sup>2</sup>  
<sup>1</sup>*Institute of Biophysics, National Research Council, Italy*  
<sup>2</sup>*European Brain Research Institute (EBRI), Rome, Italy*
- P33 Proprioceptive feedback effects muscle synergy recruitment during an isometric knee extension task**  
 Hugh Osborne<sup>1\*</sup>, Gareth York<sup>2</sup>, Piyanee Sriya<sup>2</sup>, Marc De Kamps<sup>3</sup>, and Samit Chakrabarty<sup>2</sup>  
<sup>1</sup>*University of Leeds, Institute for Artificial and Biological Computation, School of Computing, United Kingdom*  
<sup>2</sup>*University of Leeds, School of Biomedical Sciences, Faculty of Biological Sciences, United Kingdom*  
<sup>3</sup>*University of Leeds, School of Computing, Leeds, United Kingdom*
- P34 Strategies of dragonfly interception**  
 Frances Chance\*  
*Sandia National Laboratories, Department of Cognitive and Emerging Computing, Albuquerque, NM, United States of America*
- P35 The bump attractor model predicts spatial working memory impairment from changes to pyramidal neurons in the aging rhesus monkey dlPFC**  
 Sara Ibanez Solas<sup>1\*</sup>, Jennifer Luebke<sup>2</sup>, Christina Weaver<sup>1</sup>, and Wayne Chang<sup>2</sup>  
<sup>1</sup>*Franklin and Marshall College, Department of Mathematics and Computer Science, Lancaster, PA, United States of America*  
<sup>2</sup>*Boston University School of Medicine, Department of Anatomy and Neurobiology, Boston, MA, United States of America*
- P36 Brain dynamic functional connectivity: lesson from temporal derivatives and autocorrelations**  
 Jeremi Ochab<sup>1\*</sup>, Wojciech Tarnowski<sup>1</sup>, Maciej Nowak<sup>1,2</sup>, and Dante Chialvo<sup>3</sup>  
<sup>1</sup>*Jagiellonian University, Institute of Physics, Kraków, Poland*  
<sup>2</sup>*Mark Kac Complex Systems Research Center, Kraków, Poland*  
<sup>3</sup>*Universidad Nacional de San Martín and CONICET, Center for Complex Systems & Brain Sciences (CEMSC<sup>3</sup>), Buenos Aires, Argentina*
- P37 nigeLab: a fully featured open source neurophysiological data analysis toolbox**  
 Federico Barban<sup>1\*</sup>, Maxwell D. Murphy<sup>2</sup>, Stefano Buccelli<sup>1</sup>, and Michela Chiappalone<sup>3</sup>  
<sup>1</sup>*Fondazione Istituto Italiano di Tecnologia, Rehab Technologies, IIT-INAIL Lab, Genova, Italy*  
<sup>2</sup>*University of Kansas Medical Center, Department of Physical Medicine and Rehabilitation, Kansas City, United States of America*  
<sup>3</sup>*Istituto Italiano di Tecnologia, Genova, Italy*
- P38 Neural ensemble circuits with adaptive resonance frequency**  
 Alejandro Tabas<sup>1\*</sup>, Shih-Cheng Chien<sup>2</sup>  
<sup>1</sup>*Max Planck Institute for Human Cognitive and Brain Sciences, Research Group in Neural Mechanisms of Human Communication, Leipzig, Germany*  
<sup>2</sup>*Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany*

- P39 Large-scale cortical modes reorganize between infant sleep states and predict preterm development**  
James Roberts<sup>1\*</sup>, Anton Tokariev<sup>2</sup>, Andrew Zalesky<sup>3</sup>, Xuelong Zhao<sup>4</sup>, Sampsa Vanhatalo<sup>2</sup>, Michael Breakspear<sup>5</sup>, and Luca Cocchi<sup>6</sup>  
<sup>1</sup>*QIMR Berghofer Medical Research Institute, Brain Modelling Group, Brisbane, Australia*  
<sup>2</sup>*University of Helsinki, Department of Clinical Neurophysiology, Helsinki, Finland*  
<sup>3</sup>*University of Melbourne, Melbourne Neuropsychiatry Centre, Melbourne, Australia*  
<sup>4</sup>*University of Pennsylvania, Department of Neuroscience, Philadelphia, United States of America*  
<sup>5</sup>*QIMR Berghofer Medical Research Institute, Systems Neuroscience Group, Brisbane, Australia*  
<sup>6</sup>*QIMR Berghofer Medical Research Institute, Clinical Brain Networks Group, Brisbane, Australia*
- P40 Reliable information processing through self-organising synfire chains**  
Thomas Ilett\*, David Hogg, and Netta Cohen  
*University of Leeds, School of Computing, Leeds, United Kingdom*
- P41 Acetylcholine regulates redistribution of synaptic efficacy in neocortical microcircuitry**  
Cristina Colangelo\*  
*Blue Brain Project (BBP), Brain Mind Institute, EPFL, Lausanne, Switzerland, Geneva, Switzerland*
- P42 NeuroGym: A framework for training any model on more than 50 neuroscience paradigms**  
Manuel Molano-Mazon<sup>1\*</sup>, Guangyu Robert Yang<sup>2</sup>, Christopher Cueva<sup>2</sup>, Jaime De La Rocha<sup>1</sup>, and Albert Compte<sup>3</sup>  
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- P43 Synaptic dysfunctions underlying reduced working memory serial bias in autoimmune encephalitis and schizophrenia**  
Heike Stein<sup>1\*</sup>, Joao Barbosa<sup>1</sup>, Adrià Galán<sup>1</sup>, Alba Morato<sup>2</sup>, Laia Prades<sup>2</sup>, Mireia Rosa<sup>3</sup>, Eugenia Martínez<sup>4</sup>, Helena Ariño<sup>4</sup>, Josep Dalmau<sup>4</sup>, and Albert Compte<sup>3</sup>  
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- P44 Effects of heterogeneity in neuronal electric properties on the intrinsic dynamics of cortical networks**  
Svetlana Gladysheva<sup>1\*</sup>, David Boothe<sup>2</sup>, Alfred Yu<sup>2</sup>, Kelvin Oie<sup>2</sup>, Athena Claudio<sup>1</sup>, and Bailey Conrad<sup>1</sup>  
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- P45 Structure–function multi-scale connectomics reveals a major role of the fronto-striato-thalamic circuit in brain aging**  
 Paolo Bonifazi<sup>1\*</sup>, Asier Erramuzpe<sup>1</sup>, Ibai Diez<sup>1</sup>, Iñigo Gabilondo<sup>1</sup>, Matthieu Boisgontier<sup>2</sup>, Lisa Pauwels<sup>2</sup>, Sebastiano Stramaglia<sup>3</sup>, Stephan Swinnen<sup>2</sup>, and Jesus Cortes<sup>1</sup>  
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<sup>2</sup>*Katholieke Universiteit Leuven, Department of Movement Sciences, Leuven, Belgium*  
<sup>3</sup>*University of Bari, Physics, Bari, Italy*
- P46 Studying evoked potentials in large cortical networks with PGENESIS 2.4**  
 David Beeman<sup>1\*</sup>, Alfred Yu<sup>2</sup>, and Joshua Crone<sup>3</sup>  
<sup>1</sup>*University of Colorado, Department of Electrical, Computer and Energy Engineering, Boulder, CO, United States of America*  
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<sup>3</sup>*U.S. Army Research Laboratory, Computational and Information Sciences Directorate, Aberdeen Proving Ground, MD, MD, United States of America*
- P47 Automated assessment and comparison of cortical neuron models**  
 Justas Birgiolas<sup>1</sup>, Russell Jarvis<sup>1</sup>, Vergil Haynes<sup>2</sup>, Richard Gerkin<sup>1</sup>, and Sharon Crook<sup>2\*</sup>  
<sup>1</sup>*Arizona State University, School of Life Sciences, Tempe, United States of America*  
<sup>2</sup>*Arizona State University, School of Mathematical and Statistical Sciences, Tempe, AZ, United States of America*
- P48 High dimensional ion channel composition enables robust and efficient targeting of realistic regions in the parameter landscape of neuron models**  
 Marius Schneider<sup>1\*</sup>, Peter Jedlicka<sup>2</sup>, and Hermann Cuntz<sup>3,4</sup>  
<sup>1</sup>*University of Frankfurt, Institute for Physics, Butzbach, Germany*  
<sup>2</sup>*Justus Liebig University, Faculty of Medicine, Giessen, Germany*  
<sup>3</sup>*Frankfurt Institute for Advanced Studies (FIAS), Frankfurt am Main, Germany*  
<sup>4</sup>*Ernst Strüngmann Institute (ESI), Computational Neuroanatomy, Frankfurt am Main, Germany*
- P49 Modelling brain folding using neuronal placement according to connectivity requirements**  
 Moritz Groden<sup>1\*</sup>, Marvin Weigand<sup>2,3</sup>, Jochen Triesch<sup>3</sup>, Peter Jedlicka<sup>4</sup>, and Hermann Cuntz<sup>2,3</sup>  
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<sup>4</sup>*Institute of Clinical Neuroanatomy Frankfurt, ICAR3R-Justus-Liebig University Giessen, Faculty of Medicine, Giessen, Germany*
- P50 Dynamic neural field modeling of auditory categorization tasks**  
 Pake Melland<sup>1</sup>, Bob McMurray<sup>2</sup>, and Rodica Curtu<sup>1\*</sup>  
<sup>1</sup>*University of Iowa, Department of Mathematics, Iowa City, United States of America*  
<sup>2</sup>*University of Iowa, Psychological and Brain Sciences, Iowa City, United States of America*
- P51 Role of TRP channels in temperature rate coding by drosophila noxious cold sensitive neurons**  
 Natalia Maksymchuk\*, Akira Sakurai, Atit Patel, Nathaniel Himmel, Daniel Cox, and Gennady Cymbalyuk  
*Georgia State University, Neuroscience Institute, Atlanta, GA, United States of America*

- P52 Role of Na<sup>+</sup>/K<sup>+</sup> pump in dopamine neuromodulation of a mammalian central pattern generator**  
 Alex Vargas\*, Gennady Cymbalyuk  
*Georgia State University, Neuroscience Institute, Atlanta, GA, United States of America*
- P53 Hypoxic suppression of Ca<sup>2+</sup>-ATPase pumps and mitochondrial membrane potential eliminates rhythmic activity of simulated interstitial cells of Cajal**  
 Sergiy Korogod<sup>1</sup>, Iryna Kulagina<sup>1</sup>, Parker Ellingson<sup>2</sup>, Taylor Kahl<sup>2</sup>, and Gennady Cymbalyuk<sup>2\*</sup>  
<sup>1</sup>*Bogomoletz Institute of Physiology, National Academy of Sciences of Ukraine, Kiev, Ukraine*  
<sup>2</sup>*Georgia State University, Neuroscience Institute, Atlanta, GA, United States of America*
- P54 Reconstruction and simulation of the cerebellar microcircuit: a scaffold strategy to embed different levels of neuronal details**  
 Claudia Casellato<sup>1\*</sup>, Alice Geminiani<sup>2</sup>, Alessandra Pedrocchi<sup>2</sup>, Elisa Marenzi<sup>1</sup>, Stefano Casali<sup>1</sup>, Chaitanya Medini<sup>1</sup>, and Egidio d'Angelo<sup>1</sup>  
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<sup>2</sup>*Politecnico di Milano, Department of Electronics, Information and Bioengineering, Milan, Italy*
- P55 Simplified and physiologically detailed reconstructions of the cerebellar microcircuit**  
 Elisa Marenzi<sup>1\*</sup>, Chaitanya Medini<sup>1</sup>, Stefano Casali<sup>1</sup>, Martina Francesca Rizza<sup>1</sup>, Stefano Masoli<sup>1</sup>, Claudia Casellato<sup>2</sup>, and Egidio d'Angelo<sup>2</sup>  
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<sup>2</sup>*University of Pavia, Dept. of Brain and Behavioral Sciences - Unit of Neurophysiology, Pavia, Italy*
- P56 A richness of cerebellar granule cell discharge properties predicted by computational modeling and confirmed experimentally**  
 Stefano Masoli<sup>1\*</sup>, Marialuisa Tognolina<sup>1</sup>, Francesco Moccia<sup>2</sup>, and Egidio d'Angelo<sup>1</sup>  
<sup>1</sup>*University of Pavia, Department of Brain and Behavioural Sciences, Pavia, Italy*  
<sup>2</sup>*University of Pavia, Department of Biology and Biotechnology 'L. Spallanzani', Pavia, Italy*
- P57 Spatial distribution of Golgi cells inhibition and the dynamic geometry of Cerebellum granular layer activity: a computational study**  
 Stefano Casali<sup>1</sup>, Marialuisa Tognolina<sup>1</sup>, Elisa Marenzi<sup>1</sup>, Chaitanya Medini<sup>1</sup>, Stefano Masoli<sup>1\*</sup>, Martina Francesca Rizza<sup>1</sup>, Claudia Casellato<sup>2</sup>, and Egidio d'Angelo<sup>1</sup>  
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<sup>2</sup>*University of Pavia, Department of Brain and Behavioural Sciences - Unit of Neurophysiology, Pavia, Italy*
- P58 Reconstruction and simulation of cerebellum granular layer functional dynamics with detailed mathematical models**  
 Chaitanya Medini<sup>1</sup>, Elisa Marenzi<sup>1\*</sup>, Stefano Casali<sup>1</sup>, Stefano Masoli<sup>1</sup>, Claudia Casellato<sup>2</sup>, and Egidio d'Angelo<sup>2</sup>  
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<sup>2</sup>*University of Pavia, Dept. of Brain and Behavioral Sciences - Unit of Neurophysiology, Pavia, Italy*
- P59 Reconstruction of effective connectivity in the case of asymmetric phase distributions**  
 Azamat Yeldesbay<sup>1\*</sup>, Gereon Fink<sup>2</sup>, and Silvia Daun<sup>2</sup>  
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- P60 Movement related synchronization affected by aging: A dynamic graph study**  
 Nils Rosjat\*, Gereon Fink, and Silvia Daun  
*Research Centre Juelich, Institute of Neuroscience and Medicine (INM-3), Juelich, Germany*
- P61 How a scale-invariant avalanche regime is responsible for the hallmarks of spontaneous and stimulation-induced activity: a large-scale model**  
 Etienne Hugues\*, Olivier David  
*Université Grenoble Alpes, Grenoble Institut des Neurosciences, Grenoble, France*
- P62 A real-time model fitting method for single individual neurons**  
 Felix B. Kern<sup>1\*</sup>, Thomas Nowotny<sup>2</sup>, and George Kemenes<sup>1</sup>  
<sup>1</sup>*University of Sussex, School of Life Sciences, Brighton, United Kingdom*  
<sup>2</sup>*University of Sussex, School of Engineering and Informatics, Brighton, United Kingdom*
- P63 Pybrep: Efficient and extensible software to construct an anatomical basis for a physiologically realistic neural network model**  
 Ines Wichert<sup>1</sup>, Sanghun Jee<sup>2</sup>, Sungho Hong<sup>3\*</sup>, and Erik De Schutter<sup>3</sup>  
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<sup>2</sup>*Korea University, College of Life Science and Biotechnology, Seoul, South Korea*  
<sup>3</sup>*Okinawa Institute of Science and Technology, Computational Neuroscience Unit, Okinawa, Japan*
- P64 3D modeling of complex spike bursts in a cerebellar Purkinje cell**  
 Alexey Martyushev<sup>1\*</sup>, Erik De Schutter<sup>2</sup>  
<sup>1</sup>*Okinawa Institute of Science and Technology (OIST), Erik De Schutter Unit, Onna-son, Okinawa, Japan*  
<sup>2</sup>*Okinawa Institute of Science and Technology, Computational Neuroscience Unit, Onna-Son, Japan*
- P65 Hybrid modelling of vesicles with spatial reaction-diffusion processes in STEPS**  
 Iain Hepburn\*, Sarah Nagasawa, and Erik De Schutter  
*Okinawa Institute of Science and Technology, Computational Neuroscience Unit, Onna-son, Japan*
- P66 A computational model of social motivation and effort**  
 Ignasi Cos<sup>1\*</sup>, Gustavo Deco<sup>2</sup>  
<sup>1</sup>*Pompeu Fabra University, Center for Brain & Cognition, Barcelona, Spain*  
<sup>2</sup>*Universitat Pompeu Fabra, Barcelona, Spain*
- P67 Functional inference of real neural networks with artificial neural networks**  
 Mohamed Bahdine<sup>1\*</sup>, Simon V. Hardy<sup>2</sup>, and Patrick Desrosiers<sup>3</sup>  
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- P68 Stochastic axon systems: A conceptual framework**  
Skirmantas Janusonis<sup>1\*</sup>, Nils-Christian Detering<sup>2</sup>  
<sup>1</sup>University of California, Santa Barbara, Department of Psychological and Brain Sciences, Santa Barbara, CA, United States of America  
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- P69 Replicating the mouse visual cortex using Neuromorphic hardware**  
Srijanie Dey\*, Alexander Dimitrov  
Washington State University Vancouver, Mathematics and Statistics, Vancouver, WA, United States of America
- P70 Understanding modulatory effects on cortical circuits through subpopulation coding**  
Matthew Getz<sup>1\*</sup>, Chengcheng Huang<sup>2</sup>, and Brent Doiron<sup>2</sup>  
<sup>1</sup>University of Pittsburgh, Neuroscience, Pittsburgh, PA, United States of America  
<sup>2</sup>University of Pittsburgh, Mathematics, Pittsburgh, United States of America
- P71 Stimulus integration and categorization with bump attractor dynamics**  
Jose M. Esnaola-Acebes<sup>1\*</sup>, Alex Roxin<sup>1</sup>, Klaus Wimmer<sup>1</sup>, Bharath C. Talluri<sup>2</sup>, and Tobias Donner<sup>2,3</sup>  
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<sup>2</sup>University Medical Center Hamburg-Eppendorf, Department of Neurophysiology & Pathophysiology, Hamburg, Germany  
<sup>3</sup>University of Amsterdam, Department of Psychology, Amsterdam, The Netherlands
- P72 Topological phase transitions in functional brain networks**  
Fernando Santos<sup>1\*</sup>, Ernesto P Raposo<sup>2</sup>, Maurício Domingues Coutinho-Filho<sup>2</sup>, Mauro Copelli<sup>2</sup>, Cornelis J Stam<sup>3</sup>, and Linda Douw<sup>4</sup>  
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<sup>3</sup>Vrije University Amsterdam Medical Center, Department of Clinical Neurophysiology and MEG Center, Amsterdam, Netherlands  
<sup>4</sup>Vrije University Amsterdam Medical Center, Department of Anatomy & Neurosciences, Amsterdam, Netherlands
- P73 A whole-brain spiking neural network model linking basal ganglia, cerebellum, cortex and thalamus**  
Carlos Gutierrez<sup>1\*</sup>, Jun Igarashi<sup>2</sup>, Zhe Sun<sup>2</sup>, Hiroshi Yamaura<sup>3</sup>, Tadashi Yamazaki<sup>4</sup>, Markus Diesmann<sup>5</sup>, Jean Lienard<sup>1</sup>, Heidarinejad Morteza<sup>2</sup>, Benoit Girard<sup>6</sup>, Gordon Arbuthnott<sup>7</sup>, Hans Ekkehard Plesser<sup>8</sup>, and Kenji Doya<sup>1</sup>  
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- P74 Graph theory-based representation of hippocampal dCA1 learning network dynamics**  
Giuseppe Pietro Gava<sup>1\*</sup>, Simon R Schultz<sup>2</sup>, and David Dupret<sup>3</sup>  
<sup>1</sup>Imperial College London, Biomedical Engineering, London, United Kingdom  
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- P75 Measurement-oriented deep-learning workflow for improved segmentation of myelin and axons in high-resolution images of human cerebral white matter**  
Predrag Janjic<sup>1\*</sup>, Kristijan Petrovski<sup>1</sup>, Blagoja Dolgoski<sup>2</sup>, John Smiley<sup>3</sup>, Pance Zdravkovski<sup>2</sup>, Goran Pavlovski<sup>4</sup>, Zlatko Jakjovski<sup>4</sup>, Natasa Davceva<sup>4</sup>, Verica Poposka<sup>4</sup>, Aleksandar Stankov<sup>4</sup>, Gorazd Rosoklija<sup>5</sup>, Gordana Petrushevska<sup>2</sup>, Ljupco Kocarev<sup>6</sup>, and Andrew Dwork<sup>5</sup>  
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- P76 Spike latency reduction generates efficient encoding of predictions**  
Pau Vilimelis Aceituno<sup>1\*</sup>, Juergen Jost<sup>2</sup>, and Masud Ehsani<sup>1</sup>  
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- P77 Differential diffusion in a normal and a multiple sclerosis lesioned connectome with building blocks of the peripheral and central nervous system**  
Oliver Schmitt\*, Christian Nitzsche, Frauke Ruß, Lena Kuch, and Peter Eipert  
University of Rostock, Department of Anatomy, Rostock, Germany
- P78 Linking noise correlations to spatiotemporal population dynamics and network structure**  
Yanliang Shi<sup>1\*</sup>, Nicholas Steinmetz<sup>2</sup>, Tirin Moore<sup>3</sup>, Kwabena Boahen<sup>4</sup>, and Tatiana Engel<sup>1</sup>  
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- P79 Modeling the link between optimal characteristics of saccades and cerebellar plasticity**  
Hari Kalidindi\*, Lorenzo Vannucci, Cecilia Laschi, and Egidio Falotico  
Scuola Superiore Sant'Anna Pisa, The BioRobotics Institute, Pontedera, Italy
- P80 Attractors and flows in the neural dynamics of movement control**  
Paolo Del Giudice<sup>1\*</sup>, Gabriel Baglietto<sup>2</sup>, and Stefano Ferraina<sup>3</sup>  
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- P81 Information transmission in delay-coupled neuronal circuits**  
 Jaime Sánchez Claros<sup>1\*</sup>, Claudio Mirasso<sup>1</sup>, Minseok Kang<sup>2</sup>, Aref Pariz<sup>1</sup>, and Ingo Fischer<sup>1</sup>  
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- P82 A Liquid State Machine pruning method for identifying task specific circuits**  
 Dorian Florescu\*  
*Coventry University, Coventry, United Kingdom*
- P83 Cross-frequency coupling along the soma-apical dendritic axis of model pyramidal neurons**  
 Melvin Felton<sup>1</sup>, Alfred Yu<sup>2</sup>, David Boothe<sup>2</sup>, Kelvin Oie<sup>2</sup>, and Piotr Franaszczuk<sup>2\*</sup>  
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<sup>2</sup>*U.S. Army Research Laboratory, Human Research and Engineering Directorate, Aberdeen Proving Ground, MD, United States of America*
- P84 Regional connectivity increases low frequency power and heterogeneity**  
 David Boothe\*, Alfred Yu, Kelvin Oie, and Piotr Franaszczuk  
*U.S. Army Research Laboratory, Human Research and Engineering Directorate, Aberdeen Proving Ground, MD, United States of America*
- P85 Cortical folding modulates the effect of external electrical fields on neuronal function**  
 Alfred Yu, David Boothe\*, Kelvin Oie, and Piotr Franaszczuk  
*U.S. Army Research Laboratory, Human Research and Engineering Directorate, Aberdeen Proving Ground, MD, United States of America*
- P86 Data-driven modeling of mouse CA1 and DG neurons**  
 Paola Vitale<sup>1\*</sup>, Carmen Alina Lupascu<sup>1</sup>, Luca Leonardo Bologna<sup>1</sup>, Mala Shah<sup>2</sup>, Armando Romani<sup>3</sup>, Jean-Denis Courcol<sup>3</sup>, Stefano Antonel<sup>3</sup>, Werner Alfons Hilda van Geit<sup>3</sup>, Ying Shi<sup>3</sup>, Julian Martin Leslie Budd<sup>4</sup>, Attila Gulyas<sup>4</sup>, Szabolcs Káli<sup>4</sup>, Michele Migliore<sup>1</sup>, Rosanna Migliore<sup>1</sup>, Maurizio Pezzoli<sup>5</sup>, Sara Sárday<sup>6</sup>, Luca Tar<sup>6</sup>, Daniel Schlingloff<sup>7</sup>, and Peter Berki<sup>4</sup>  
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<sup>7</sup>*Hungarian Academy of Sciences and Semmelweis University, Institute of Experimental Medicine and János Szentágothai Doctoral School of Neurosciences, Budapest, Hungary*
- P87 Memory compression in the hippocampus leads to the emergence of place cells**  
 Marcus K. Benna\*, Stefano Fusi  
*Columbia University, Center for Theoretical Neuroscience, Zuckerman Mind Brain Behavior Institute, New York, NY, United States of America*

- P88 The information decomposition and the information delta: A unified approach to disentangling non-pairwise information**  
James Kunert-Graf\*, Nikita Sakhanenko, and David Galas  
*Pacific Northwest Research Institute, Galas Lab, Seattle, WA, United States of America*
- P89 Homeostatic mechanism of myelination for age-dependent variations of axonal conductance speed in the pathophysiology of Alzheimer's disease**  
Maurizio De Pittà<sup>1</sup>, Giulio Bonifazi<sup>1\*</sup>, Tania Quintela-López<sup>2</sup>, Carolina Ortiz-Sanz<sup>2</sup>, María Botta<sup>2</sup>, Alberto Pérez-Samartín<sup>2</sup>, Carlos Matute<sup>2</sup>, Elena Alberdi<sup>2</sup>, and Adhara Gaminde-Blasco<sup>2</sup>  
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- P90 Collective dynamics of a heterogeneous network of active rotators**  
Pablo Ruiz\*, Jordi Garcia-Ojalvo  
*Universitat Pompeu Fabra, Department of Experimental and Health Sciences, Barcelona, Spain*
- P91 A hidden state analysis of prefrontal cortex activity underlying trial difficulty and erroneous responses in a distance discrimination task**  
Danilo Benozzo<sup>1\*</sup>, Giancarlo La Camera<sup>2</sup>, and Aldo Genovesio<sup>1</sup>  
<sup>1</sup>*Sapienza University of Rome, Department of Physiology and Pharmacology, Rome, Italy*  
<sup>2</sup>*Stony Brook University, Department of Neurobiology and Behavior, Stony Brook, NY, United States of America*
- P92 Neural model of the visual recognition of social interactions**  
Mohammad Hovaidi-Ardestani\*, Martin Giese  
*Hertie Institute for Clinical Brain Research, Centre for Integrative Neuroscience, Department of Cognitive Neurology, University Clinic Tübingen, Tübingen, Germany*
- P93 Learning of generative neural network models for EMG data constrained by cortical activation dynamics**  
Alessandro Salatiello\*, Martin Giese  
*Center for Integrative Neuroscience & University Clinic Tübingen, Dept of Cognitive Neurology, Tübingen, Germany*
- P94 A neuron can make reliable binary, threshold gate like, decisions if and only if its afferents are synchronized.**  
Timothee Masquelier<sup>1\*</sup>, Matthieu Gilson<sup>2</sup>  
<sup>1</sup>*CNRS, Toulouse, France*  
<sup>2</sup>*Universitat Pompeu Fabra, Center for Brain and Cognition, Barcelona, Spain*
- P95 Unifying network descriptions of neural mass and spiking neuron models and specifying them in common, standardised formats**  
Jessica Dafflon<sup>1</sup>, Angus Silver<sup>2</sup>, and Pdraig Gleeson<sup>2\*</sup>  
<sup>1</sup>*King's College London, Centre for Neuroimaging Sciences, London, United Kingdom*  
<sup>2</sup>*University College London, Dept. of Neuroscience, Physiology & Pharmacology, London, United Kingdom*

- P96 NeuroFedora: a ready to use Free/Open Source platform for Neuroscientists**  
 Ankur Sinha<sup>1\*</sup>, Luiz Bazan<sup>2</sup>, Luis M. Segundo<sup>2</sup>, Zbigniew Jedrzejewski-Szmek<sup>2</sup>, Christian J. Kellner<sup>2</sup>, Sergio Pascual<sup>2</sup>, Antonio Trande<sup>2</sup>, Manas Mangaonkar<sup>2</sup>, Tereza Hlaváčková<sup>2</sup>, Morgan Hough<sup>2</sup>, Ilya Gradina<sup>2</sup>, and Igor Gnatenko<sup>2</sup>  
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<sup>2</sup>Fedora Project
- P97 Flexibility of patterns of avalanches in source-reconstructed magnetoencephalography**  
 Pierpaolo Sorrentino<sup>1\*</sup>, Rosaria Rucco<sup>2</sup>, Fabio Baseli<sup>3</sup>, Carmine Granata<sup>4</sup>, Rosita Di Micco<sup>5</sup>, Alessandro Tessitore<sup>5</sup>, Giuseppe Sorrentino<sup>2</sup>, and Leonardo L Gollo<sup>1</sup>  
<sup>1</sup>QIMR Berghofer Medical Research Institute, Systems Neuroscience Group, Brisbane, Australia  
<sup>2</sup>University of Naples Parthenope, Department of movement science, Naples, Italy  
<sup>3</sup>University of Naples Parthenope, Department of Engineering, Naples, Italy  
<sup>4</sup>National Research Council of Italy, Institute of Applied Sciences and Intelligent Systems, Pozzuoli, Italy  
<sup>5</sup>University of Campania Luigi Vanvitelli, Department of Neurology, Naples, Italy
- P98 A learning mechanism in cortical microcircuits for estimating the statistics of the world**  
 Jordi-Ysard Puigbò Llobet<sup>1\*</sup>, Xerxes Arsiwalla<sup>1</sup>, Paul Verschure<sup>2</sup>, and Miguel Ángel González-Ballester<sup>3</sup>  
<sup>1</sup>Institute for Bioengineering of Catalonia, Barcelona, Spain  
<sup>2</sup>Institute for BioEngineering of Catalonia (IBEC), Catalan Institute of Advanced Studies (ICREA), SPECS Lab, Barcelona, Spain  
<sup>3</sup>UPF, ICREA, DTIC, Barcelona, Spain
- P99 Generalisation of frequency mixing and temporal interference phenomena through Volterra analysis**  
 Nicolas Perez Nieves\*, Dan Goodman  
 Imperial College London, Electrical and Electronic Engineering, London, United Kingdom
- P100 Neural topic modelling**  
 Pamela Hathway\*, Dan Goodman  
 Imperial College London, Department of Electrical and Electronic Engineering, London, United Kingdom
- P101 An attentional inhibitory feedback network for multi-label classification**  
 Yang Chu\*, Dan Goodman  
 Imperial College London, Electrical Engineering, London, United Kingdom
- P102 Closed-loop sinusoidal stimulation of ventral hippocampal terminals in prefrontal cortex preferentially entrains circuit activity at distinct frequenc**  
 Maxym Myroshnychenko<sup>1\*</sup>, David Kupferschmidt<sup>2</sup>, and Joshua Gordon<sup>3</sup>  
<sup>1</sup>National Institutes of Health, National Institute of Neurological Disorders and Stroke, Bethesda, MD, United States of America  
<sup>2</sup>National Institute of Neurological Disorders and Stroke, Integrative Neuroscience Section, Bethesda, MD, United States of America  
<sup>3</sup>National Institutes of Health, National Institute of Mental Health, Bethesda, United States of America

- P103 The shape of thought: data-driven synthesis of neuronal morphology and the search for fundamental parameters of form**  
 Joe Graham\*  
*SUNY Downstate Medical Center, Department of Physiology and Pharmacology, Brooklyn, NY, United States of America*
- P104 An information-theoretic framework for examining information flow in the brain**  
 Praveen Venkatesh\*, Pulkit Grover  
*Carnegie Mellon University, Electrical and Computer Engineering, Pittsburgh, PA, United States of America*
- P105 Detection and evaluation of bursts and rate onsets in terms of novelty and surprise**  
 Junji Ito<sup>1\*</sup>, Emanuele Lucrezia<sup>1</sup>, Guenther Palm<sup>2</sup>, and Sonja Gruen<sup>1,3</sup>  
<sup>1</sup>*Jülich Research Centre, Institute of Neuroscience and Medicine (INM-6), Jülich, Germany*  
<sup>2</sup>*University of Ulm, Institute of Neural Information Processing, Ulm, Germany*  
<sup>3</sup>*Jülich Research Centre, Institute of Neuroscience and Medicine (INM-10), Jülich, Germany*
- P106 Precise spatio-temporal spike patterns in macaque motor cortex during a reach-to-grasp task**  
 Alessandra Stella<sup>1\*</sup>, Pietro Quaglio<sup>1</sup>, Alexa Riehle<sup>2</sup>, Thomas Brochier<sup>2</sup>, and Sonja Gruen<sup>1</sup>  
<sup>1</sup>*Jülich Research Centre, Institute of Neuroscience and Medicine (INM-6 and INM-10), Jülich, Germany*  
<sup>2</sup>*CNRS - Aix-Marseille Université, Institut de Neurosciences de la Timone (INT), Marseille, France*
- P107 Translating mechanisms of theta rhythm generation from simpler to more detailed network models**  
 Alexandra Chatzikalymniou<sup>1\*</sup>, Frances Skinner<sup>2</sup>, and Melisa Gumus<sup>3</sup>  
<sup>1</sup>*Krembil Research Institute and University of Toronto, Department of Physiology, Toronto, Canada*  
<sup>2</sup>*Krembil Research Institute, Division of Fundamental Neurobiology, Toronto, Canada*  
<sup>3</sup>*Krembil Research Institute and University of Toronto, Institute of Medical Sciences, Toronto, Canada*
- P108 NeuroViz: A web platform for visualizing and analyzing neuronal databases**  
 Elizabeth Haynie<sup>1</sup>, Kidus Debesai<sup>1</sup>, Edgar Juarez Cabrera<sup>1</sup>, Anca Doloc-Mihu<sup>2</sup>, and Cengiz Gunay<sup>1\*</sup>  
<sup>1</sup>*Georgia Gwinnett College, School of Science and Technology, Lawrenceville, United States of America*  
<sup>2</sup>*Georgia Gwinnett College, Information Technology/ SST, Decatur, GA, United States of America*
- P109 Computational analysis of disinhibitory and neuromodulatory mechanisms for induction of hippocampal plasticity**  
 Ines Guerreiro<sup>1\*</sup>, Zhenglin Gu<sup>2</sup>, Jerrel Yake<sup>2</sup>, and Boris Gutkin<sup>1</sup>  
<sup>1</sup>*École Normale Supérieure, Paris, France*  
<sup>2</sup>*NIEHS, Department of Health and Human Services, Research Triangle Park, United States of America*
- P110 Coherence states of inter-communicating gamma oscillatory neural circuits**  
 Gregory Dumont\*, Boris Gutkin  
*École Normale Supérieure, Paris, France*

- P111 Mechanisms of working memory stabilization by an external oscillatory input**  
 Nikita Novikov<sup>1\*</sup>, Boris Gutkin<sup>2</sup>  
<sup>1</sup>Higher School of Economics, Centre for cognition and decision making, Moscow, Russia  
<sup>2</sup>École Normale Supérieure, Paris, France
- P112 Prediction of mean firing rate shift induced by externally applied oscillations in a spiking network model**  
 Kristina Vodorezova<sup>1\*</sup>, Nikita Novikov<sup>1</sup>, and Boris Gutkin<sup>2</sup>  
<sup>1</sup>Higher School of Economics, Center for Cognition and Decision Making, Moscow, Russia  
<sup>2</sup>École Normale Supérieure, Paris, France
- P113 Augmenting the source-level EEG signal using structural connectivity**  
 Katharina Glomb<sup>1\*</sup>, Joana Cabral<sup>2</sup>, Margherita Carboni<sup>3,4</sup>, Maria Rubega<sup>4</sup>, Sebastien Tourbier<sup>1</sup>, Serge Vulliemoz<sup>3,4</sup>, Emeline Mullier<sup>1</sup>, Morten L Kringelbach<sup>5</sup>, Giannarita Iannotti<sup>4</sup>, Martin Seeber<sup>4</sup>, and Patric Hagmann<sup>1</sup>  
<sup>1</sup>Centre Hospitalier Universitaire Vaudois, Department of Radiology, Lausanne, Switzerland  
<sup>2</sup>University of Minho, Life and Health Sciences Research Institute, Braga, Portugal  
<sup>3</sup>University Hospital of Geneva, Geneva, Switzerland  
<sup>4</sup>University of Geneva, Department of Fundamental Neurosciences, Geneva, Switzerland  
<sup>5</sup>University of Oxford, Department of Psychiatry, Oxford, United Kingdom
- P114 Inferring birdsong neural learning mechanisms from behavior**  
 Hazem Toutounji<sup>1\*</sup>, Anja Zai<sup>1</sup>, Ofer Tchernichovski<sup>2</sup>, Dina Lipkind<sup>3</sup>, and Richard Hahnloser<sup>1</sup>  
<sup>1</sup>Institute of Neuroinformatics, UZH/ETH, Zurich, Switzerland  
<sup>2</sup>Hunter College, New York, United States of America  
<sup>3</sup>City University of New York, York College, New York, United States of America
- P115 A two-compartment neuron model with ion conservation and ion pumps**  
 Marte J. Sætra<sup>1\*</sup>, Gaute Einevoll<sup>2</sup>, and Geir Halnes<sup>2</sup>  
<sup>1</sup>University of Oslo, Department of Physics, Oslo, Norway  
<sup>2</sup>Norwegian University of Life Sciences, Faculty of Science and Technology, Aas, Norway
- P116 Endogenously oscillating motoneurons produce undulatory output in a connectome-based neuromechanical model of *C. elegans* without proprioception**  
 Haroon Anwar<sup>1\*</sup>, Lan Deng<sup>2</sup>, Jack Denham<sup>3</sup>, Thomas Ranner<sup>3</sup>, Netta Cohen<sup>4</sup>, Casey Diekman<sup>5</sup>, and Gal Haspel<sup>2</sup>  
<sup>1</sup>Princeton Neuroscience Institute, Princeton, NJ, United States of America  
<sup>2</sup>New Jersey Institute of Technology, Brain Research Institute, Newark, United States of America  
<sup>3</sup>University of Leeds, School of Computing, Leeds, United Kingdom  
<sup>4</sup>University of Leeds, Leeds, United Kingdom  
<sup>5</sup>New Jersey Institute of Technology, Mathematics Sciences, Newark, United States of America
- P117 Optimized reservoir computing with stochastic recurrent networks**  
 Sandra Nestler\*, Christian Keup, David Dahmen, and Moritz Helias  
 Jülich Research Centre, Institute of Neuroscience and Medicine (INM-6), Jülich, Germany



**P118 Coordination between individual neurons across mesoscopic distances**

David Dahmen<sup>1\*</sup>, Moritz Layer<sup>1</sup>, Lukas Deutz<sup>2</sup>, Paulina Dabrowska<sup>1,3</sup>, Nicole Voges<sup>1,3</sup>, Michael Von Papez<sup>1,3</sup>, Sonja Gruen<sup>1,4</sup>, Markus Diesmann<sup>1,3</sup>, and Moritz Helias<sup>1</sup>

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<sup>4</sup>*Jülich Research Centre, Institute of Neuroscience and Medicine (INM-10), Juelich, Germany*

**P119 Learning to learn on high performance computing**

Sandra Diaz-Pier<sup>1\*</sup>, Alper Yegenoglu<sup>1</sup>, Wouter Klijn<sup>1</sup>, Alexander Peyser<sup>1</sup>, Wolfgang Maass<sup>2</sup>, Anand Subramoney<sup>3</sup>, Giuseppe Visconti<sup>3</sup>, and Michael Herty<sup>3</sup>

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<sup>3</sup>*RWTH Aachen University, Institute of Geometry and Practical Mathematics, Department of Mathematics, Aachen, Germany*

**P120 A novel method to encode sequences in a computational model of speech production**

Meropi Topalidou\*, Emre Neftci, and Gregory Hickok

*University of California, Irvine, Department of Cognitive Sciences, Irvine, CA, United States of America*

## Monday Posters

### Posters P121 – P240

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- P121 Origin of  $1/f^\alpha$  Beta noise structure in M/EEG power spectra**  
Rick Evertz<sup>1\*</sup>, David Liley<sup>2</sup>, and Damien Hicks<sup>3</sup>  
<sup>1</sup>*Swinburne University, Centre for Human Psychopharmacology, North Melbourne, Australia*  
<sup>2</sup>*University of Melbourne, Department of Medicine, Melbourne, Australia*  
<sup>3</sup>*Swinburne University, Department of Physics and Astronomy, Hawthorn, Australia*
- P122 A neural mechanism for predictive optokinetic eye movement**  
Ruben-Dario Pinzon-Morales, Shuntaro Miki, and Yutaka Hirata\*  
*Chubu University, Robotics Science and Technology, Kasugai, Aichi, Japan*
- P123 Evaluation of context dependency in VOR motor learning using artificial cerebellum**  
Shogo Takatori\*, Keiichiro Inagaki, and Yutaka Hirata  
*Chubu University, Robotics Science and Technology, Kasugai, Aichi, Japan*
- P124 A computational model of the spontaneous activity of gonadotropin-releasing cells in the teleost fish medaka**  
Geir Halnes<sup>1\*</sup>, Simen Tennøe<sup>2</sup>, Gaute Einevoll<sup>1</sup>, Trude M. Haug<sup>3</sup>, Finn-Arne Weltzien<sup>4</sup>, and Kjetil Hodne<sup>4</sup>  
<sup>1</sup>*Norwegian University of Life Sciences, Faculty of Science and Technology, Aas, Norway*  
<sup>2</sup>*University of Oslo, Department of Informatics, Oslo, Norway*  
<sup>3</sup>*University of Oslo, Institute of Oral Biology, Oslo, Norway*  
<sup>4</sup>*Norwegian University of Life Sciences, Department of Basic Sciences and Aquatic Medicine, Aas, Norway*
- P125 Neural transmission delays and predictive coding: Real-time temporal alignment in a layered network with Hebbian learning**  
Anthony Burkitt<sup>1\*</sup>, Hinze Hogendoorn<sup>2</sup>  
<sup>1</sup>*University of Melbourne, Department of Biomedical Engineering, Melbourne, Australia*  
<sup>2</sup>*University of Melbourne, Melbourne School of Psychological Sciences, Melbourne, Australia*
- P126 Emergence of 'columnette' orientation map in mouse visual cortex**  
Peijia Yu\*, Brent Doiron, and Chengcheng Huang  
*University of Pittsburgh, Department of Mathematics, Pittsburgh, PA, United States of America*
- P127 Decoupled reaction times and choices in expectation-guided perceptual decisions**  
Lluís Hernández-Navarro<sup>1\*</sup>, Ainhoa Hermoso-Mendizabal<sup>1</sup>, Jaime De La Rocha<sup>2</sup>, and Alexandre Hyafil<sup>3</sup>  
<sup>1</sup>*IDIBAPS, Barcelona, Spain*  
<sup>2</sup>*IDIBAPS, Theoretical Neurobiology, Barcelona, Spain*  
<sup>3</sup>*UPF, Center for Brain and Cognition, Barcelona, Spain*

- P128 V1 visual neurons: receptive field types vs spike shapes**  
 Syeda Zehra<sup>1</sup>, Hamish Meffin<sup>2</sup>, Damien Hicks<sup>3</sup>, Tatiana Kameneva<sup>1\*</sup>, and Michael Ibbotson<sup>4</sup>  
<sup>1</sup>*Swinburne University of Technology, Telecommunication Electrical Robotics and Biomedical Engineering, Melbourne, Australia*  
<sup>2</sup>*University of Melbourne, Department of Optometry and Visual Science, Melbourne, Australia*  
<sup>3</sup>*Swinburne University, Department of Physics and Astronomy, Hawthorn, Australia*  
<sup>4</sup>*National Vision Research Institute, University of Melbourne, Melbourne, Australia*
- P129 Synaptic basis for contrast-dependent shifts in functional cell identity in mouse primary visual cortex**  
 Molis Yunzab<sup>1\*</sup>, Veronica Choi<sup>2</sup>, Hamish Meffin<sup>1</sup>, Shaun Cloherty<sup>3</sup>, Nicholas Priebe<sup>2</sup>, and Michael Ibbotson<sup>1</sup>  
<sup>1</sup>*National Vision Research Institute, Melbourne, Australia*  
<sup>2</sup>*University of Texas Austin, Centre for Learning and Memory, Austin, United States of America*  
<sup>3</sup>*Monash University, Department of Physiology, Clayton, Australia*
- P130 An encoding mechanism for translating between temporal sequences and spatial patterns**  
 Nathalia Cristimann<sup>1\*</sup>, Gustavo Soroka<sup>2</sup>, and Marco Idiart<sup>1</sup>  
<sup>1</sup>*Universidade Federal do Rio Grande do Sul, Institute of Physics, Porto Alegre, Brazil*  
<sup>2</sup>*Universidade Federal do Rio Grande do Sul, Instituto de Ciências Básicas da Saúde, Porto Alegre, Brazil*
- P131 Building Python interactive neuroscience applications using Geppetto**  
 Matteo Cantarelli<sup>1,2\*</sup>, Padraig Gleeson<sup>5</sup>, Adrian Quintana<sup>1,3</sup>, Angus Silver<sup>5</sup>, William W Lytton<sup>6</sup>, Salvador Dura-Bernal<sup>6</sup>, Facundo Rodriguez<sup>1</sup>, Boris Marin<sup>7,5</sup>, Robert Court<sup>4</sup>, Matt Earnshaw<sup>5</sup>, and Giovanni Idilli<sup>1,2</sup>  
<sup>1</sup>*MetaCell Ltd. LLC, Oxford, UK/Boston, USA*  
<sup>2</sup>*OpenWorm Foundation, Delaware, USA*  
<sup>3</sup>*EyeSeeTea Ltd., London, UK*  
<sup>4</sup>*Institute for Adaptive and Neural Computation, University of Edinburgh, UK*  
<sup>5</sup>*University College London, Dept. of Neuroscience, Physiology & Pharmacology, London, United Kingdom*  
<sup>6</sup>*State University of New York Downstate Medical Center, Brooklyn, NY, USA*  
<sup>7</sup>*Universidade Federal do ABC, São Bernardo do Campo, Brazil*
- P132 Hierarchy of inhibitory circuit acts as a switch key for network function in a model of the primary motor cortex**  
 Heidarinejad Morteza\*, Zhe Sun, and Jun Igarashi  
*Riken, Computational Engineering Applications Unit, Saitama, Japan*
- P133 Spatially organized connectivity for signal processing in a model of the rodent primary somatosensory cortex**  
 Zhe Sun\*, Heidarinejad Morteza, and Jun Igarashi  
*Riken, Computational Engineering Applications Unit, Saitama, Japan*
- P134 Probing the association between axonal sprouting and seizure activity using a coupled neural mass model**  
 Jaymar Soriano<sup>1\*</sup>, Takatomi Kubo<sup>2</sup>, and Kazushi Ikeda<sup>2</sup>  
<sup>1</sup>*University of the Philippines, Department of Computer Science, Quezon City, Philippines*  
<sup>2</sup>*Nara Institute of Science and Technology, Ikoma, Japan*

- P135 Evaluation of signal processing of Golgi cells and Basket cells in vestibular ocular reflex motor learning using artificial cerebellum**  
Taiga Matsuda\*, Keiichiro Inagaki  
*Chubu University, Kasugai, Japan*
- P136 Development of a self-motivated treadmill task that quantifies differences in learning behavior in mice for optogenetic studies of basal ganglia**  
Po-Han Chen\*, Dieter Jaeger  
*Emory University, Department of Biology, Atlanta, GA, United States of America*
- P137 Compensatory effects of dendritic retraction on excitability and induction of synaptic plasticity**  
Martin Mittag<sup>1\*</sup>, Manfred Kaps<sup>2</sup>, Thomas Deller<sup>3</sup>, Hermann Cuntz<sup>4</sup>, and Peter Jedlicka<sup>5</sup>  
<sup>1</sup>*Justus Liebig University Giessen, Giessen, Germany*  
<sup>2</sup>*Justus Liebig University Giessen, Department of Neurology, Giessen, Germany*  
<sup>3</sup>*Goethe University Frankfurt, Institute of Clinical Neuroanatomy, Neuroscience Center, Frankfurt am Main, Germany*  
<sup>4</sup>*Frankfurt Institute for Advanced Studies (FIAS) & Ernst Strüngmann Institute (ESI), Computational Neuroanatomy, Frankfurt/Main, Germany*  
<sup>5</sup>*Justus Liebig University, Faculty of Medicine, Giessen, Germany*
- P138 Lognormal distribution of spine sizes is preserved following homo- and heterosynaptic plasticity in the dentate gyrus**  
Nina Rößler<sup>1\*</sup>, Tassilo Jungenitz<sup>2</sup>, Stephan Schwarzacher<sup>2</sup>, and Peter Jedlicka<sup>3</sup>  
<sup>1</sup>*Goethe University Frankfurt, Frankfurt, Germany*  
<sup>2</sup>*Goethe University Frankfurt, Institute of Clinical Neuroanatomy, Frankfurt, Germany*  
<sup>3</sup>*Justus Liebig University, Faculty of Medicine, Giessen, Germany*
- P139 Inferring the dynamic of personalized large-scale brain network models using Bayesian framework**  
Meysam Hashemi<sup>1\*</sup>, Anirudh Vattikonda<sup>1</sup>, Viktor Sip<sup>1</sup>, Maxime Guye<sup>2</sup>, Marmaduke Woodman<sup>1</sup>, and Viktor Jirsa<sup>1</sup>  
<sup>1</sup>*Aix-Marseille Université, Institut de Neurosciences des Systèmes, Marseille, France*  
<sup>2</sup>*Aix-Marseille Université, Institut de Neurosciences de la Timone, Marseille, France*
- P140 Personalized brain network model for deep brain stimulation on treatment-resistant depression: Spatiotemporal network organization by stimulation**  
Sora An<sup>1\*</sup>, Jan Fousek<sup>1</sup>, Vineet Tiruvadi<sup>2</sup>, Filomeno Cortese<sup>3</sup>, Gwen van Der Wijk<sup>4</sup>, Laina McAusland<sup>5</sup>, Rajamannar Ramasubbu<sup>6</sup>, Zelma Kiss<sup>7</sup>, Andrea Protzner<sup>8</sup>, and Viktor Jirsa<sup>1</sup>  
<sup>1</sup>*Aix Marseille Universite, Institute de Neurosciences, Marseille, France*  
<sup>2</sup>*Emory University School of Medicine, Department of Psychiatry and Behavioral Sciences, Atlanta, Georgia, United States of America*  
<sup>3</sup>*University of Calgary, Seaman Family MR Centre, Foothills Medical Centre, Hotchkiss Brain Institute, Calgary, Alberta, Canada*  
<sup>4</sup>*University of Calgary, Department of Psychology, Calgary, Alberta, Canada*  
<sup>5</sup>*University of Calgary, Department of Clinical Neurosciences, Calgary, Alberta, Canada*  
<sup>6</sup>*University of Calgary, Hotchkiss Brain Institute, Cumming School of Medicine, Calgary, Alberta, Canada*  
<sup>7</sup>*University of Calgary, Hotchkiss Brain Institute, Department of Clinical Neurosciences, Calgary, Alberta, Canada*  
<sup>8</sup>*University of Calgary, Hotchkiss Brain Institute, Department of Psychology, Calgary, Alberta, Canada*

- P141 Transmission time delays organize the brain network synchronization dynamics**  
 Spase Petkoski\*, Viktor Jirsa  
*Aix-Marseille University, Institut de Neurosciences des Systèmes, Marseille, France*
- P142 Mutual information vs. transfer entropy in spike-based neuroscience**  
 Mireille Conrad\*, Renaud Jolivet  
*University of Geneva, Nuclear and Corpuscular Physics Department, Genève, Switzerland*
- P143 Plasticity rules for learning sequential inputs under energetic constraints**  
 Dmytro Grytskyi<sup>1\*</sup>, Renaud Jolivet<sup>1,2</sup>  
<sup>1</sup>*University of Geneva, Geneva, Switzerland*  
<sup>2</sup>*CERN, DPNC, Genève, Switzerland*
- P144 Hierarchical inference interactions in dynamic environments**  
 Zachary Kilpatrick<sup>1\*</sup>, Tahra Eissa<sup>1</sup>, Nicholas Barendregt<sup>1</sup>, Joshua Gold<sup>2</sup>, and Kresimir Josic<sup>3</sup>  
<sup>1</sup>*University of Colorado Boulder, Applied Mathematics, Boulder, Colorado, United States of America*  
<sup>2</sup>*University of Pennsylvania, Neuroscience, Philadelphia, Pennsylvania, United States of America*  
<sup>3</sup>*University of Houston, Mathematics, Houston, United States of America*
- P145 Optimizing sequential decisions in the drift-diffusion model**  
 Khanh Nguyen<sup>1\*</sup>, Zachary Kilpatrick<sup>2</sup>, and Kresimir Josic<sup>1</sup>  
<sup>1</sup>*University of Houston, Mathematics, Houston, TX, United States of America*  
<sup>2</sup>*University of Colorado Boulder, Applied Mathematics, Boulder, CO, United States of America*
- P146 Degeneracy in hippocampal CA1 neurons**  
 Rosanna Migliore<sup>1\*</sup>, Carmen Alina Lupascu<sup>1</sup>, Luca Leonardo Bologna<sup>1</sup>, Armando Romani<sup>2</sup>, Jean-Denis Courcol<sup>2</sup>, Werner Alfons Hilda van Geit<sup>2</sup>, Alex M Thomson<sup>3</sup>, Audrey Mercer<sup>3</sup>, Sigrun Lange<sup>3</sup>, Christian A Rössert<sup>2</sup>, Ying Shi<sup>2</sup>, Olivier Hagens<sup>2</sup>, Maurizio Pezzoli<sup>2</sup>, Tamas Freund<sup>4</sup>, Eilif Muller<sup>2</sup>, Felix Schuermann<sup>2</sup>, Henry Markram<sup>2</sup>, Michele Migliore<sup>1</sup>, and Stefano Antonel<sup>2</sup>  
<sup>1</sup>*Institute of Biophysics, National Research Council, Italy*  
<sup>2</sup>*École Polytechnique Fédérale de Lausanne, Blue Brain Project, Lausanne, Switzerland*  
<sup>3</sup>*University College London, London, United Kingdom*  
<sup>4</sup>*Institute of Experimental Medicine, Hungarian Academy of Sciences, Hungary*
- P147 Mechanisms of combined electrical and optogenetic costimulation**  
 William Hart<sup>1</sup>, Paul Stoddart<sup>1</sup>, and Tatiana Kameneva<sup>2\*</sup>  
<sup>1</sup>*Swinburne University of Technology, ARC Centre for Biodevices, Melbourne, Australia*  
<sup>2</sup>*Swinburne University of Technology, Telecommunication Electrical Robotics and Biomedical Engineering, Hawthorn, Australia*
- P148 Real-time Bayesian decoding of taste from neural populations in gustatory cortex**  
 Daniel Svedberg\*, Bradly Stone, and Donald Katz  
*Brandeis University, Department of Neuroscience, Waltham, MA, United States of America*

- P149 Effects of value on early sensory activity and motor preparation during rapid sensorimotor decisions**  
L. Alexandra Martinez-Rodriguez\*, Simon P. Kelly  
*University College Dublin, School of Electrical & Electronic Engineering, Dublin, Ireland*
- P150 Astrocytes restore connectivity and synchronization in dysfunctional cerebellar networks**  
Paolo Bonifazi<sup>1\*</sup>, Sivan Kanner<sup>2</sup>, Miri Goldin<sup>1</sup>, Ronit Galron<sup>2</sup>, Eshel Ben Jacob<sup>3</sup>, Ari Barzilai<sup>2</sup>, and Maurizio De Pittà<sup>4</sup>  
<sup>1</sup>*Biocruces Health Research Institute, Neurocomputational imaging, Bilbao, Spain*  
<sup>2</sup>*Tel Aviv University, Department of Neurobiology, Tel Aviv, Israel*  
<sup>3</sup>*Tel Aviv University, School of Physics and Astronomy, Tel Aviv, Israel*  
<sup>4</sup>*Basque Center for Applied Mathematics: BCAM, Bilbao, Spain*
- P151 S1 neurons process spontaneous pain information using nonlinear distributed coding**  
Sa-Yoon Park<sup>1\*</sup>, Heera Yoon<sup>2</sup>, Sun Kwang Kim<sup>2</sup>, Sang Jeong Kim<sup>3</sup>, and Chang-Eop Kim<sup>4</sup>  
<sup>1</sup>*Gachon University, Department of Physiology, Seongnam, South Korea*  
<sup>2</sup>*Kyung Hee University, Department of Physiology, Seoul, South Korea*  
<sup>3</sup>*Seoul National University, Department of Physiology, Seoul, South Korea*  
<sup>4</sup>*Gachon University, Department of Physiology, Seoul, South Korea*
- P152 Dynamic Worm: Computational investigation of locomotion through integration of connectomics, neural dynamics and biomechanics in *C. elegans***  
Eli Shlizerman<sup>1,2\*</sup>, Jimin Kim<sup>2</sup>  
<sup>1</sup>*University of Washington, Departments of Applied Mathematics, Seattle, WA, United States of America*  
<sup>2</sup>*University of Washington, Electrical & Computer Engineering, Seattle, United States of America*
- P153 Inhibitory structures may interrupt the coherence of slow activity in deep anesthesia**  
Pangyu Joo\*, Seunghwan Kim  
*Pohang University of Science and Technology, Physics Department, Pohang, South Korea*
- P154 Data-driven predictive models for information processing in the small brain of *Caenorhabditis elegans***  
Chentao Wen\*, Kotaro Kimura  
*Nagoya City University, Graduate School of Natural Sciences, Nagoya, Japan*
- P155 A neural network model of naming impairment and treatment response in bilingual speakers with aphasia**  
Claudia Penalzoza<sup>1\*</sup>, Uli Grasemann<sup>2</sup>, Maria Dekhtyar<sup>1</sup>, Risto Miikkulainen<sup>2</sup>, and Swathi Kiran<sup>1</sup>  
<sup>1</sup>*Boston University, Department of Speech, Language and Hearing Sciences, Boston, United States of America*  
<sup>2</sup>*University of Texas at Austin, Department of Computer Science, Austin, United States of America*

- P156 Modeling hindlimb elevation angles during intact locomotion and locomotion evoked by MLR- and epidural spinal stimulation in decerebrate cats**  
 Boris Prilutsky<sup>1\*</sup>, Ilya Rybak<sup>2</sup>, Sergey Markin<sup>2</sup>, Pavel Zelenin<sup>3</sup>, Tatiana Deliagina<sup>3</sup>, Yury Gerasimenko<sup>4</sup>, Pavel Musienko<sup>5</sup>, and Alexander Klishko<sup>6</sup>  
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<sup>5</sup>*Pavlov Institute of Physiology, Motor Physiology Laboratory, St. Petersburg, Russia*  
<sup>6</sup>*Georgia Tech, Marietta, GA, United States of America*
- P157 How do local neural populations know about the predictability of sound sequences**  
 Shih-Cheng Chien<sup>1\*</sup>, Burkhard Maess<sup>1</sup>, and Thomas Knoesche<sup>2</sup>  
<sup>1</sup>*Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany*  
<sup>2</sup>*MPI for Human Cognitive and Brain Sciences, Department of Neurophysics, Leipzig, Germany*
- P158 Action potential propagation in long-range axonal fibre bundles**  
 Helmut Schmidt<sup>1\*</sup>, Thomas Knoesche<sup>2</sup>  
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<sup>2</sup>*MPI for Human Cognitive and Brain Sciences, Department of Neurophysics, Leipzig, Germany*
- P159 From damped oscillations to synchronous bursting: Describing the effects of synaptic depression on the collective behavior of spiking neurons**  
 Richard Gast<sup>1\*</sup>, Helmut Schmidt<sup>2</sup>, Harald Möller<sup>3</sup>, Nikolaus Weiskopf<sup>3</sup>, and Thomas Knoesche<sup>3</sup>  
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<sup>3</sup>*MPI for Human Cognitive and Brain Sciences, Department of Neurophysics, Leipzig, Germany*
- P160 Prefrontal oscillations modulate the propagation of neuronal activity required for working memory**  
 Jason Sherfey<sup>1\*</sup>, Salva Ardid<sup>2</sup>, Michael Hasselmo<sup>1</sup>, Earl Miller<sup>3</sup>, and Nancy Kopell<sup>2</sup>  
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<sup>3</sup>*Massachusetts Institute of Technology, The Picower Institute for Learning and Memory, Cambridge, United States of America*
- P161 Model of respiration's projections to the brain reproduces physiological changes and predicts emotion's cognitive influences**  
 Julius Cueto<sup>1\*</sup>, Hoshinori Kanazawa<sup>1</sup>, Shogo Yonekura<sup>1</sup>, Satoko Hirabayashi<sup>2</sup>, Noritoshi Atsumi<sup>2</sup>, Masami Iwamoto<sup>2</sup>, and Yasuo Kuniyoshi<sup>1</sup>  
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<sup>2</sup>*TOYOTA CENTRAL R&D LABS., INC., Nagakute, Japan*

- P162 EEG simulation reveals that changes in cortical morphology and global connectivity during development affect neonatal EEG**  
Tomoaki Morioka<sup>1\*</sup>, Hoshinori Kanazawa<sup>2</sup>, Keiko Fujii<sup>2</sup>, and Yasuo Kuniyoshi<sup>2</sup>  
<sup>1</sup>*The University of Tokyo, Tokyo, Japan*  
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- P163 Distinct temporal structure of ACh receptor activation determines responses of VTA activity to endogenous ACh and nicotine**  
Ekaterina Morozova<sup>1</sup>, Philippe Faure<sup>2</sup>, Boris Gutkin<sup>3\*</sup>, Christopher Lapish<sup>4</sup>, and Alexey Kuznetsov<sup>5</sup>  
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<sup>5</sup>*Indiana University-Purdue University at Indianapolis, Department of Mathematical Sciences, Indianapolis, United States of America*
- P164 Basal Ganglia role in learning reward actions and executing previously learned choices**  
Alexey Kuznetsov\*  
*IUPUI, Indianapolis, IN, United States of America*
- P165 Short-term plasticity in PV and SST interneurons enhances neural code propagation in the feed-forward network model**  
Jeongheon Gwak\*, Jeehyun Kwag  
*Korea University, Brain and Cognitive Engineering, Seoul, South Korea*
- P166 Differential roles of PV and SST interneurons in spike-timing pattern propagation in the cortical feedforward network**  
Hyun Jae Jang<sup>1\*</sup>, James M. Rowland<sup>2</sup>, Hyowon Chung<sup>1</sup>, Blake A Richards<sup>3</sup>, Michael M. Kohl<sup>2</sup>, and Jeehyun Kwag<sup>1</sup>  
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<sup>3</sup>*University of Toronto Scarborough, Department of Biological Sciences, Toronto, Canada*
- P167 The State of the MIIND Simulator**  
Marc De Kamps<sup>1\*</sup>, Hugh Osborne<sup>2</sup>, Lukas Deutz<sup>3</sup>, Mikkel Elle Lepperød<sup>4</sup>, and Yi Ming Lai<sup>5</sup>  
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- P168 Optimal conditions for reliable representation of asynchronous spikes in feed-forward neural networks**  
 Sayan Faraz<sup>1</sup>, Milad Lankarany<sup>2\*</sup>  
<sup>1</sup>University of Toronto, Toronto, Canada  
<sup>2</sup>The Krembil Research Institute - University Health Network, Computational Neuroscience Program, Toronto, Canada
- P169 Optogenetic data mining with empirical mode decomposition**  
 Sorinel Oprisan<sup>1\*</sup>, Xandre Clementsmith<sup>1</sup>, Tams Tompa<sup>2</sup>, and Antonieta Lavin<sup>3</sup>  
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<sup>2</sup>University of Miskolc, Miskolc, Hungary  
<sup>3</sup>Medical University of South Carolina, Charleston, SC, United States of America
- P170 High channel count electrophysiological recordings in prefrontal cortex in a novel spatial memory task**  
 Claudia Böhm\*, Albert Lee  
 HHMI Janelia Research Campus, Ashburn, United States of America
- P171 Exploring the machine learning model space commonly used in Neuroimaging using Automated Machine Learning**  
 Jessica Dafflon\*, Federico Turkheimer, James Cole, and Robert Leech  
 King's College London, Centre for Neuroimaging Sciences, London, United Kingdom
- P172 Effects of cellular excitatory-inhibitory composition on neuronal dynamics**  
 Oleg Vinogradov<sup>1\*</sup>, Nirit Sukenik<sup>2</sup>, Elisha Moses<sup>2</sup>, and Anna Levina<sup>3</sup>  
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<sup>2</sup>Weizmann Institute of Science, Physics of Complex Systems, Rehovot, Israel  
<sup>3</sup>University of Tübingen, Tübingen, Germany
- P173 Towards a unified definition of the clustering coefficient for brain networks.**  
 Mehrdad Hasanpour<sup>1\*</sup>, Paolo Massobrio<sup>2</sup>, and Anna Levina<sup>3</sup>  
<sup>1</sup>University of Tübingen, Institute for Physics, Tübingen, Germany  
<sup>2</sup>University of Genova, Department of Informatics, Bioengineering, Robotics, System Engineering (DIBRIS), Genova, Italy  
<sup>3</sup>University of Tübingen, Tübingen, Germany
- P174 Electric field effects improve resynchronization in the sparsely connected pacemaker nucleus of weakly electric fish.**  
 Aaron Regan Shifman\*, John Lewis  
 University of Ottawa, Department of Biology, Ottawa, Canada
- P175 A self-consistent theory of autocorrelations in sparse networks of spiking neurons**  
 Sebastian Vellmer<sup>1\*</sup>, Benjamin Lindner<sup>2</sup>  
<sup>1</sup>Bernstein Center for Computational Neuroscience, Complex Systems and Neurophysics, Berlin, Germany  
<sup>2</sup>Humboldt University Berlin, Physics Department, Berlin, Germany

- P176 Stationary statistics and linear response of nonlinear Drift-Diffusion model across long sequences of trials**  
 Sebastian Vellmer<sup>1\*</sup>, Benjamin Lindner<sup>2</sup>  
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<sup>2</sup>*Humboldt University Berlin, Physics Department, Berlin, Germany*
- P177 Model order reduction of multiscale models in neuroscience**  
 Ippa Seppälä\*, Mikko Lehtimäki, Lassi Paunonen, and Marja-Leena Linne  
*Tampere University, Tampere, Finland*
- P178 Modeling the influence of neuron-astrocyte interactions on signal transmission in neuronal networks**  
 Jugoslava Acimovic<sup>1\*</sup>, Tiina Manninen<sup>1</sup>, Heidi Teppola<sup>1</sup>, Sacha van Albada<sup>2</sup>, Markus Diesmann<sup>2</sup>, and Marja-Leena Linne<sup>3</sup>  
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<sup>3</sup>*Tampere University, Tampere, Finland*
- P179 Topological analysis of LFP data**  
 Leonid Fedorov<sup>1\*</sup>, Tjeerd Dijkstra<sup>2</sup>, Yusuke Murayama<sup>1</sup>, Christoph Bohle<sup>3</sup>, and Nikos Logothetis<sup>1</sup>  
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<sup>3</sup>*University of Tübingen, Mathematisch-Naturwissenschaftliche Fakultät, Tübingen, Germany*
- P180 Mechanisms of stimulus-induced broadband Gamma Oscillations in a stochastic Wilson-Cowan model**  
 Arthur Powanwe\*, Andre Longtin  
*University of Ottawa, Department of Physics and Centre for Neural Dynamics, Ottawa, Canada*
- P181 Phase synchronization and information transfer between coupled bursty-oscillatory neural networks in the gamma band.**  
 Arthur Powanwe\*, Andre Longtin  
*University of Ottawa, Department of Physics and Centre for Neural Dynamics, Ottawa, Canada*
- P182 Data-driven jump-diffusion modelling with application to electric fish**  
 Alexandre Melanson<sup>1\*</sup>, Andre Longtin<sup>2</sup>  
<sup>1</sup>*University of Moncton, Physique et Astronomie, Moncton, Canada*  
<sup>2</sup>*University of Ottawa, Department of Physics and Centre for Neural Dynamics, Ottawa, Canada*
- P183 Alcohol influence on fear conditioning and extinction in a new amygdala model**  
 Alexey Kuznetsov<sup>1\*</sup>, Adam Lonnberg<sup>2</sup>  
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<sup>2</sup>*University of Evansville, Department of Mathematics, Evansville, United States of America*

- P184 Whole-brain network modelling of psilocybin treatment for depression**  
 Jakub Vohryzek<sup>1\*</sup>, Robin Carhart-Harris<sup>2</sup>, Gustavo Deco<sup>3</sup>, Morten Kringelbach<sup>4</sup>, Joana Cabral<sup>5</sup>, and Louis-David Lord<sup>4</sup>  
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<sup>4</sup>University of Oxford, Department of Psychiatry, Oxford, United Kingdom  
<sup>5</sup>University of Minho, Life and Health Sciences Research Institute, Braga, Portugal
- P185 Thalamo-cortical microcircuit model of Beta-rhythm generation in Parkinson's disease and attenuation during deep brain stimulation**  
 Amirali Farokhniaee\*, John Fleming, Karthik Sridhar, and Madeleine Lowery  
 University College Dublin, Neuromuscular Systems Lab, School of Electrical and Electronic Engineering, Dublin, Ireland
- P186 Phase-amplitude coupled oscillations and information flow in a multiscale model of M1 micro-circuits**  
 Salvador Dura-Bernal<sup>1\*</sup>, Benjamin A Suter<sup>2</sup>, Samuel A Neymotin<sup>3</sup>, Gordon Mg Shepherd<sup>4</sup>, and William W Lytton<sup>1</sup>  
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<sup>4</sup>Northwestern University, United States of America
- P187 Avalanche power-law values by layer and cell type in simulated mouse primary motor cortex (M1)**  
 Donald Doherty<sup>1\*</sup>, Salvador Dura-Bernal<sup>2</sup>, and William W Lytton<sup>2</sup>  
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- P188 Mathematical tools for phase control and their role in neural communication**  
 Gemma Huguet\*, Alberto Pérez-Cervera, and Tere M-Seara  
 Universitat Politècnica de Catalunya, Departament de Matemàtiques, Barcelona, Spain
- P189 Emergence of binding capabilities in generic spiking neural networks**  
 Michael Müller<sup>1\*</sup>, Robert Legenstein<sup>1</sup>, Christos H. Papadimitriou<sup>2</sup>, and Wolfgang Maass<sup>1</sup>  
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- P190 Joint effect of Spike-timing-dependent and short-term plasticity in a network of Hodgkin-Huxley neurons**  
Ewandson Luiz Lameu<sup>1\*</sup>, Fernando Borges<sup>2</sup>, Kelly Cristiane Iarosz<sup>3</sup>, Antonio Marcos Batista<sup>4</sup>, and Elbert E. N. Macau<sup>1</sup>  
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- P191 Transcending model limitations via empirically-tuned parameters**  
Alexandre René<sup>1\*</sup>, Andre Longtin<sup>1,2</sup>, and Jakob H. Macke<sup>3</sup>  
<sup>1</sup>University of Ottawa, Department of Physics, Ottawa, Canada  
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<sup>3</sup>Technical University of Munich, Munich, Germany
- P192 Hippocampal volume and functional connectivity transitions during the early stage of Alzheimer's disease: a Spiking Neural Network-based study.**  
Gianluca Susi<sup>1\*</sup>, Isabel Suárez Méndez<sup>1</sup>, David López Sanz<sup>1</sup>, Maria Eugenia López García<sup>1</sup>, Emanuele Paracone<sup>2</sup>, Ernesto Pereda<sup>5</sup>, and Fernando Maestu<sup>1</sup>  
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<sup>2</sup>University of Rome 'Tor Vergata', Department of civil engineering and computer science, Rome, Italy  
<sup>3</sup>University of La Laguna, Industrial Engineering, San Cristobal de La Laguna, Spain
- P193 A pipeline integrating high-density EEG analysis and graph theory: a feasibility study on resting state functional connectivity**  
Riccardo Iandolo<sup>1\*</sup>, Michela Chiappalone<sup>2</sup>, Jessica Samogin<sup>3</sup>, Federico Barban<sup>4</sup>, Stefano Buccelli<sup>1</sup>, Gaia Taberna<sup>3</sup>, Marianna Semprini<sup>1</sup>, and Dante Mantini<sup>3</sup>  
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- P194 Channelrhodopsin-2 model with improved computational efficiency**  
Ruben Schoeters<sup>1\*</sup>, Thomas Tarnaud<sup>1</sup>, Wout Joseph<sup>1</sup>, Robrecht Raedt<sup>2</sup>, Emmeric Tanghe<sup>1</sup>, and Luc Martens<sup>1</sup>  
<sup>1</sup>University of Ghent, Waves - Information technology, Ghent, Belgium  
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- P195 A model of presynaptic KV7 channel function in hippocampal mossy fiber bouton**  
Elisabetta Giacalone<sup>1\*</sup>, Michele Migliore<sup>1</sup>, David Anthony Brown<sup>2</sup>, Mala Shah<sup>3</sup>, and Katuscia Martinello<sup>3</sup>  
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- P196 Characterization of the network dynamics of interconnected brain regions on-a-chip**  
Martina Brofiga\*, Paolo Massobrio, and Sergio Martinoia  
*University of Genova, Department of Informatics, Bioengineering, Robotics, System Engineering (DIBRIS), Genova, Italy*
- P197 SpykeTorch: Efficient simulation of convolutional spiking neural networks with at most one spike per neuron**  
Milad Mozafari<sup>1</sup>, Mohammad Ganjtabesh<sup>1</sup>, Abbas Nowzari-Dalini<sup>1</sup>, and Timothee Masquelier<sup>2\*</sup>  
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<sup>2</sup>*CNRS, Toulouse, France*
- P198 Slow-wave activity enrichment across brain states in the mouse**  
Antonio Pazienti<sup>1</sup>, Miguel Dasilva<sup>2</sup>, Andrea Galluzzi<sup>1</sup>, Maria V. Sanchez-Vives<sup>2,3</sup>, and Maurizio Mattia<sup>1\*</sup>  
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<sup>3</sup>*ICREA, Systems Neuroscience, Barcelona, Spain*
- P199 A spiking neural network model of the N400 congruency effect**  
Nirav Porwal<sup>1\*</sup>, Howard Bowman<sup>2</sup>, Maxine Lintern<sup>1</sup>, Kimron Shapiro<sup>1</sup>, and Eirini Mavritsaki<sup>1</sup>  
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<sup>2</sup>*University of Kent, Centre for Cognitive Neuroscience and Cognitive Systems and the School of Computing, Canterbury, United Kingdom*
- P200 Maximizing transfer entropy promotes spontaneous formation of assembly sequences in recurrent spiking networks**  
David Kappel<sup>1\*</sup>, Christian Tetzlaff<sup>1</sup>, Florentin Wörgötter<sup>1</sup>, and Christian Mayr<sup>2</sup>  
<sup>1</sup>*University of Göttingen, Bernstein Center for Computational Neuroscience, Göttingen, Germany*  
<sup>2</sup>*TU Dresden, Chair of Highly-Parallel VLSI Systems and Neuro-Microelectronics, Dresden, Germany*
- P201 Accelerating 3D intracellular NEURON simulations**  
Cameon Conte<sup>1</sup>, Adam Jh Newton<sup>2</sup>, Lia Eggleston<sup>3</sup>, Michael Hines<sup>4</sup>, William W Lytton<sup>2</sup>, and Robert McDougal<sup>4\*</sup>  
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<sup>3</sup>*Yale University, Yale College, New Haven, CT, United States of America*  
<sup>4</sup>*Yale University, Department of Neuroscience, CT, United States of America*
- P202 How do stimulus statistics change the receptive fields of cells in primary visual cortex?**  
Ali Almasi<sup>1\*</sup>, Shi Sun<sup>2</sup>, Molis Yunzab<sup>1</sup>, Michael Ibbotson<sup>1</sup>, and Hamish Meffin<sup>1</sup>  
<sup>1</sup>*National Vision Research Institute, Melbourne, Melbourne, Australia*  
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- P203 Extracellular spike waveform predicts whether single units recorded in visual cortex are tuned to orientation**  
 Shi Sun<sup>1</sup>, Ali Almasi<sup>2</sup>, Molis Yunzab<sup>2</sup>, Michael Ibbotson<sup>2</sup>, and Hamish Meffin<sup>2\*</sup>  
<sup>1</sup>*The University of Melbourne, Vision Science, Melbourne, Australia*  
<sup>2</sup>*National Vision Research Institute, Melbourne, Australia*
- P204 Visual alpha generators in a spiking thalamocortical microcircuit model**  
 Renan O. Shimoura<sup>1\*</sup>, Antônio C. Roque<sup>1</sup>, Markus Diesmann<sup>2</sup>, and Sacha van Albada<sup>2</sup>  
<sup>1</sup>*University of São Paulo, Department of Physics, Ribeirão Preto, Brazil*  
<sup>2</sup>*Jülich Research Centre, Institute of Neuroscience and Medicine (INM-6) and Institute for Advanced Simulation (IAS-6), Jülich, Germany*
- P205 Neuronal avalanches in developing networks of Hawkes spiking neurons**  
 Sven Goedeke<sup>1\*</sup>, Felipe Yaroslav Kalle Kossio<sup>2</sup>, and Raoul-Martin Memmesheimer<sup>1</sup>  
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- P206 Quantifying transfer learning in mice and machines**  
 Ildelfons Magrans De Abril, Doug Ollerenshaw, Marina Garrett, Peter Groblewski, Shawn Olsen, and Stefan Mihalas\*  
*Allen Institute for Brain Science, Modelling, Analysis and Theory, Seattle, WA, United States of America*
- P207 Modeling and building a disinhibitory circuit in V1 that achieves context-switching**  
 Doris Voina<sup>1\*</sup>, Stefano Recanatesi<sup>2</sup>, Eric Shea-Brown<sup>1</sup>, and Stefan Mihalas<sup>3</sup>  
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<sup>3</sup>*Allen Institute for Brain Science, Modelling, Analysis and Theory, Seattle, WA, United States of America*
- P208 Quantifying the dynamic effects of conceptual combination on word meanings using neural networks**  
 Nora E Aguirre-Celis<sup>1\*</sup>, Risto Miikkulainen<sup>2</sup>  
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- P209 On-line decoding of attempted movements from source reconstructed potentials.**  
 Timothée Proix<sup>1\*</sup>, Christoph Pokorny<sup>2</sup>, Martin Seeber<sup>1</sup>, Stephanie Trznadel<sup>3</sup>, Andrea Galvez<sup>2</sup>, David d’Croz-Baron<sup>4</sup>, Aude Yulzari<sup>3</sup>, Simon Duboue<sup>2</sup>, Ruxandra Iancu-Ferfoggia<sup>5</sup>, Ammar Kassouha<sup>5</sup>, Karin Diserens<sup>6</sup>, Anne-Chantal Heritier Barras<sup>5</sup>, Jean-Paul Janssens<sup>5</sup>, Ujwal Chaudhary<sup>7</sup>, Niels Birbaumer<sup>7</sup>, Christoph Michel<sup>2</sup>, and Tomislav Milekovic<sup>2</sup>  
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<sup>6</sup>*Vaud University Hospital, Lausanne, Switzerland*  
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- P210 Nonlinear functional co-activations: dynamical, directed and delayed.**  
 Ignacio Cifre<sup>1\*</sup>, Jeremi Ochab<sup>2</sup>, Dante Chialvo<sup>3,4</sup>, and Tatiana Miller<sup>4</sup>  
<sup>1</sup>*Universit Ramon Llull, Barcelona, Spain*  
<sup>2</sup>*Jagiellonian University, Institute of Physics, Kraków, Poland*  
<sup>3</sup>*Universidad Nacional de San Martín, Buenos Aires, Argentina*  
<sup>4</sup>*Center for Complex Systems & Brain Sciences (CEMSC<sup>3</sup>), Buenos Aires, Argentina*
- P211 A co-evolving model for synaptic pruning**  
 Ana Paula Millán Vidal\*  
*University of Granada, Granada, Spain*
- P212 A theoretical approach to intrinsic timescales in spiking neural networks**  
 Alexander van Meegen\*, Sacha van Albada  
*Jülich Research Centre, Institute of Neuroscience and Medicine (INM-6) and Institute for Advanced Simulation (IAS-6), Juelich, Germany*
- P213 Pontine mechanisms of abnormal breathing**  
 William Barnett<sup>1\*</sup>, Lucas Koolen<sup>2</sup>, Thomas Dick<sup>3</sup>, Ana Abdala<sup>2</sup>, and Yaroslav Molkov<sup>1</sup>  
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<sup>2</sup>*University of Bristol, School of Physiology, Pharmacology & Neuroscience, Biomedical Sciences Faculty, Bristol, United Kingdom*  
<sup>3</sup>*Case Western Reserve University, School of Medicine, Department of Medicine, Cleveland, United States of America*
- P214 Interlimb coordination during split-belt locomotion: a modeling study**  
 Elizaveta Latash<sup>1\*</sup>, William Barnett<sup>2</sup>, Robert Capps<sup>1</sup>, Simon Danner<sup>3</sup>, Ilya Rybak<sup>3</sup>, and Yaroslav Molkov<sup>1</sup>  
<sup>1</sup>*Georgia State University, Department of Mathematics & Statistics, Atlanta, GA, United States of America*  
<sup>2</sup>*Georgia State University, Georgia State University, Atlanta, GA, United States of America*  
<sup>3</sup>*Drexel University College of Medicine, Department of Neurobiology and Anatomy, Philadelphia, PA, United States of America*
- P215 Sympathetic and parasympathetic mechanisms of enhanced respiratory modulation of blood pressure and heart rate during slow deep breathing**  
 Robert Capps<sup>1\*</sup>, William Barnett<sup>1</sup>, Elizaveta Latash<sup>2</sup>, Erica Wehrwein<sup>3</sup>, Thomas Dick<sup>4</sup>, and Yaroslav Molkov<sup>2</sup>  
<sup>1</sup>*Georgia State University, Atlanta, GA, United States of America*  
<sup>2</sup>*Georgia State University, Department of Mathematics & Statistics, Atlanta, GA, United States of America*  
<sup>3</sup>*Michigan State University, Physiology, East Lansing, United States of America*  
<sup>4</sup>*Case Western Reserve University, School of Medicine, Department of Medicine, Cleveland, United States of America*
- P216 Pairwise models inferred from hippocampal data generate states typical of low-dimensional attractors**  
 Lorenzo Posani<sup>1\*</sup>, Simona Cocco<sup>1</sup>, and Rémi Monasson<sup>1,2</sup>  
<sup>1</sup>*Ecole Normale Supérieure, Physics, Paris, France*  
<sup>2</sup>*CNRS, Paris, France*

- P217 Information transfer in modular spiking networks**  
 Barna Zajzon<sup>1,2\*</sup>, Renato Duarte<sup>1,2</sup>, and Abigail Morrison<sup>2</sup>  
<sup>1</sup>Jülich Research Center, Institute of Neuroscience and Medicine (INM-6), Jülich, Germany  
<sup>2</sup>Jülich Research Centre, Institute for Advanced Simulation (IAS-6), Jülich, Germany
- P218 Modelling the micro-structure of the mouse whole-neocortex connectome**  
 Michael Reimann\*, Michael Gevaert, Ying Shi, Huanxiang Lu, Henry Markram, and Eilif Muller  
 École Polytechnique Fédérale de Lausanne, Blue Brain Project, Switzerland
- P219 Impact of higher-order network structure on emergent cortical activity**  
 Max Nolte<sup>1\*</sup>, Michael Reimann<sup>1</sup>, Eyal Gal<sup>2</sup>, Henry Markram<sup>1</sup>, and Eilif Muller<sup>1</sup>  
<sup>1</sup>Ecole Polytechnique Fédérale de Lausanne, Blue Brain Project, Lausanne, Switzerland  
<sup>2</sup>The Hebrew University of Jerusalem, Edmond and Lily Safra Center for Brain Sciences, Jerusalem, Israel
- P220 Biophysical modeling of LTP and LTD in the somatosensory cortex**  
 Giuseppe Chindemi<sup>1\*</sup>, Vincent Delattre<sup>1</sup>, Michael Doron<sup>2</sup>, Michael Graupner<sup>3</sup>, James King<sup>1</sup>, Pramod Kumbhar<sup>1</sup>, Rodrigo Perin<sup>4</sup>, Srikanth Ramaswamy<sup>1</sup>, Michael Reimann<sup>1</sup>, Christian A Rössert<sup>1</sup>, Werner Alfons Hilda van Geit<sup>1</sup>, Idan Segev<sup>2</sup>, Henry Markram<sup>1</sup>, and Eilif Muller<sup>1</sup>  
<sup>1</sup>Ecole Polytechnique Fédérale de Lausanne, Blue Brain Project, Lausanne, Switzerland  
<sup>2</sup>Hebrew University of Jerusalem, Department of Neurobiology, Jerusalem, Israel  
<sup>3</sup>Université Paris Descartes, Laboratoire de Physiologie Cérébrale - UMR 8118, CNRS, Paris, France  
<sup>4</sup>École Polytechnique Fédérale de Lausanne, Laboratory of Neural Microcircuitry, Lausanne, Switzerland
- P221 Realistic models of molecular layer inhibitory interneurons of the cerebellar cortex**  
 Martina Francesca Rizza<sup>1\*</sup>, Stefano Masoli<sup>1</sup>, Egidio d'Angelo<sup>1</sup>, Francesca Locatelli<sup>1</sup>, Francesca Prestori<sup>1</sup>, Diana Sánchez Ponce<sup>2</sup>, and Alberto Muñoz<sup>2</sup>  
<sup>1</sup>University of Pavia, Department of Brain and Behavioural Sciences, Pavia, Italy  
<sup>2</sup>Universidad Politécnica, Centro de Tecnología Biomédica, Madrid, Spain
- P222 Excitability differences between small and large sensory nerve fibers may be explained by different ion channel distribution**  
 Jenny Tigerholm\*, Aida H. Poulsen, Ole K. Andersen, and Carsten D. Mørch  
 Aalborg university, Department of Health Science and Technology, Aalborg, Denmark
- P223 A new spectral graph model of brain oscillations**  
 Ashish Raj<sup>1\*</sup>, Xihe Xie<sup>2</sup>, Chang Cai<sup>2</sup>, Pratik Mukherjee<sup>2</sup>, Eva Palacios<sup>2</sup>, and Srikantan Nagarajan<sup>2</sup>  
<sup>1</sup>University of California San Francisco, Radiology and Biomedical Imaging, San Francisco, CA, United States of America  
<sup>2</sup>UCSF, Radiology, San Francisco, United States of America
- P224 Controlling burst activity allows for a multiplexed neural code in cortical circuits**  
 Filip Vercausse<sup>1\*</sup>, Henning Sprekeler<sup>1</sup>, Paola Suárez<sup>1</sup>, and Richard Naud<sup>2</sup>  
<sup>1</sup>Technical University Berlin, Berlin, Germany  
<sup>2</sup>University of Ottawa, Ottawa, Canada



- P225 Reinforcement-mediated plasticity in a spiking model of the drosophila larva olfactory system**  
 Anna-Maria Jürgensen<sup>1\*</sup>, Afshin Khalili<sup>1</sup>, and Martin Paul Nawrot<sup>2</sup>  
<sup>1</sup>University of Cologne, Cologne, Germany  
<sup>2</sup>University of Cologne, Computational Systems Neuroscience, Institute of Zoology, Cologne, Germany
- P226 Inhibitory clustering and adaptation: critical features in modeling the neocortex**  
 Vahid Rostami<sup>1\*</sup>, Thomas Rost<sup>1</sup>, Alexa Riehle<sup>2</sup>, Sacha van Albada<sup>3</sup>, and Martin Paul Nawrot<sup>1</sup>  
<sup>1</sup>University of Cologne, Computational Systems Neuroscience, Institute of Zoology, Cologne, Germany  
<sup>2</sup>CNRS - Aix-Marseille Université, Institut de Neurosciences de la Timone (INT), Marseille, France  
<sup>3</sup>Jülich Research Centre, Institute of Neuroscience and Medicine (INM-6) and Institute for Advanced Simulation (IAS-6), Juelich, Germany
- P227 Representation of isometric wrist movement in the motor and somatosensory cortices of primates**  
 Nasima Sophia Razizadeh<sup>1\*</sup>, Marita Metzler<sup>1</sup>, Yifat Prut<sup>2</sup>, and Martin Paul Nawrot<sup>1</sup>  
<sup>1</sup>University of Cologne, Computational Systems Neuroscience, Institute of Zoology, Cologne, Germany  
<sup>2</sup>The Hebrew University, Department of Medical Neurobiology, IMRIC, Hadassah Medical School, Jerusalem, Israel
- P228 Temporal credit-assignment in a detailed spiking model of the fly mushroom body can solve olfactory learning in dynamic odor environments.**  
 Hannes Rapp\*, Martin Paul Nawrot  
 University of Cologne, Computational Systems Neuroscience, Institute of Zoology, Cologne, Germany
- P229 Model of the fruit fly's mushroom body reproduces olfactory extinction learning**  
 Magdalena Anna Springer<sup>1\*</sup>, Johannes Felsenberg<sup>2</sup>, and Martin Paul Nawrot<sup>1</sup>  
<sup>1</sup>University of Cologne, Computational Systems Neuroscience, Institute of Zoology, Cologne, Germany  
<sup>2</sup>Friedrich Miescher Institute for Biomedical Research, Basel, Switzerland
- P230 Modelling a biologically realistic microcircuit of the Drosophila mushroom body calyx**  
 Miriam Faxel<sup>1\*</sup>, Gaia Tavosanis<sup>2</sup>, Philipp Ranft<sup>3</sup>, and Martin Paul Nawrot<sup>4</sup>  
<sup>1</sup>University of Cologne, Köln, Germany  
<sup>2</sup>German Center for Neurodegenerative Diseases, Dendrite Differentiation Unit, Bonn, Germany  
<sup>3</sup>German Center for Neurodegenerative Diseases, Dynamics of Neuronal Circuits, Bonn, Germany  
<sup>4</sup>University of Cologne, Computational Systems Neuroscience, Institute of Zoology, Cologne, Germany
- P231 Relevance of non-synaptic interactions in the neural encoding of odorants: a good start is half the battle**  
 Mario Pannunzi<sup>1\*</sup>, Paul Szyszka<sup>2</sup>, and Thomas Nowotny<sup>3</sup>  
<sup>1</sup>University of Sussex, Department of Informatics, Brighton, United Kingdom  
<sup>2</sup>University of Otago, Dunedin, New Zealand  
<sup>3</sup>University of Sussex, School of Engineering and Informatics, Brighton, United Kingdom
- P232 Learning a reward distribution with reward prediction errors in a model of the Drosophila mushroom body**  
 James Bennett\*, Thomas Nowotny  
 University of Sussex, School of Engineering and Informatics, Brighton, United Kingdom

- P233 Does structure in neural correlations match anatomical structure?**  
Thomas Delaney\*, Cian O'Donnell  
*University of Bristol, Computer Science, Bristol, United Kingdom*
- P234 The structure of the population code in V1 and V4 microcircuits responding to natural stimuli.**  
Veronika Koren<sup>1\*</sup>, Ariana Andrei<sup>2</sup>, Ming Hu<sup>3</sup>, Valentin Dragoi<sup>2</sup>, and Klaus Obermayer<sup>1</sup>  
<sup>1</sup>*Technische Universität Berlin, Institute of Software Engineering and Theoretical Computer Science, Berlin, Germany*  
<sup>2</sup>*University of Texas Medical School, Department of Neurobiology and Anatomy, Houston, Texas, United States of America*  
<sup>3</sup>*Massachusetts Institute of Technology, Picower Institute for Learning and Memory, Cambridge, Massachusetts, United States of America*
- P235 Diversity of networks activity is provided by chemical plus electrical synapses**  
Kesheng Xu<sup>1\*</sup>, Jean Paul Maidana<sup>2</sup>, and Patricio Orio<sup>1</sup>  
<sup>1</sup>*Universidad de Valparaíso, Centro Interdisciplinario de Neurociencia de Valparaíso, Valparaíso, Chile*  
<sup>2</sup>*Universidad de Valparaíso, Estadística, Valparaíso, Chile*
- P236 Is human connectome optimized to enhance dynamic cortical ignition?**  
Samy Castro<sup>1\*</sup>, Wael El-Deredy<sup>1</sup>, Demian Battaglia<sup>2</sup>, and Patricio Orio<sup>3</sup>  
<sup>1</sup>*Universidad de Valparaíso, Centro de Investigación y Desarrollo en Ingeniería en Salud, Valparaíso, Chile*  
<sup>2</sup>*Aix-Marseille Université, Institut de Neurosciences des Systèmes, Marseille, France*  
<sup>3</sup>*Universidad de Valparaíso, Instituto de Neurociencia, Valparaíso, Chile*
- P237 Comparing the effects of adaptation and synaptic filtering on the timescale of recurrent networks**  
Manuel Beiran\*, Srdjan Ostojic  
*Ecole Normale Supérieure, Department of Cognitive Studies, Paris, France*
- P238 Computations of inhibition of return mechanisms by modulating V1 dynamics**  
David Berga<sup>1\*</sup>, Xavier Otazu<sup>1,2</sup>  
<sup>1</sup>*Universitat Autònoma de Barcelona, Computer Vision Center, Barcelona, Spain*  
<sup>2</sup>*Dept. of Computer Science, Barcelona, Spain*
- P239 Long-range recurrent connectivity – cost-effective circuit for natural image perception**  
Seungdae Baek\*, Youngjin Park, and Se-Bum Paik  
*Korea Advanced Institute of Science and Technology, Department of Bio and Brain Engineering, Daejeon, South Korea*
- P240 Extracting whole-brain functional subnetworks for the prediction of cognitive and clinical conditions**  
Andrea Insabato<sup>1\*</sup>, Matthieu Gilson<sup>2</sup>, and Vicente Pallarés<sup>1</sup>  
<sup>1</sup>*Universty Pompeu Fabra, Barcelona, Spain*  
<sup>2</sup>*Universitat Pompeu Fabra, Center for Brain and Cognition, Barcelona, Spain*

**Tuesday Posters**  
**Posters P241 – P358**

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**P241 State transition network analysis of the resting state human brain cortex**

Jiyoung Kang\*, Hae-Jeong Park

*Yonsei University, College of Medicine, Seoul, South Korea*

**P242 Optimization and validation of a point neuron model to simulate the activity of olivocerebellar neurons**

Alice Geminiani<sup>1\*</sup>, Egidio d'Angelo<sup>2</sup>, Claudia Casellato<sup>2</sup>, and Alessandra Pedrocchi<sup>1</sup>

<sup>1</sup>*Politecnico di Milano, Department of Electronics, Information and Bioengineering, Milan, Italy*

<sup>2</sup>*University of Pavia, Dept. of Brain and Behavioral Sciences - Unit of Neurophysiology, Pavia, Italy*

**P243 Modelling complex cells of early visual cortex using predictive coding**

Angelo Franciosini\*, Victor Boutin, and Laurent Perrinet

*CNRS - Aix-Marseille Université, Institut de Neurosciences de la Timone, Marseille, France*

**P244 Distributed representations and learning in neuronal networks**

Matthieu Gilson<sup>1\*</sup>, David Dahmen<sup>2</sup>, Ruben Moreno-Bote<sup>3</sup>, Moritz Helias<sup>2</sup>, Andrea Insabato<sup>1</sup>, and Jean-Pascal Pfister<sup>4</sup>

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<sup>3</sup>*Universitat Pompeu Fabra, Center for Brain and Cognition & DTIC, Barcelona, Spain*

<sup>4</sup>*ETH Zurich, Zurich, Switzerland*

**P245 Electrical synapses shape responses to transient inputs to canonical circuits**

Julie Haas<sup>1\*</sup>, Tuan Pham<sup>2</sup>

<sup>1</sup>*Lehigh University, Dept. of Biological Sciences, Bethlehem, PA, United States of America*

<sup>2</sup>*University of Chicago, Graduate Program in Computational Neuroscience, Chicago, IL, United States of America*

**P246 Sensory processing and abstract categorization in cortical and deep neural networks**

Dimitris Pinotsis\*

*City–University of London and MIT, London, United Kingdom*

**P247 Substantia nigra pars compacta dopamine axons die back; a bioenergetic model to explain mechanisms of degeneration in Parkinson's disease**

Teresa Ruiz Herrero<sup>1</sup>, Eleftheria Pissadaki<sup>2\*</sup>

<sup>1</sup>*Biogen Inc, Quantitative Medicine and Clinical Technologies, Research and Development, Cambridge, MA, United States of America*

<sup>2</sup>*Biogen Inc, Quantitative Medicine and Clinical Technologies, Cambridge, MA, United States of America*

- P248 Breakdown of spatial coding and neural synchronization in epilepsy using a computational model**  
 Spyridon Chavlis<sup>1\*</sup>, Ioanna Pandi<sup>2</sup>, Tristan Shuman<sup>3</sup>, Daniel Aharoni<sup>4</sup>, Denise Cai<sup>3</sup>, Peyman Golshani<sup>4</sup>, and Panayiota Poirazi<sup>5</sup>  
<sup>1</sup>*Foundatuion for Research and Technology-Hellas, Institute of Computer Science, Heraklion, Greece*  
<sup>2</sup>*University of Crete, School of Medicine, Heraklion, Greece*  
<sup>3</sup>*Icahn School of Medicine at Mount Sinai, Department of Neuroscience and Friedman Brain Institute, New York, United States of America*  
<sup>4</sup>*University of California, Department of Neurology, David Geffen School of Medicine, Los Angeles, United States of America*  
<sup>5</sup>*FORTH, IMBB, Heraklion, Greece*
- P249 Structured connectivity exploits NMDA-non-linearities to induce diverse responses in a PFC circuit.**  
 Stefanos S. Stefanou, Athanasia Papoutsis\*, and Panayiota Poirazi  
*FORTH, IMBB, Heraklion, Greece*
- P250 Spiking patterns in the zebrafish larvae**  
 Nicolas Doyon<sup>1\*</sup>, Patrick Desrosiers<sup>2</sup>, Simon V. Hardy<sup>3</sup>, Jean-Christophe Rindy-Turcotte<sup>1</sup>, and Jasmine Poirier<sup>4</sup>  
<sup>1</sup>*Université Laval, Mathematics and Statistics, Quebec, Canada*  
<sup>2</sup>*Laval University, Département de physique, de génie physique et d'optique, Quebec, Canada*  
<sup>3</sup>*Laval University, Département d'informatique et de génie logiciel, Quebec, Canada*  
<sup>4</sup>*Laval University, Physics, Quebec, Canada*
- P251 Impact of brain parcellation on parameter optimization of the whole-brain dynamical models**  
 Thanos Manos<sup>1\*</sup>, Sandra Diaz-Pier<sup>2</sup>, Felix Hoffstaedter<sup>1</sup>, Jan Schreiber<sup>3</sup>, Alexander Peyser<sup>2</sup>, Simon B. Eickhoff<sup>1</sup>, and Oleksandr V. Popovych<sup>1</sup>  
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<sup>2</sup>*Jülich Research Centre, SimLab Neuroscience, Jülich, Germany*  
<sup>3</sup>*Research Centre Jülich, Institute of Neuroscience and Medicine, Structural and functional organization of the brain (INM-1), Jülich, Germany*
- P252 Ion channel correlations emerge from the simultaneous regulation of multiple neuronal properties**  
 Jane Yang<sup>1\*</sup>, Steve Prescott<sup>2</sup>  
<sup>1</sup>*University of Toronto & The Hospital for Sick Children, Institute of Biomaterials and Biomedical Engineering, Toronto, Canada*  
<sup>2</sup>*University of Toronto, Neurosciences and Mental Health and Dept. Physiology, Institute of Biomaterials and Biomedical Eng, Toronto, Canada*
- P253 A new framework for modelling neural-ECM signalling and interaction**  
 Nicolangelo Iannella<sup>1\*</sup>, Anders Malthé-Sørensen<sup>2</sup>, Gaute Einevoll<sup>3</sup>, Marianne Fyhn<sup>1</sup>, and Kristian Prydz<sup>1</sup>  
<sup>1</sup>*University of Oslo, Department of Biosciences, Oslo, Norway*  
<sup>2</sup>*University of Oslo, Department of Physics, Oslo, Norway*  
<sup>3</sup>*Norwegian University of Life Sciences, Faculty of Science and Technology, Aas, Norway*

- P254 In silico Spinal cord model shows the viability of targeting segmental foci along rostrocaudal axis for eliciting a variety of movement types**  
 Madhav Vinodh, Raghu Iyengar, and Mohan Raghavan\*  
*Indian Institute of Technology, Hyderabad, Biomedical Engineering, Hyderabad, India*
- P255 Slow-gamma frequencies are optimally guarded against neurodegenerative impairments**  
 Pedro Maia<sup>1\*</sup>, J. Nathan Kutz<sup>2</sup>, and Ashish Raj<sup>1</sup>  
<sup>1</sup>*University of California San Francisco, Radiology and Biomedical Imaging, San Francisco, CA, United States of America*  
<sup>2</sup>*University of Washington, Department of Applied Mathematics, Seattle, WA, United States of America*
- P256 A mathematical investigation of chemotherapy induced peripheral neuropathy**  
 Parul Verma<sup>1\*</sup>, Achim Kienle<sup>2</sup>, Dietrich Flockerzi<sup>2</sup>, and Doraiswami Ramkrishna<sup>1</sup>  
<sup>1</sup>*Purdue University, Chemical Engineering, West Lafayette, IN, United States of America*  
<sup>2</sup>*Max Planck Institute for Dynamics of Complex Technical Systems, Magdeburg, Germany*
- P257 Estimating the readily-releasable vesicle pool size at synaptic connections in neocortex**  
 Natali Barros Zulaica<sup>1\*</sup>, Giuseppe Chindemi<sup>1</sup>, Rodrigo Perin<sup>2</sup>, Henry Markram<sup>1</sup>, Srikanth Ramaswamy<sup>1</sup>, Eilif Muller<sup>1</sup>, and John Ramon<sup>1</sup>  
<sup>1</sup>*École Polytechnique Fédérale de Lausanne, Blue Brain Project, Lausanne, Switzerland*  
<sup>2</sup>*École Polytechnique Fédérale de Lausanne, Laboratory of Neural Microcircuitry, Lausanne, Switzerland*
- P258 Extracellular synaptic and action potential signatures in the hippocampal formation : a modelling study**  
 Amelie Aussel<sup>1,2\*</sup>, Harry Tran<sup>1</sup>, Laure Buhry<sup>2</sup>, Steven Le Cam<sup>1</sup>, Louis Maillard<sup>1,3</sup>, Sophie Colnat-Coulbois<sup>1,4</sup>, Valérie Louis Dorr<sup>2</sup>, and Radu Ranta<sup>1</sup>  
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<sup>2</sup>*Université de Lorraine, LORIA UMR CNRS 7503, Nancy, France*  
<sup>3</sup>*Université de Lorraine, CHRU Nancy Service de Neurologie, Nancy, France*  
<sup>4</sup>*Université de Lorraine, CHRU Nancy Service de Neurochirurgie, Nancy, France*
- P259 Neural architecture for representing sound in cortex**  
 Alex Reyes\*  
*New York University, Center for Neural Science, New York, NY, United States of America*
- P260 Firing rate of neurons with dendrites, soma and axon in the fluctuation-driven, low-rate limit**  
 Robert Gowers<sup>1\*</sup>, Yulia Timofeeva<sup>2</sup>, and Magnus Richardson<sup>3</sup>  
<sup>1</sup>*University of Warwick, Centre for Doctoral Training in Mathematics for Real-World Systems, Coventry, United Kingdom*  
<sup>2</sup>*University of Warwick, Department of Computer Science, Coventry, United Kingdom*  
<sup>3</sup>*University of Warwick, Warwick Mathematics Institute, Coventry, United Kingdom*
- P261 Noise can counterintuitively synchronize dynamics on the human connectome**  
 James Pang<sup>1\*</sup>, Leonardo L Gollo<sup>2</sup>, and James Roberts<sup>1</sup>  
<sup>1</sup>*QIMR Berghofer Medical Research Institute, Brain Modelling Group, Brisbane, Australia*  
<sup>2</sup>*QIMR Berghofer Medical Research Institute, Brisbane, Australia*

- P262 Neural heterogeneity in the gain control mechanism of antennal lobe improves odorant classification**  
 Aaron Montero<sup>\*</sup>, Jessica Lopez-Hazas, and Francisco B Rodriguez  
*Universidad Autónoma Madrid, Ingeniería Informática, Madrid, Spain*
- P263 Tuning a computational model of the electromotor system to patterns of interpulse intervals recorded from *Gnathonemus petersii* specimens**  
 Angel Lareo<sup>1\*</sup>, Pablo Varona<sup>2</sup>, and Francisco B Rodriguez<sup>2</sup>  
<sup>1</sup>*Universidad Autónoma de Madrid, Grupo de Neurocomputación Biológica, Madrid, Spain*  
<sup>2</sup>*Universidad Autónoma de Madrid, Ingeniería Informática, Madrid, Spain*
- P264 Kenyon Cells threshold distribution adapts to pattern complexity in a bioinspired computational learning model of the locust olfactory system**  
 Jessica Lopez-Hazas, Aaron Montero<sup>\*</sup>, and Francisco B Rodriguez  
*Universidad Autónoma Madrid, Ingeniería Informática, Madrid, Spain*
- P265 Biologically realistic mean-field models of conductance-based networks of spiking neurons**  
 Matteo Di Volo<sup>1\*</sup>, Cristiano Capone<sup>2</sup>, Alain Destexhe<sup>3</sup>, and Alberto Romagnoni<sup>4</sup>  
<sup>1</sup>*CNRS, Paris, France*  
<sup>2</sup>*INFN, sezione di Roma, INFN, sezione di Roma, Rome, Italy*  
<sup>3</sup>*CNRS, Department of Integrative and Computational Neuroscience (ICN), Gif-sur-Yvette, France*  
<sup>4</sup>*Ecole normale supérieure ENS, Département d'informatique, Paris, France*
- P266 Interplay between network structure and synaptic strength on information transmission in hierarchical modular cortical networks**  
 Rodrigo Pena<sup>1</sup>, Vinicius Lima<sup>2</sup>, Renan O. Shimoura<sup>2</sup>, Joao-Paulo Novato<sup>2</sup>, and Antônio C. Roque<sup>2\*</sup>  
<sup>1</sup>*New Jersey Institute of Technology, Federated Department of Biological Sciences, Newark, NJ, United States of America*  
<sup>2</sup>*University of Sao Paulo, Dept. Physics, FFCLRP, Ribeirao Preto, Brazil*
- P267 Wavenet identification and input estimation from single voltatge traces**  
 Toni Guillamon<sup>1\*</sup>, Carlos A. Claumann<sup>2</sup>, Enric Fossas<sup>3</sup>, and Nestor Roqueiro<sup>4</sup>  
<sup>1</sup>*Universitat Politecnica de Catalunya, Mathematics, Barcelona, Spain*  
<sup>2</sup>*Researcher, Florianopolis, Brazil*  
<sup>3</sup>*Universitat Politecnica de Catalunya, Automatic Control, Barcelona, Spain*  
<sup>4</sup>*Federal University of Santa Catarina, Automação e Sistemas, Florianopolis, Brazil*
- P268 A biophysical model for the tripartite synapse under metabolic stress**  
 Manu Kalia<sup>1\*</sup>, Stephan van Gils<sup>1</sup>, Michel J.a.m. van Putten<sup>2</sup>, and Christine R. Rose<sup>3</sup>  
<sup>1</sup>*University of Twente, Applied Mathematics, Enschede, Netherlands*  
<sup>2</sup>*University of Twente, Department of Clinical Neurophysiology, Enschede, Netherlands*  
<sup>3</sup>*Heinrich Heine University Duesseldorf, Institute of Neurobiology, Duesseldorf, Germany*
- P269 Fluctuation-driven plasticity allows for flexible rewiring of neuronal assemblies**  
 Federico Devalle<sup>1</sup>, Ernest Montbrió<sup>1</sup>, and Alex Roxin<sup>2\*</sup>  
<sup>1</sup>*Universitat Pompeu Fabra, Department of Information and Communication Technologies, Barcelona, Spain*  
<sup>2</sup>*Centre de Recerca Matemàtica, Barcelona, Spain*

- P270 Exploring mechanisms of intermittent patterns of neural synchrony**  
Joel Zirkle<sup>1</sup>, Leonid Rubchinsky<sup>1,2\*</sup>  
<sup>1</sup>Indiana University Purdue University Indianapolis, Department of Mathematical Sciences, Indianapolis, IN, United States of America  
<sup>2</sup>Indiana University School of Medicine, Stark Neurosciences Research Institute, Indianapolis, IN, United States of America
- P271 Substantia Nigra pars reticulata responses to direct and indirect pathway GABAergic projections depend on intracellular chloride dynamics**  
Ryan Phillips\*, Jonathan Rubin  
University of Pittsburgh, Department of Mathematics, Pittsburgh, PA, United States of America
- P272 Comparing spikes and the local field potential (LFP) in V1 between experimental data and a comprehensive biophysical model**  
Espen Hagen<sup>1\*</sup>, Alexander J Stasik<sup>1</sup>, Yazan Billeh<sup>2</sup>, Joshua Siegle<sup>2</sup>, Kael Dai<sup>2</sup>, Torbjørn V Ness<sup>3</sup>, Marianne Fyhn<sup>4</sup>, Torkel Hafting<sup>5</sup>, Christof Koch<sup>2</sup>, Shawn Olsen<sup>2</sup>, Gaute Einevoll<sup>3</sup>, Anton Arkhipov<sup>2</sup>, Atle E. Rimehaug<sup>6</sup>, and Malin B. Røe<sup>4</sup>  
<sup>1</sup>University of Oslo, Department of Physics, Oslo, Norway  
<sup>2</sup>Allen Institute for Brain Science, Modelling, Analysis and Theory, Seattle, WA, United States of America  
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- P273 Impact of intrinsic neuronal properties in cortical network-dynamics**  
Leonardo Dalla Porta<sup>1\*</sup>, Almudena Barbero<sup>1</sup>, Albert Compte<sup>1</sup>, and Maria V. Sanchez-Vives<sup>1,2</sup>  
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- P274 Wave propagation, dynamical richness and predictability under different brain states**  
Alessandra Camassa<sup>1\*</sup>, Miguel Dasilva<sup>1</sup>, Maurizio Mattia<sup>2</sup>, and Maria V. Sanchez-Vives<sup>1,3</sup>  
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- P275 Classification of brain states across the awake-sleep transition in the cortex of rats.**  
Belen De Sancristobal<sup>1\*</sup>, Ruben Moreno-Bote<sup>1,2</sup>, Melody Torao<sup>3</sup>, and Maria V. Sanchez-Vives<sup>3,4</sup>  
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- P276 Propagating densities of spontaneous activity in cortical slices**  
Roman Arango<sup>1\*</sup>, Pedro Mateos-Aparicio<sup>2</sup>, Emili Balaguer-Ballester<sup>1</sup>, and Maria V. Sanchez-Vives<sup>2,3</sup>  
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- P277 Recovery time after stimulation in mice characterizes brain complexity under different levels of anesthesia**  
 Manel Vila-Vidal<sup>1\*</sup>, Ane López-González<sup>1</sup>, Miguel Dasilva<sup>2</sup>, Gustavo Deco<sup>3</sup>, and Maria V. Sanchez-Vives<sup>2,4</sup>  
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<sup>3</sup>*Universitat Pompeu Fabra, Barcelona, Spain*  
<sup>4</sup>*ICREA, Systems Neuroscience, Barcelona, Spain*
- P278 Unsupervised learning of sparse spatio-temporal receptive fields through inhibitory plasticity; A model of the mammalian early visual system**  
 Samuel Sutton\*, Volker Steuber, and Michael Schmuker  
*University of Hertfordshire, Biocomputation Research Group, Hatfield, United Kingdom*
- P279 Capacitance clamp**  
 Paul Pfeiffer<sup>1\*</sup>, Federico José Barreda Tomás<sup>2</sup>, Jiameng Wu<sup>3</sup>, Jan-Hendrik Schleimer<sup>1</sup>, Imre Vida<sup>2</sup>, and Susanne Schreiber<sup>1</sup>  
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<sup>3</sup>*Humboldt-Universität zu Berlin, Bernstein Center for Computational Neuroscience, Berlin, Germany*
- P280 Biologically realistic behaviors from a superconducting neuron model**  
 Patrick Crotty<sup>1\*</sup>, Kenneth Segall<sup>1</sup>, and Daniel Schult<sup>2</sup>  
<sup>1</sup>*Colgate University, Department of Physics and Astronomy, Hamilton, NY, United States of America*  
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- P281 Calculating local field potential from spiking neural network model**  
 Rahmi Elibol<sup>1,2\*</sup>, Neslihan Serap Sengor<sup>2</sup>  
<sup>1</sup>*Erzincan University, Istanbul, Turkey*  
<sup>2</sup>*Istanbul Technical University, Electronics and Communication Engineering Dept., Istanbul, Turkey*
- P282 Lagrangian neurodynamics for real-time error-backpropagation across cortical areas**  
 Dominik Dold<sup>1\*</sup>, Akos Ferenc Kungl<sup>1</sup>, João Sacramento<sup>2</sup>, Mihai A. Petrovici<sup>3</sup>, Kaspar Schindler<sup>4</sup>, Jonathan Binas<sup>5</sup>, Yoshua Bengio<sup>5</sup>, and Walter Senn<sup>3</sup>  
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- P283 Spatiotemporal discrimination in attractor networks with short-term synaptic plasticity**  
 Benjamin Ballintyn<sup>1\*</sup>, Paul Miller<sup>2</sup>, and Benjamin Shlaer<sup>3</sup>  
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- P284 Time-dependent dopamine modulation of projection neurons in the mosquito olfactory system**  
 Suh Woo Jung<sup>1</sup>, Eli Shlizerman<sup>1,2\*</sup>  
<sup>1</sup>University of Washington, Department of Electrical Engineering, Seattle, WA, United States of America  
<sup>2</sup>University of Washington, Departments of Applied Mathematics, Seattle, WA, United States of America
- P285 Identifying functional pathways of oxygen sensation in caenorhabditis elegans using systematic computational ablation**  
 Jimin Kim<sup>1\*</sup>, Eli Shlizerman<sup>1,2</sup>  
<sup>1</sup>University of Washington, Electrical and Computer Engineering, Seattle, WA, United States of America  
<sup>2</sup>University of Washington, Applied Mathematics, Seattle, WA, United States of America
- P286 A circuit model for temporal sequence learning**  
 Ian Cone<sup>1\*</sup>, Harel Shouval<sup>2</sup>  
<sup>1</sup>Rice University, Applied Physics, Houston, TX, United States of America  
<sup>2</sup>UTHealth, Neurobiology and Anatomy, Houston, United States of America
- P287 Exploring interneuron specific control of oriens lacunosum moleculare (OLM) interneuron recruitment in CA1 hippocampus**  
 Alexandre Guet-McCreight\*, Frances Skinner  
 Krembil Research Institute, Division of Fundamental Neurobiology, Toronto, Canada
- P288 Shaping connectivity and dynamics of neuronal networks with physical constraints**  
 Adriaan Ludl\*, Jordi Soriano  
 Universitat de Barcelona, Departament de Física de la Matèria Condensada, UB Institute of Complex Systems, Barcelona, Spain
- P289 Application of control theory to neural learning in the brain**  
 Catherine Davey<sup>1\*</sup>, David Grayden<sup>1</sup>, Anthony Burkitt<sup>1</sup>, Bastian Oetemo<sup>2</sup>, and Artemio Soto-Breceda<sup>1</sup>  
<sup>1</sup>University of Melbourne, Department of Biomedical Engineering, Melbourne, Australia  
<sup>2</sup>University of Melbourne, School of Computing and Information Systems, Melbourne, Australia
- P290 From episodic to semantic memory: A computational model**  
 Denis Alevi<sup>1\*</sup>, Richard Kempster<sup>2</sup>, and Henning Sprekeler<sup>1</sup>  
<sup>1</sup>Technical University Berlin, Berlin, Germany  
<sup>2</sup>Humboldt University of Berlin, Institute for Theoretical Biology, Berlin, Germany
- P291 Short-term facilitation and neurotransmitter spillover counteract each other in neuronal information transmission**  
 Mehrdad Salmasi<sup>1,2,3\*</sup>, Stefan Glasauer<sup>2,3,5</sup>, and Martin Stemmler<sup>2,4</sup>  
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<sup>5</sup>Brandenburg University of Technology Cottbus-Senftenberg, Germany

- P292 Reconstructing connectome of the cortical column with biologically-constrained associative learning**  
Danke Zhang\*, Chi Zhang, and Armen Stepanyants  
*Northeastern University, Department of Physics, Boston, MA, United States of America*
- P293 Phase dependence of the termination of absence seizures by cerebellar input to thalamocortical networks**  
Julia Goncharenko<sup>1\*</sup>, Lieke Kros<sup>2</sup>, Reinoud Maex<sup>1</sup>, Neil Davey<sup>1</sup>, Christoph Metzner<sup>3</sup>, Chris De Zeeuw<sup>2</sup>, Freek Hoebeek<sup>2</sup>, and Volker Steuber<sup>1</sup>  
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<sup>2</sup>*Erasmus MC, Department of Neuroscience, Rotterdam, Netherlands*  
<sup>3</sup>*Technische Universität Berlin, Department of Software Engineering and Theoretical Computer Science, Berlin, Germany*
- P294 Growth rules for repair of asynchronous irregular network models following peripheral lesions**  
Ankur Sinha<sup>1\*</sup>, Christoph Metzner<sup>2</sup>, Neil Davey<sup>1</sup>, Rod Adams<sup>1</sup>, Michael Schmuker<sup>1</sup>, and Volker Steuber<sup>1</sup>  
<sup>1</sup>*University of Hertfordshire, Biocomputation Research Group, Hatfield, United Kingdom*  
<sup>2</sup>*Technische Universität Berlin, Department of Software Engineering and Theoretical Computer Science, Berlin, Germany*
- P295 The effect of alterations of schizophrenia-associated genes on gamma band auditory steady-state responses**  
Christoph Metzner<sup>1\*</sup>, Gili Karni<sup>1</sup>, Hana McMahon-Cole<sup>1</sup>, Tuomo Mäki-Marttunen<sup>2</sup>, and Volker Steuber<sup>3</sup>  
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- P296 Conservation and change of organizational features during the evolution of neocortical circuits in mammals**  
Rodrigo Suarez\*  
*The University of Queensland, Brisbane, Australia*
- P297 Integrating classifiers and electrophysiology to better understand hearing loss**  
Samuel Smith<sup>1\*</sup>, Mark Wallace<sup>1</sup>, Joel Berger<sup>2</sup>, and Christian Sumner<sup>3</sup>  
<sup>1</sup>*University of Nottingham, Hearing Sciences, Nottingham, United Kingdom*  
<sup>2</sup>*University of Iowa, Neurosurgery, Iowa City, United States of America*  
<sup>3</sup>*Nottingham Trent University, Psychology, Nottingham, United Kingdom*
- P298 Transition probability in decision-making process**  
Nicoladie Tam\*  
*University of North Texas, Department of Biological Sciences, Denton, TX, United States of America*

- P299 Figure-ground detection by a population of neurons with a variety of receptive-field structures in monkey V4**  
Ko Sakai<sup>1\*</sup>, Kouji Kimura<sup>1</sup>, Yukako Yamane<sup>2</sup>, and Hiroshi Tamura<sup>3</sup>  
<sup>1</sup>University of Tsukuba, Department of Computer Science, Tsukuba, Japan  
<sup>2</sup>Japan Society for Promotion of Science, Tokyo, Japan  
<sup>3</sup>Osaka University, Graduate School of Frontiers Bioscience, Osaka, Japan
- P300 Brief mindfulness training induces structural plasticity within brain hub**  
Rongxiang Tang<sup>1</sup>, Yi-Yuan Tang<sup>2\*</sup>  
<sup>1</sup>Washington University in St. Louis, Psychological and Brain Sciences, St. Louis, WA, United States of America  
<sup>2</sup>Texas Tech University, Lubbock, TX, United States of America
- P301 Short-term mindfulness meditation changes grey matter in insula**  
Rongxiang Tang<sup>1</sup>, Yi-Yuan Tang<sup>2\*</sup>  
<sup>1</sup>Washington University in St. Louis, Psychological and Brain Sciences, St. Louis, WA, United States of America  
<sup>2</sup>Texas Tech University, Lubbock, TX, United States of America
- P302 Ultrasonic neuromodulation in multi-compartmental neuron models**  
Thomas Tarnaud\*, Wout Joseph, Luc Martens, Timothy van Renterghem, and Emmeric Tanghe  
University of Ghent, Waves - Information technology (INTEC), Ghent, Belgium
- P303 Universal automated seizure focus prediction consistent with post-operative outcome**  
Manel Vila-Vidal<sup>1\*</sup>, Carmen Pérez Enríquez<sup>2</sup>, Rodrigo Rocamora<sup>2</sup>, Gustavo Deco<sup>3</sup>, and Adrià Tauste Campo<sup>1</sup>  
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<sup>2</sup>Hospital del Mar Medical Research Institute, Epilepsy Monitoring Unit, Department of Neurology, Barcelona, Spain  
<sup>3</sup>Universitat Pompeu Fabra, Barcelona, Spain
- P304 Linearly optimal Fisher discriminant analysis of neuronal activity**  
Matias Calderini\*, Nareg Berberian, and Jean-Philippe Thivierge  
University of Ottawa, Department of Psychology, Ottawa, Canada
- P305 Temporal processing with oscillation-driven balanced spiking reservoirs with conductance based synapses**  
Philippe Vincent-Lamarre\*, Jean-Philippe Thivierge  
University of Ottawa, Department of Psychology, Ottawa, Canada
- P306 Emergence of gamma rhythms in V1 during the critical period requires balance of activity between interneuron subtypes**  
Justin Domhof, Paul Tiesinga\*  
Radboud University, Neuroinformatics, Nijmegen, Netherlands
- P307 Rodent whisking enters the third dimension**  
Benoit Meynard, Charl Linssen, and Paul Tiesinga\*  
Radboud University, Neuroinformatics, Nijmegen, Netherlands

- P308 Finite element method pipeline to optimize electrical properties of ECoG**  
Meron Vermaas<sup>1\*</sup>, Maria Carla Piastra<sup>2,3</sup>, Nick Ramsey<sup>4</sup>, and Paul Tiesinga<sup>1</sup>  
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- P309 A burst motif for attentional control**  
Pablo Casaní Galdón\*, Paul Tiesinga  
*Radboud University, Donders Institute for Brain, Neuroinformatics, Nijmegen, Netherlands*
- P310 A combined volume conduction and nerve fiber model for assessment of electrode design in relation to preferential activation of small cutaneous nerve**  
Aida H. Poulsen\*, Ole K. Andersen, Carsten D. Mørch, and Jenny Tigerholm  
*Aalborg University, Health Science and Technology, Aalborg, Denmark*
- P311 Possible mechanisms for gamma-nested oscillations in the hippocampus**  
Marco Segneri<sup>1\*</sup>, Simona Olmi<sup>2</sup>, and Alessandro Torcini<sup>1</sup>  
<sup>1</sup>*Université de Cergy-Pontoise, Laboratoire de Physique Théorique et Modélisation, Pontoise, France*  
<sup>2</sup>*Inria Sophia Antipolis Mediterranee Research Centre, MathNeuro Team, Sophia Antipolis, France*
- P312 Coexistence of fast and slow gamma oscillations in one population of inhibitory spiking neurons**  
Hongjie Bi<sup>1\*</sup>, Matteo Di Volo<sup>2</sup>, Marco Segneri<sup>1</sup>, and Alessandro Torcini<sup>1</sup>  
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<sup>2</sup>*Unite de Neurosciences, Information et Complexité (UNIC), Gif sur Yvette, France*
- P313 Transition from asynchronous to oscillatory dynamics in balanced spiking networks with instantaneous synapses**  
Matteo Di Volo<sup>1\*</sup>, Alessandro Torcini<sup>2</sup>  
<sup>1</sup>*CNRS, Paris, France*  
<sup>2</sup>*Université de Cergy-Pontoise, Laboratoire de physique théorique et modélisation, Pontoise, France*
- P314 A simple model of neural autapse reconciles diverse experimental observations**  
Hazem Toutounji\*  
*Institute of Neuroinformatics, UZH/ETH, Zurich, Switzerland*
- P315 A Bayesian model explains how individual and mutual properties of action and outcome affect sense of agency**  
Roberto Legaspi\*, Taro Toyoizumi  
*Rikem Center for Brain Science, Neural Computation and Adaptation, Wakoshi, Saitama, Japan*

- P316 A map-based model for the membrane potential of healthy and unhealthy neurons and cardiac cells**  
Mauricio Girardi-Schappo<sup>1\*</sup>, Patrick A. Morelo<sup>2</sup>, Rafael V. Stenzinger<sup>2</sup>, and Marcelo H. R. Tragtenberg<sup>2</sup>  
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<sup>2</sup>Federal University of Santa Catarina, Department of Physics, Florianopolis, SC, Brazil
- P317 Deterministic search process underlies memory recall**  
Michelangelo Naim\*, Mikhail Katkov, and Misha Tsodyks  
Weizmann Institute of Science, Neurobiology, Rehovot, Israel
- P318 Geometry of sensory response extremizes correlations in a phenomenological model of autism**  
Rashid Williams-Garcia<sup>1,2\*</sup>, G. Bard Ermentrout<sup>1</sup>, and Nathan Urban<sup>2</sup>  
<sup>1</sup>University of Pittsburgh, Department of Mathematics, Pittsburgh, PA, United States of America  
<sup>2</sup>University of Pittsburgh, Department of Neurobiology, Pittsburgh, PA, United States of America
- P319 Modeling implicates inhibitory network bistability as an underpinning of seizure initiation**  
Scott Rich<sup>1\*</sup>, Homeira Chameh<sup>1</sup>, Marjan Rafiee<sup>1</sup>, Katie Ferguson<sup>1</sup>, Frances Skinner<sup>1</sup>, and Taufik Valiante<sup>2</sup>  
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<sup>2</sup>Krembil Research Institute and University of Toronto, Fundamental Neurobiology; Departments of Surgery (Neurosurgery) and ECE, Toronto, Canada
- P320 High frequency neurons help routing information in brain networks**  
Claudio Mirasso<sup>1\*</sup>, Aref Pariz<sup>1</sup>, Santiago Canals<sup>2</sup>, and Alireza Valizadeh<sup>3</sup>  
<sup>1</sup>Universitat de les Illes Balears, Instituto de Física Interdisciplinar y Sistemas Complejos, Palma de Mallorca, Spain  
<sup>2</sup>Instituto de Neurociencias de Alicante, Sant Joan d'Alacant, Spain  
<sup>3</sup>Institute for Advanced Studies in Basic Sciences, Zanjan, Iran
- P321 Hybrid circuits to assess sequential neural rhythms from low dimensional observations**  
Irene Elices Ocon<sup>1\*</sup>, Manuel Reyes-Sanchez<sup>1</sup>, Rodrigo Amaducci<sup>1</sup>, Rafael Levi<sup>2</sup>, Francisco B Rodriguez<sup>1</sup>, and Pablo Varona<sup>1</sup>  
<sup>1</sup>Universidad Autónoma Madrid, Ingeniería Informática, Madrid, Spain  
<sup>2</sup>University of Southern California, Department of Biological Sciences, Los Angeles, CA, United States of America
- P322 Robotic locomotion driven by the flexible rhythm of a living Central Pattern Generator**  
Rodrigo Amaducci<sup>1</sup>, Irene Elices Ocon<sup>2\*</sup>, Manuel Reyes-Sanchez<sup>2</sup>, Rafael Levi<sup>3</sup>, Francisco B Rodriguez<sup>2</sup>, and Pablo Varona<sup>2</sup>  
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<sup>3</sup>University of Southern California, Department of Biological Sciences, Los Angeles, CA, United States of America
- P323 Transfer of rich living circuit dynamics to neuron models through graded synapses**  
Manuel Reyes-Sanchez\*, Rodrigo Amaducci, Irene Elices Ocon, Francisco B Rodriguez, and Pablo Varona  
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- P324 Lost order and rhythm in a mouse model for neurodegenerative motor neuron disease**  
Soju Seki<sup>1</sup>, David H Terman<sup>2</sup>, Antonios Pantazis<sup>3</sup>, Riccardo Olcese<sup>4</sup>, Martina Wiedau-Pazos<sup>5</sup>, Scott H Chandler<sup>1</sup>, and Sharmila Venugopal<sup>1\*</sup>  
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<sup>5</sup>University of California, Los Angeles, Department of Neurology, Los Angeles, CA, United States of America
- P325 Do human brain functional networks obey power law scaling?**  
Riccardo Zucca<sup>1\*</sup>, Xerxes Arsiwalla<sup>2</sup>, Hoang Le<sup>3</sup>, Mikail Rubinov<sup>4</sup>, and Paul Verschure<sup>5</sup>  
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<sup>5</sup>Institute for BioEngineering of Catalonia (IBEC), Catalan Institute of Advanced Studies (ICREA), SPECS Lab, Barcelona, Spain
- P326 Self beyond the body: self-generated task-relevant distal cues modulate performance and the body ownership**  
Klaudia Grechuta<sup>1</sup>, Laura Ulysse<sup>1\*</sup>, Belen Rubio<sup>2</sup>, and Paul Verschure<sup>3</sup>  
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- P327 Integrated information as a measure of volitional control in intracranial functional connectivity networks**  
Xerxes Arsiwalla<sup>1\*</sup>, Daniel Pacheco<sup>2</sup>, and Paul Verschure<sup>3</sup>  
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<sup>2</sup>IBEC, Neural Engineering, Barcelona, Spain  
<sup>3</sup>Institute for BioEngineering of Catalonia (IBEC), Catalan Institute of Advanced Studies (ICREA), SPECS Lab, Barcelona, Spain
- P328 Learning joint attention in reinforcement learning agents through intrinsic rewards**  
Oriol Corcoll Andreu\*, Abdullah Makkeh, Dirk Oliver Theis, and Raul Vicente Zafra  
Tartu University, Institute of Computer Science, Tartu, Estonia
- P329 Catecholaminergic contributions to asynchronous broadband activity driven by top-down attention in the human cortex**  
Vicente Medel<sup>1\*</sup>, Samy Castro<sup>2</sup>, Martin Irani<sup>1</sup>, Brice Follet<sup>1</sup>, Jean-Philippe Lachaux<sup>3</sup>, Nicolás Crossley<sup>1</sup>, and Tomás Ossandón<sup>1</sup>  
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- P330 Not all dendrites are equal: location-dependent dendritic integration of inputs**  
 Everton Agnes\*, Chaitanya Chintaluri, and Tim P. Vogels  
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- P331 Codependent synaptic plasticity: interacting synapses for stable learning in spiking networks**  
 Everton Agnes\*, Tim P. Vogels  
*University of Oxford, Centre for Neural Circuits and Behaviour, Oxford, United Kingdom*
- P332 A canonical model for explaining heterogeneous behavior in perceptual decision making**  
 Genis Prat-Ortega<sup>1\*</sup>, Klaus Wimmer<sup>2</sup>, Tobias Donner<sup>3</sup>, Alex Roxin<sup>4</sup>, Jaime De La Rocha<sup>5</sup>, Cristina Pericas<sup>1</sup>, and Niklas Wilming<sup>6</sup>  
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<sup>5</sup>*IDIBAPS, Theoretical Neurobiology, Barcelona, Spain*  
<sup>6</sup>*UKE, Hamburg, Germany*
- P333 Prefrontal circuit specialization underlying task-triggered changes in population codes in spatial working memory**  
 Nicolás Pollán Hauer<sup>1\*</sup>, Joao Barbosa<sup>2</sup>, Adrià Galán<sup>2</sup>, Bijan Pesaran<sup>3</sup>, Christos Constantinidis<sup>4</sup>, Gianluigi Mongillo<sup>5</sup>, Albert Compte<sup>6</sup>, and Klaus Wimmer<sup>1</sup>  
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<sup>6</sup>*IDIBAPS, Systems Neuroscience, Barcelona, Spain*
- P334 Interactions between feedback signals for the modulation of border ownership selective neurons**  
 Nobuhiko Wagatsuma<sup>1\*</sup>, Ernst Niebur<sup>2</sup>, Brian Hu<sup>3</sup>, and Rüdiger von der Heydt<sup>4</sup>  
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<sup>3</sup>*Allen Institute for Brain Science, United States of America*  
<sup>4</sup>*Johns Hopkins University, Krieger Mind/Brain Institute, Baltimore, United States of America*
- P335 Neural variability quenching during decision-making: Neural individuality and its prestimulus complexity**  
 Annemarie Wolff\*  
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- P336 The retina predicts information in inertial stochastic dynamics**  
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- P337 Robustness to the removal of connections in spiking neural networks evolved for temporal pattern recognition**  
Muhammad Yaqoob<sup>1</sup>, Neil Davey<sup>2</sup>, Volker Steuber<sup>2\*</sup>, and Borys Wrobel<sup>1</sup>  
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<sup>2</sup>University of Hertfordshire, Biocomputation Research Group, Hatfield, United Kingdom
- P338 Neuronal hyperactivity by age-dependent alternations of brain structural connectivity in APOE4 carriers: Preliminary computational study**  
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- P339 Integration of a reinforcement learning module in REACH model for adaptive arm control**  
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- P340 Building a spiking network model of the cerebellum on K computer using NEST and MONET simulators**  
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- P341 Neuromusculoskeletal model for bipedal locomotion under a pathological condition**  
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- P342 Developing a spiking neuron network model of the basal ganglia performing reinforcement learning**  
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- P343 Parallel computing of a cortico-thalamo-cerebellar circuit using tile partitioning parallelization method by MONET simulator**  
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- P344 Dendritic discrimination of temporal input sequences in cerebellar Purkinje cells**  
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- P345 Arbor – a morphologically-detailed neural network simulation library for contemporary high-performance computing architectures**  
 Nora Abi Akar<sup>1</sup>, Ben Cumming<sup>1</sup>, Felix Huber<sup>2</sup>, Vasileos Karakasis<sup>3</sup>, Anne Küsters<sup>4</sup>, Wouter Klijn<sup>4</sup>, Alexander Peyser<sup>4\*</sup>, and Stuart Yates<sup>1</sup>  
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 Aurel A. Lazar, Chung-Heng Yeh\*  
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 Silvia Daun<sup>1</sup>, Azamat Yeldesbay<sup>2\*</sup>  
<sup>1</sup>Research Centre Juelich, Institute of Neuroscience and Medicine (INM-3), Juelich, Germany  
<sup>2</sup>University of Cologne, Institute of Zoology, Cologne, Germany
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