CNS 2017

26th Annual Computational Neuroscience Meeting

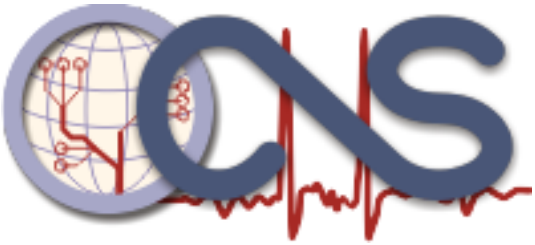
July 15-20 2017
University of Antwerp, Belgium

The Programme Book

Universiteit Antwerpen

Contents

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



Overview

Organization for Computational Neurosciences (OCNS)

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- **CNS Program Chair: Anthony Burkitt** (University of Melbourne, Australia).
- **CNS Publication Chair: Ingo Bojak** (University of Reading, UK).
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- **Si Wu** (Beijing Normal University, China).

2017 Local Organizers

- **Michele Giugliano** (University of Antwerp, Belgium).
- **Daniele Marinazzo** (University of Ghent, Belgium).

Fundraising

OCNS, Inc is a US non-profit, 501(c)(3) serving organization supporting the Computational Neuroscience community internationally. We seek sponsorship from corporate and philantropic 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.

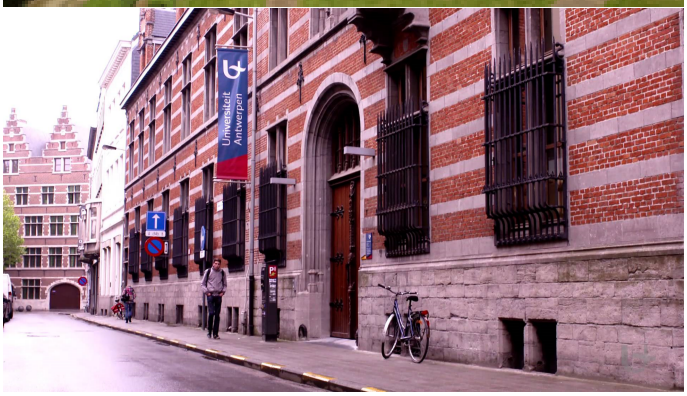
Timetable

	Tutorials	Main meeting						Workshops	
	Sat, 15 July	Sun, 16 July		Mon, 17 July		Tue, 18 July		Wed, 19 July	Thu, 20 July
8:00	Registration	Registration		Registration		Registration		Registration	Registration
9:00	**TUTORIALS** *morning session 1*	**Announcements**		**Announcements**		**Announcements**		**WORKSHOPS** *morning session*	**WORKSHOPS** *morning session*
9:10		**Keynote 2** *P. Poirazi*		**Keynote 3** *E. De Schutter*		**Keynote 4** *K. Friston*			
9:20									
9:30									
9:50									
10:00									
10:10	Break	Break		Break		Break			
10:20									
10:30								Break	Break
10:40	**TUTORIALS** *morning session 2*	**Oral Session I**	**O1**	**Oral Session IV**	**O9**	**Oral Session VII**	**O17**		
10:50									
11:00			**O2**		**O10**		**O18**	**WORKSHOPS** *morning session*	**WORKSHOPS** *morning session*
11:10									
11:20			**O3**		**O11**		**O19**		
11:30									
11:40			**O4**		**O12**		**O20**		
11:50									
12:00	Lunch Break	Lunch Break		Lunch Break		Lunch Break			
12:10									
12:20									
12:30								Lunch Break	Lunch Break
13:10									
13:20									
13:30	**TUTORIALS** *afternoon session 1*	**Oral Session II**	**O5**	**Oral Session V**	**Featured Oral 2**	**OCNS Member Meeting**			
13:40									
13:50			**O6**						
14:00									
14:10			**Featured Oral 1**		**O13**			**WORKSHOPS** *afternoon session*	**WORKSHOPS** *afternoon session*
14:20									
14:30					**O14**	**Oral Session VIII**	**O21**		
14:40									
14:50	Break	Break		Break			**Featured Oral 3**		
15:00									
15:10									
15:20	**TUTORIALS** *afternoon session 2*	**Oral Session III**	**O7**	**Oral Session VI**	**O15**				
15:30									
15:40			**O8**		**O16**	Break		Break	Break
15:50									
16:00		**Poster Session I P1-P104**		**Poster Session II P105-P209**		**Poster Session III P210-314**		**WORKSHOPS** *afternoon session*	**WORKSHOPS** *afternoon session*
16:10									
16:20									
17:00	**Welcome and Announcements**								
17:10									
17:20	**Keynote 1** *S. Denham*								
17:30									
17:40									
17:50									
18:00									
18:10									
18:20	**Welcome Reception**								
18:30									
18:50									
19:00				**CNS Party**		Travel to Banquet			
19:10									
19:20									
19:30						**BANQUET!**			
19:50									
20:00									
20:10									
20:20									
21:00									

General Information

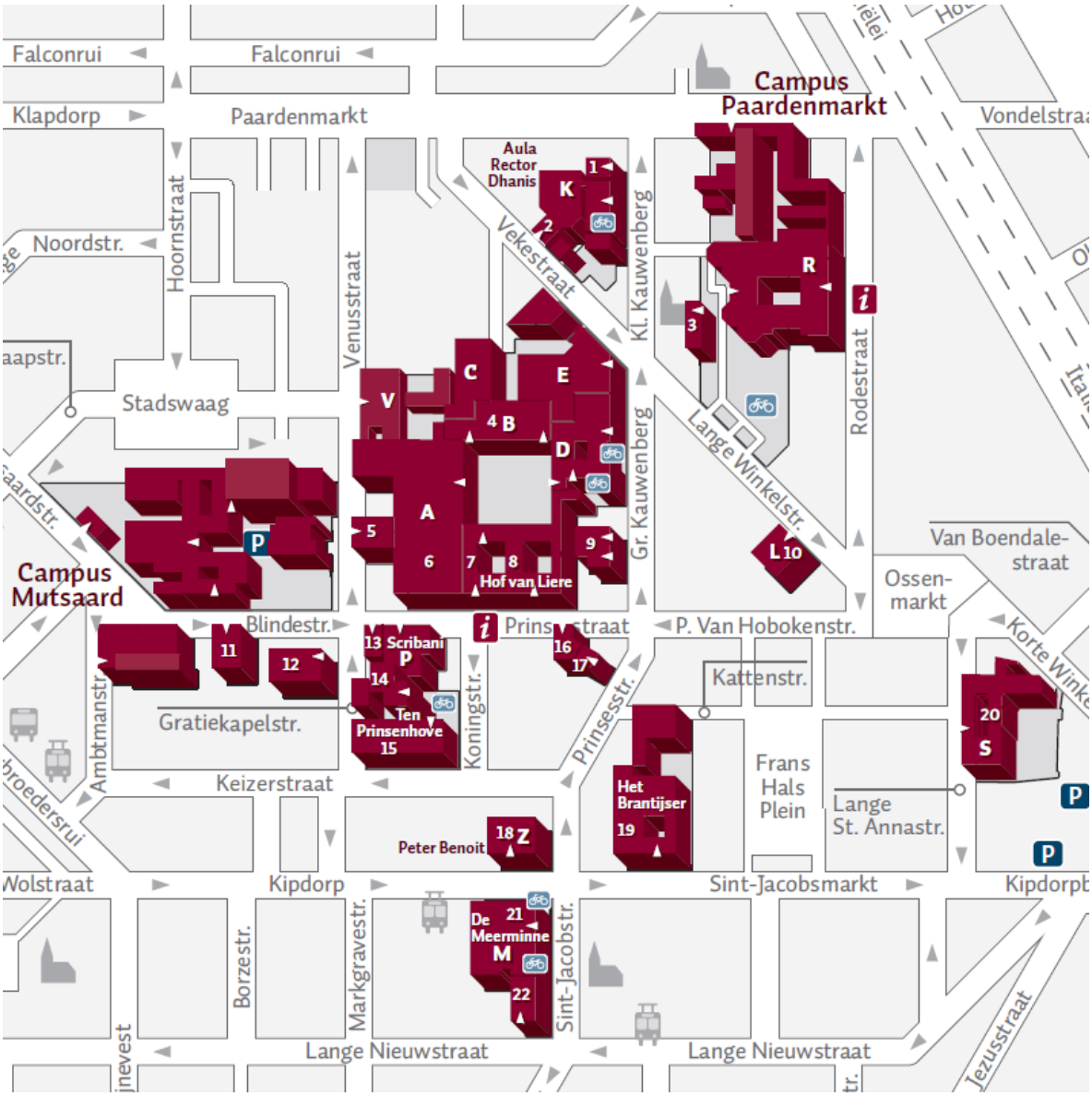
Meeting venue

City Campus of Antwerp University
Kleine Kauwenberg 14 and Grote Kauwenberg 2
Antwerp
Belgium



The conference will be held in the City Campus of Antwerp University, located in the historical center of Antwerp. The campus is well served by public transport. The main train station is within walking distance, as well as several bus stops.

Plan of the campus:



Meeting room locations:

See summary on back cover or single maps included in the corresponding sections (Tutorials, Main Meeting, Workshops).

Getting to the conference venue

From Brussels-Zaventem Airport:

A.
Take the train to conveniently travel from Brussels Airport to Antwerp Central Station. Brussels Airport-Zaventem station is located on level -1 of the terminal, at a small distance from the arrivals hall (2nd floor) and the departures hall (3rd floor). The trip lasts 32 minutes, and the fare is 11.60 EUR. Info:
http://www.brusselsairport.be/en/passngr/to-from-brussels-airport/train

B.
There is also a Antwerp-Brussels Airport express. The stop "Kon. Astridplein" (near the central station) is always served, the stop "Crowne Plaza" is only served on request. First departure 3am, last departure midnight, travel time 45 minutes. Tickets: 10 EUR. Info http://www.airportexpress.be/page?&orl=2&ssn=&lng=2&pge=4

From Amsterdam Schiphol Airport:

Take the train to conveniently travel from Amsterdam Schiphol Airport to Antwerp Central Station. You can use the Thalys fast train, trip duration circa 60 min, tickets around 50 EUR. Info: https://www.thalys.com/be/en/

Information for poster presentations

The poster area is located in building E (SportHall) as shown in the campus map. Poster boards will be numbered. Fixing adhesive material will be available. Poster orientation is portrait and maximum net dimensions are 180 cm x 95 cm (A0 is smaller than 120 x 85 cm/ or 47 x 33 in).

Poster Sessions will be held on July 16, 17, and 18 from 4:00 pm to 7:00 pm
Poster set up:
Sunday, July 16, 2017: From 8 am to 4 pm
Monday, July 17, 2017: From 8 am to 4 pm
Tuesday, July 18, 2017: From 8 am to 4 pm

Poster should be removed:
Sunday, Monday, July 16 and 17, 2017: Next day morning latest
Tuesday, July 18, 2017: Before 7 pm

Posters that are not removed by the stated time will be discarded. The organisers are not responsible for loss or damage to posters not removed by the given times.

Registration and locations

Registration will be held at the hall of the Auditorium K.001 Aula Rector Dhanis. The entrance is at Kleine Kauwenberg 14.

Registration hours:

July 15: From 8 am to 6:30 pm
July 16: From 8 am to 7 pm
July 17: From 8 am to 7 pm
July 18: From 8 am to 6:30 pm
July 19: From 8:30 am to 6:30 pm
July 20: From 8:30 am to 6:30 pm

Locations (see also floor plans in the Tutorials, Main Meeting and Workshop sections):

What	Where
Tutorials	Aulas B.001, B.002, B.003, B.004, K.101, K.102
Keynote Lectures and Oral Sessions:	Auditorium K.001 Aula Rector Dhanis
Workshops	Aulas C.101, C.102, K.101, K.102, K.103, K.201, K.202, K.203
OCNS board/program committee meetings	Aula E.201
Welcome Reception	Hall Auditorium K.001 Aula Rector Dhanis
Coffee Breaks	Hallway Building B through E

Local information

Good to Know
Detailed information is available on the official Belgium website at https://www.belgium.be/en/about_belgium.

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

Insurance
The organisers do not accept responsibility for individual medical, travel or personal insurance. All participants are strongly advised to take out their own personal insurance before travelling to Antwerp.

Currency & Banking
The Euro (EUR) is the official currency of Belgium. Exchange of foreign currency is available at the Airports, Central Station, and at most hotels, banks and exchange offices throughout the city. International credit cards are accepted for payments in hotels, restaurants and shops. Payment in cash (in EUR) is also available in some restaurants and shops, so please ask for details on-site if necessary. You can find the official exchange rates on the European Central Bank website at:
https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates.

Electricity
Belgium uses a 230 volt 50 Hz system. Sockets follow the standard also used in France, Denmark, Poland, Greece, Italy, Ireland and other countries and also have a grounding pin sticking out of the power socket, which is also known as a type E socket.

Shopping
Most shops in Antwerp are open from 9:30 am to 6:00 pm, from Monday to Saturday. However, some grocery stores may be open until 8:00 pm, from Monday to Sunday.

Time Zone
Belgium is on Central European Time (CET), which is Greenwich Mean Time (GMT) + 1 hour. Note that April to October is daylight saving time, i.e. GMT + 2 hours.

Tipping
Service is usually included in the bill in most bars and restaurants, but tips are welcome.

Tours
Tours are not a part of the meeting. If you wish to explore the city, check the possibilities in your hotel or choose the tour directly at: http://www.visitantwerpen.be/en

Transportation

https://static.delijn.be/Images/Antwerpen%20centrum%201op7500_tcm5-5301.pdf

Get around by public transportation
The public transportation company De Lijn (www.delijn.be/en/) operates a dense network of buses, trams, and underground tram connections in the city and its surroundings. If you plan on taking a bus or tram more than 5 times, then buy a 10-ride card (Lijnkaart) costing 15 EUR. They can be bought at self-service machine (no electronic payment means accepted however) or at fixed points in town (e.g. most supermarkets and any place that sells newspapers, just ask the cashier). Every time you enter a bus or tram, just put that card in one of the yellow ticket machines. A single ticket bought from the driver in the bus costs more (3.00 EUR per ride). For one fare, you can ride up to 1h within the city boundaries. The central bus station is the Franklin Rooseveltplaats, walking distance from the congress venue and also very close to the central railway station. Nearly all buses leave from there, or from the Antwerp-Central or Antwerp-Berchem train stations.

http://www.visitantwerpen.be/en/plan-your-visit/transport-antwerp/public-transport

On foot
Most things to see are within walking distance from the venue of the conference. These are near or within the Boulevards, the half-moon of avenues where there were once 16th century city-walls. This old town center, with a diameter of about 1.5 km can be walked, but there is excellent public transport.

By horse (!)
Horse tram (paardentram: (www.werkendtrekpaard.be/paardentram/) leaves from the Grote Markt every hour. It is an approximately 40 minutes / 1.5 mile touristic ride through the city.

Weather
The month of July is a typical summer month with daily high temperatures, which can occasionally exceed 30 degrees C. You can check for current weather conditions in Antwerp at www.meteovista.be

Important Telephone Numbers
112: General Emergency for Europe
100: Fire and Ambulance
101: Police

Free Wi-Fi
Free Wi-Fi is provided at the meeting venue. Each registered participant will receive their own unique password.

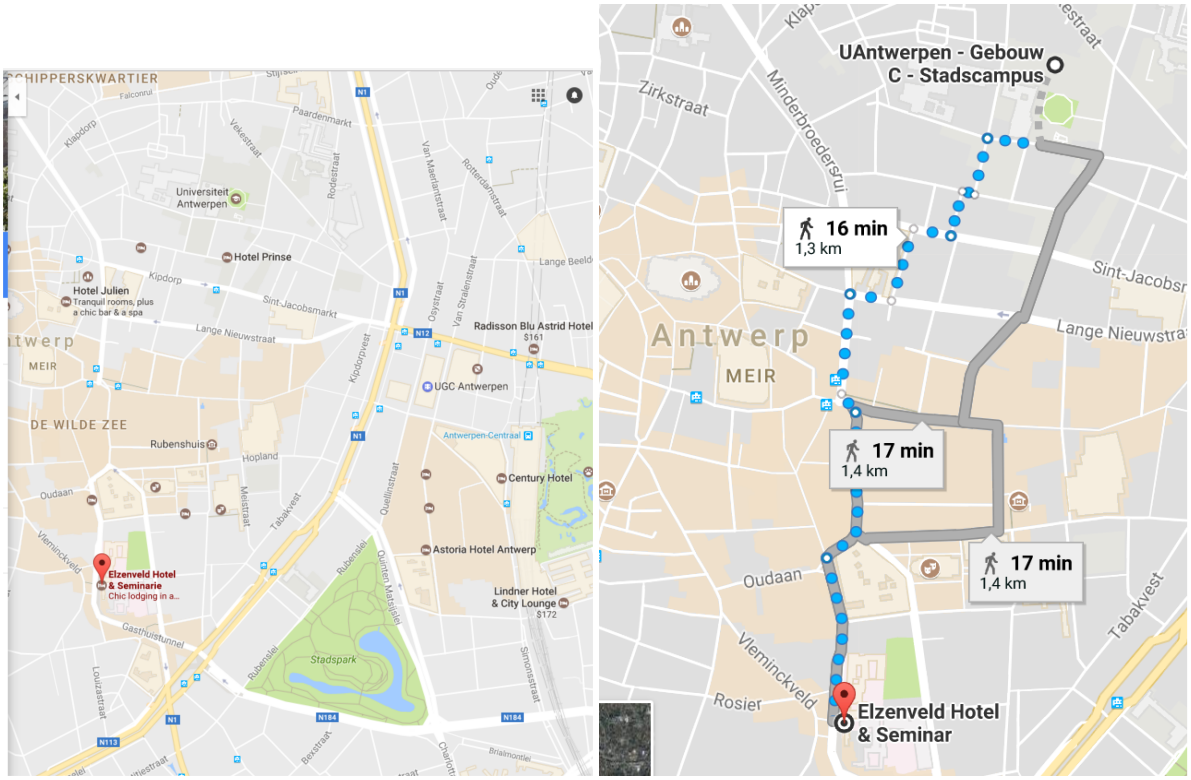
Taxi Services
Taxis are available, but they can be quite expensive. They await customers at specific locations around town (waving your hand will seldom work) like the Groenplaats (near the cathedral) or the central railway station. You can recognize these places by an orange TAXI sign. The prices are fixed in the taximeter. Beware that Antwerp and Brussels were named as the most congested cities in Europe and North America.

DTM Taxi - Transport - Moving: +32 03 366 66 66

Antwerp - Tax N.V.: +32 03 238 38 38

Gala Dinner

Date: Tuesday, July 18, 2017
Time: 7:30 PM
Venue: Elzenveld Seminar Centre, Lange Gasthuisstraat 45, 2000 Antwerpen http://www.elzenveld.be/en/hotel
Recommended dress code: Casual
How to get there: The easiest way to reach Elzenveld Seminar Centre from the meeting venue is on foot, it takes 18 min (1,5 km). By public transportation, it takes 10 min (i.e. Tramline n. 7 from Antwerpen Keizerstraat direction to Antwerpen Mechelseplein). Tramline n. 4 also stops right in front of the door (Antwerpen Mechelseplein).



Elzenveld Hotel and Conference Center:
The inner courtyard, chapel, former hospital wards, monastery and presbytery, all dating from the 15th to 17th century, now form an oasis of hospitality in Antwerp's city centre. The medieval section of the building has been beautifully restored and adapted to modern needs. Since time immemorial, bodies have been healed and spirits ministered to in this place. Aperitifs will be served in the Chapel, or in the garden if the weather allows, followed by a walking dinner in the Van Gessel Room.

CNS Party

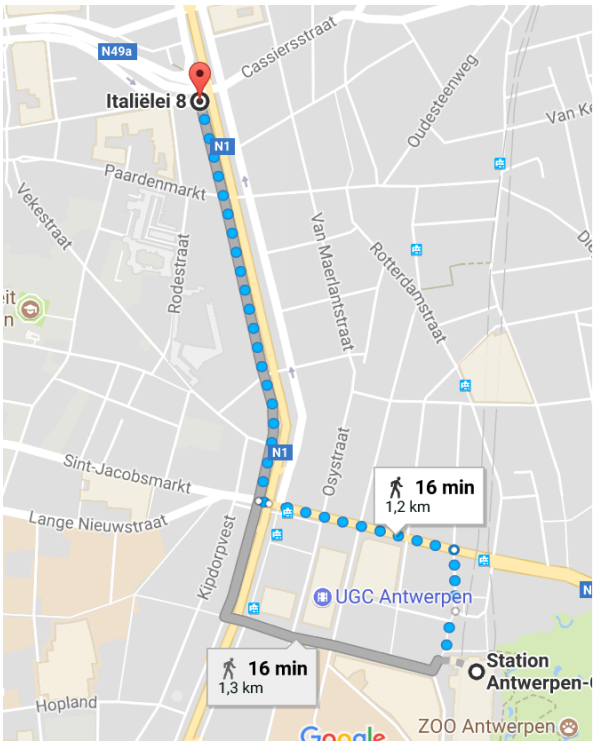
Date: Monday, July 17, 2017
Time: 8:30 PM - 00:30 AM
Venue: Party Room HAVN CHURCH, Italielei 8, 2000 Antwerp (www.havnchurch.com)
Recommended dress code: Casual

The party will take place in the HAVN CHURCH (http://www.havnchurch.com/). The building was originally used as a Catholic church, built in late Gothic style during the 16th century. It was seized by the Reformed in the 17th century. Today, it is no longer a church and it used as a ballroom, where night parties, banquets and weddings are celebrated.

Each participant will get a voucher for free drinks (beer, wine or soda) for the entire duration of the party. Cava will be served during the first hour and a half of the event. Note that neither (finger) food nor snacks will be served on site.

How to get there: From the meeting venue, it takes ĩ0min (750m) on foot, while from the "Centraal" railway station it takes about 16 min on foot, or 12-15 min by public transportation (i.e. bus n. 720, 730, 770, 771, 776 from Rooseveltplaats Bus Station, direction Antwerpen Sint-Jansplein; or tram n. 12 from Centraal Station, direction Antwerpen Richard).


N49a
N1
Hessenplein
Stijfselstraat
11 min
850 m
Italiëlei 8
Rijnpoortvest
10 min
800 m
Paardenmarkt
Vekestraat
Venusstraat
UAntwerpen - Gebouw
C - Stadscampus
Universiteit
Antwerpen
Rodestraat
Prinsstraat
10 min
800 m
Begijnhof


N49a
Cassiersstraat
Italiëlei 8
N1
Oudesteenweg
Paardenmarkt
Vekestraat
Rodestraat
Van Maerlantstraat
Rotterdamstraat
Sint-Jacobsmarkt
Oystraat
16 min
1,2 km
Lange Nieuwstraat
Kipdorpvest
UGC Antwerpen
16 min
1,3 km
Station
Antwerpen-
Hopland
ZOO Antwerpen

Restaurants

Selected restaurants close to the venue:

Boston Steak House
Burger restaurant
De Keyserlei 55, 2018 Antwerpen

Bourla Schouwburg
Belgian cuisine
Komedieplaats 19, 2000 Antwerpen
http://bourlaschouwburg.nu/

Cafe Imperial
Belgian-French cuisine
Meir 50, 2000 Antwerpen
www.cafe-imperial.be

Comocomo
Spanish restaurant
Kammenstraat 75, 2000 Antwerpen

De Pottekijker
Belgian restaurant and grill
Kaasrui 5, 2000 Antwerpen
www.depottekijker.be

Ellis Gourmet Burger
Burger Restaurant
Sint-Aldegondiskaai 52, 2000 Antwerpen
www.ellisgourmetburger.be

Gran Duca
Italian restaurant
De Keyserlei 28, 2018 Antwerpen
https://www.granduca.be/

Gustav
Grills cuisine
Van Ertbornstraat 2, 2018 Antwerpen
www.brasseriegustav.be

Gusto
Belgian-French cuisine
Steenhouwersvest 29, 2000 Antwerpen
www.mygusto.be

Horta Grand Cafe & Art Nouveau Zaal
European restaurant
Hopland 2, 2000 Antwerpen
www.grandcafehorta.be

Korean Barbecue
Korean food
Statiestraat 8, 2018 Antwerpen

Roma
Italian restaurant
Statiestraat 19, 2018 Antwerpen

Rubens Inn
Belgian restaurant
Wapper 17, 2000 Antwerpen
www.rubensinn.be

Super Natural
Snakbar
Minderbroedersrui 47, 2000 Antwerpen

Umi Sushi
Asian cuisine
Groenplaats 8, 2000 Antwerpen
www.umi-sushi.be

Wagamama
Japanese food
De Keyserlei 13, 2018 Antwerpen

More Antwerp restaurant you can find at: http://www.cnsorg.org/cns-2017-local-info.

Program

Tutorials

T1 **Subcellular modeling**
Room B.001, 15/07/2017, 09:00 - 17:00

Andrew Gallimore, Okinawa Institute of Science and Technology, Japan
Weiliang Chen, Okinawa Institute of Science and Technology, Japan

T2 **Detailed modeling of structure and function at the cellular level**
Room B.002, 15/07/2017, 09:00 - 17:00

Benjamin Torben-Nielsen, Demiurge Technologies AG, Switzerland
Elisabetta Iavarone, Swiss Federal Institute of Technology in Lausanne, Switzerland

T3 **Simulation of large-scale neural networks**
Room B.003, 15/07/2017, 09:00 - 17:00

Sacha J. van Albada, Julich Research Centre and JARA, Germany
Jonas Stapmanns, Julich Research Centre and JARA, Germany

T4 **Modeling and analysis of extracellular potentials**
Room B.004, 15/07/2017, 09:00 - 12:00

Gaute T. Einevoll, Norwegian University of Life Sciences & University of Oslo, Norway
Espen Hagen, Dept. of Physics, University of Oslo, Norway

T5 **Neuroscience data analysis**
Room K.101, 15/07/2017, 13:30 - 17:00

Arvind Kumar, KTH Royal Institute of Technology, Sweden
Michael Denker, Julich Research Centre, Germany

T6 **Neuroinformatics Resources for Computational Modellers**
Room B.004, 15/07/2017, 13:30 - 17:00

Padraig Gleeson, University College London, UK
Andrew P. Davison, French National Center for Scientific Research, France

Main Meeting

Saturday July 15

9:00 – **Registration (Hall Auditorium K.001 Aula Rector Dhanis)**

9:00 – 16:30 **Tutorials (Aulas B.001, B.002, B.003, B.004, K.101)**

17:00 – 17:15 **Welcome and announcements (Auditorium K.001 Aula Rector Dhanis)**

17.15 – 18:15 K1 **Keynote 1:**
Auditory scene analysis: support and challenges for predictive coding
Sue Denham

18:30 **Welcome reception (Hall Auditorium K.001 Aula Rector Dhanis)**

Sunday July 16

9:00 – 9:10 **Announcements (Auditorium K.001 Aula Rector Dhanis)**

9:10 – 10:10 K2 **Keynote 2:**
Information coding with dendrites: lessons from computational models
Panayiota Poirazi

10:10 – 10:40 **Break**

Oral session I: Single-cell properties and modeling

10:40 – 11:00 O1 ***Impact of axon initial segment geometry on excitability***
Sarah Goethals, Romain Brette*

11:00 – 11:20 O2 ***Can integrate-and-fire models simulate robust neuromodulation?***
Tomas van Pottelbergh*, Rodolphe Sepulchre

11:20 – 11:40 O3 ***Sholl analysis predicted by dendrite spanning fields***
Alex Bird*, Hermann Cuntz

11:40 – 12:00 O4 ***Flexible Bayesian inference for complex models of single neurons***
Pedro Goncalves*, Jan-Matthis Luckmann, Giacomo Bassetto, Marcel Nonnenmacher, and Jakob Macke

12:00 – 13:30 **Break for lunch**

Oral session II: Sensory processing: Vision and olfaction

13:30 – 13:50 O5 ***Learning to read out predictive information in early visual processing***
Audrey Sederberg*, Jason Maclean, and Stephanie Palmer

13:50 – 14:10 O6 ***Closed-loop estimation of retinal network sensitivity reveals signature of efficient coding***
Ulisse Ferrari*, Christophe Gardella, Olivier Marre, and Thierry Mora

14:10 – 14:50 F1 **Featured Oral 1:**
Mixture processing in a biophysical model of the early olfactory system of honeybees
Ho Ka Chan*, Thomas Nowotny

14:50 – 15:20 **Break**

Oral session III: Synapses and plasticity

15:20 – 15:40 O7 ***Learning Quantal Parameters through Expectation-Maximization***
Emina Ibrahimovic*, Martin Müller, and Jean-Pascal Pfister

15:40 – 16:00 O8 ***Emergence of disparity selective neurons through spike-based learning from naturalistic stereoscopic datasets***
Tushar Chauhan*, Timothee Masquelier, Alexandre Montlibert, and Benoit Cottereau

16:00 – 19:00 **Poster session I: Posters P1 – P104 (Building E)**

Monday July 17

9:00 – 9:10 **Announcements (Auditorium K.001 Aula Rector Dhanis)**

9:10 – 10:10 K3 **Keynote 3:**
Molecular models of the early and late phases of bidirectional plasticity at cerebellar synapses
Erik De Schutter

10:10 – 10:40 **Break**

Oral session IV: Memory, decisions, and pathological activity

10:40 – 11:00 O9 ***Cortical correlations support optimal sequence memory***
Moritz Helias*, Jannis Schuecker, David Dahmen, and Sven Goedeke

11:00 – 11:20 O10 ***Rats decisions flexibly integrate sensory information and recent history of outcomes***
Alexandre Hyafil*, Ainhoa Hermoso Mendizabal, Pavel Ernesto Rueda-Orozco, Santiago Jaramillo, David Robbe, and Jaime de La Rocha

11:20 – 11:40 O11 ***Nicotinic modulation of hierarchal inhibitory circuit control over resting state ultraslow fluctuations in the prefrontal cortex***
Marie Rooy*, Fani Koukouli, David Digregorio, Uwe Maskos, and Boris Gutkin

11:40 – 12:00 O12 ***The minimalistic mathematical model of the cerebral blood flow effects during cortical spreading depression***
Andrey Verisokin*, Darya V. Verveyko, and Dmitry Postnov

12:00 – 13:30 **Break for lunch**

Oral session V: Network structure and coherent activity

13:30 – 14:10 F2 **Featured Oral 2:**
Heterogeneous layers stabilize propagation of a multiplexed spike signal in a feed-forward network
Dongqi Han*, Sungho Hong

14:10 – 14:30 O13 ***Necessity for coherence in motor control***
Willy Wong*, Omid Talakoub, Robert Chen, and Milos Popovic

14:30 – 14:50 O14 ***Dissecting gamma phase and amplitude-specific information routing in V4 of macaque during selective attention***
Dmitriy Lisitsyn*, Eric Drebitz, Iris Grothe, Sunita Mandon, Andreas Kreiter, and Udo A Ernst

14:50 – 15:20 **Break**

Oral session VI: Neural mass models

15:20 – 15:40 O15 ***Structure-Function Relationships via Neural Field Theory***
Peter A Robinson*, Xuelong Zhao, Kevin Aquino, John Griffiths, Grishma Mehta-Pandejee, Natasha Gabay, James Maclaurin, and Somwrita Sarkar

15:40 – 16:00 O16 ***Dynamic Operations of Hierarchically Interacting Canonical Microcircuits***
Tim Kunze*, Jens Haueisen, and Thomas R. Knösche

16:00 – 19:00 **Poster session II: Posters P105 – 209 (Building E)**

19:00 **CNS Party (Party Room, Havn Church)**

Tuesday July 18

9:00 – 9:10 **Announcements (Auditorium K.001 Aula Rector Dhanis)**

9:10 – 10:10 K4 **Keynote 4:**
I am therefore I think
Karl Friston

10:10 – 10:40 **Break**

Oral session VII: Large networks and large scale simulations

10:40 – 11:00 O17 ***Learning structure of 3D objects with cortical columns***
Subutai Ahmad*, Yuwei Cui, Marcus Lewis, and Jeff Hawkins

11:00 – 11:20 O18 ***Influence of network topology on spreading of epileptic seizure***
Simona Olmi*, Spase Petkoski, Fabrice Bartolomei, Maxime Guye, and Viktor Jirsa

11:20 – 11:40 O19 ***A model-based approach for detecting multiple change points in multivariate spike count data***
Hazem Toutounji*, Daniel Durstewitz

11:40 – 12:00 O20 ***Geppetto: an open source visualisation and simulation platform for neuroscience***
Matteo Cantarelli*, Adrian Quintana, Boris Marin, Matt Earnshaw, Padraig Gleeson, Robert Court, Robert A McDougal, R Angus Silver, Salvador Dura-Bernal, Stephen Larson, William W Lytton, and Giovanni Idili

12:00 – 13:30 **Break for lunch**

13:30 – 14:30 **OCNS Member Meeting**

Oral session VIII: Grid cells and place cells

14:30 – 14:50 O21 ***Position is coherently represented during flickering instabilities of place-cell cognitive maps in the hippocampus***
Lorenzo Posani*, Simona Cocco, Karel Ježek, and Rémi Monasson

14:50 – 15:30 F3 **Featured Oral 3:**
Modeling grid fields instead of modeling grid cells
Sophie Rosay*, Tanja Wernle, and Alessandro Treves

15:30 – 16:00 **Break**

16:00 – 19:00 **Poster session III: Posters P210 – P314 (Building E)**

19:30 **Gala Dinner (Elzenveld Seminar Centre)**

Wednesday July 19 and Thursday July 20

9:00 – 10:30 **Workshop Morning Session 1 (Aulas C.101, C.102, K.101, K.102, K.103, K.201, K.202, K.203)**

10:30 – 11:00 **Break**

11:00 – 12:30 **Workshop Morning Session 2**

12:30 – 14:00 **Break for Lunch**

14:00 – 15:30 **Workshop Afternoon Session 1**

15:30 – 16:00 **Break**

16:00 – 18:00 **Workshop Afternoon Session 2**

Workshops

W1 **Neuronal Oscillations: Mechanisms and Functionality**
Room K.202, Wed and Thur 9:00 to 18:00

Horacio G Rotstein, New Jersey Institute of Technology
Frances Skinner, Krembil Research Institute
Vassilis Cutsuridis, University of Lincoln

W2 **Methods of Information Theory in Computational Neuroscience**
Room C.101, Wed and Thur 9:00 to 18:00

Joseph T. Lizier, University of Sydney
Viola Priesemann, Max Planck Institute for Dynamics and Self-organisation
Justin Dauwels, Nanyang Technological University
Taro Toyoizumi, RIKEN Brain Science Institute
Alexander G Dimitrov, Washington State University
Lubomir Kostal, Academy of Sciences of the Czech Republic
Michael Wibral, Goethe University, Frankfurt

W3 **Recent Methods and Analyses for Large-scale Neuronal Population Recordings**
Room C.102, Wed and Thur 9:00 to 18:00

Michela Chiappalone, Istituto Italiano di Tecnologia, Genova
Valentina Pasquale, Istituto Italiano di Tecnologia, Genova
Pierre Yger, Institut de la Vision, INSERM, Paris

W4 **New Advances in Theoretical Tools for the Study of Large-scale Neural Systems**
Room K.101, Wed 9:00 to 18:00 and Thur 9:00 to 12:30

Simona Olmi, Institute of Complex Systems- CNR
David Angulo-Garcia, Aix-Marseille University
Benjamin Lindner, Humboldt University Berlin

W5 **Theoretical Neuroscience in the Human Brain Project**
Room K.201, Wed 9:00 to 18:00

Michele Giugliano, Universiteit Antwerpen
Alain Destexhe, Centre National de la Recherche Scientifique (CNRS)
Viktor Jirsa, Aix-Marseille University

W6 **Computational and Experimental Advances in Cerebellum Research**
Room K.102, Wed 9:00 to 18:00

Erik De Schutter, Okinawa Institute of Science and Technology
Yunliang Zang, Okinawa Institute of Science and Technology

W7 **Principles and Applications of Extracellular Potentials**
Room K.203, Wed 9:00 to 18:00

Michiel Remme, Humboldt University Berlin
Torbjoern Ness, Norwegian University of life Sciences
Gaute Einevoll, Norwegian University of life Sciences - University of Oslo

W8 **Fingerprints and Applications of Brain Dynamics Estimated from Neuroimaging Data**
Room K.103, Wed 9:00 to 18:00

Matthieu Gilson, University Pompeu Fabra
Tim van Hartevelt, Oxford

W9 **Emerging Models in Scientific Communication and Discussion**
Room K.201, Thur 9:00 to 18:00

Romain Brette, Institut de la Vision, Paris

W10 **Reaction-diffusion Modeling for Neurobiology**
Room K.203, Thur 9:00 to 18:00

Robert McDougal, Yale University
William W Lytton, SUNY Downstate
Avrama Blackwell, George Mason

W11 **Recent Developments in Epilepsy Modeling**
Room K.103, Thur 9:00 to 18:00

Wim van Drongelen, The University of Chicago
Stephan A. van Gils, University of Twente

W12 **Neuroscience Gateway: Enabling Developers and Users to Utilize Open High Performance Computing Resources for Large Scale Simulations**
Room K.101, Thur 14:00 to 18:00

Amit Majumdar, University of California San Diego, La Jolla
Subhashini Sivagnanam, University of California San Diego, La Jolla
Ted Carnevale, Yale University

W13 **Cortical Function: Towards Understanding and Developing Integrative Theories**
Room K.102, Thur 14:00 to 18:00

Hamish Meffin, The University of Melbourne
Anthony Burkitt, The University of Melbourne

W14 **Postdoc Career Workshop**
Room K.102, Thur 9:00 to 12:30

Joanna Jedrzejewska-Szmek, University of Warsaw

Abstracts

Tutorials

T1 Subcellular modeling

Room B.001, 15/07/2017, 09:00 - 17:00

Andrew Gallimore, Okinawa Institute of Science and Technology, Japan
Weiliang Chen, Okinawa Institute of Science and Technology, Japan

Many important neural functions are controlled by complex networks of intracellular proteins and signalling molecules. A variety of modular signalling pathways connect and interact to form large networks possessing emergent properties irreducible to individual molecules or pathways. These include bistable and ultrasensitive switches, as well as feedback regulation, and synchronisation. These properties are essential for the induction and regulation of critical neural functions, such as long-term depression and potentiation. The complexity of these networks renders their analysis by inspection alone unfeasible, and we must turn to computational modelling to understand them.

The first half of this tutorial will focus on the structure and function of intracellular networks and deterministic methods for modelling and analysing them. We will use a number of important subcellular pathways to illustrate the key concepts and demonstrate the importance and utility of deterministic methods in their modelling and simulation. We will discuss both the biochemistry of these pathways and their mathematical representation. We will then discuss how these modular pathways connect and interact to form large networks. Important network motifs and their emergent properties will also be explained with specific examples given, as well as mathematical methods for their analysis. We will discuss a number of tools for simulating these differential equation models, but will use the open source software Copasi in the tutorial, owing to its ease of installation and use. Participants will have the opportunity to build and simulate their own signalling pathway model in Copasi. This part of the tutorial will serve as a good introduction to molecular systems modelling for those with little prior experience, and will assume little more than a grasp of basic differential equations and biochemistry.

The second half of the tutorial will focus on more advanced modelling approaches based on several state of the art software packages. We will explain how the time evolution of real molecular systems can diverge from a differential equation-based description due to concepts such as probabilistic interactions in small volumes and spatial heterogeneity. We will describe mathematical approaches to modelling stochastic effects and diffusion and introduce a number of software tools that are based on such descriptions. These include particle-tracking packages such as MCell and Smoldyn, and voxel-based packages such as NeuroRD and STEPS. We will then demonstrate the typical modeling practices with these applications, from model and geometry description to simulation execution and data gathering. Finally, we will briefly discuss recent advances and expected near-future directions of the field.

References

[1] STEPS: http://steps.sourceforge.net

[2] MCell: http://mcell.org/

[3] Smoldyn: http://www.smoldyn.org/

[4] NeuroRD: http://krasnow1.gmu.edu/CENlab/software.html

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T2 Detailed modeling of structure and function at the cellular level

Room B.002, 15/07/2017, 09:00 - 17:00

Benjamin Torben-Nielsen, Demiurge Technologies AG, Switzerland
Elisabetta Iavarone, Swiss Federal Institute of Technology in Lausanne, Switzerland

In the morning session, we introduce the morphology of dendrites and axons, the specialised input and output arborisations of neurons. Their shape is pivotal for brain functioning for two reasons: First, overlap between dendrites and axons defines the micro-circuit. Second, the shape and membrane composition of dendrites define how inputs are transformed into relevant outputs. In this tutorial, we will start by explaining the importance of morphologies and how to quantify them (say, in order to distinguish healthy from pathological morphologies). We will touch on algorithmic synthesis of large numbers of unique neuronal morphologies for application in large-scale modelling efforts. We finish the morning session with a hands-on tutorial using btmorph [1] to analyse populations of neuronal morphologies.

In the afternoon session, we explain how neuronal dynamics takes place at the single neuron level and how dendrites turn input signals into an output. We briefly explain the conductance-based and compartmental-modelling paradigms to simulate the dynamics on neurons with detailed membrane composition and elaborate neuronal morphologies. We then proceed to show several free community resources to construct, simulate, share and analyse single neuron models. We will also introduce methods to quantify neurons electrophysiological properties. We end the afternoon session with a hands-on demonstration of how to construct and simulate detailed models of neurons using NEURON and python [2] and on how to constrain their free parameters with experimental data using BluePyOpt [7].

References

[1] Torben-Nielsen B. An efficient and extendable Python library to analyze neuronal morphologies. Neuroinformatics 12:619-622, 2014.

[2] James G.K., Hines M., Hill S., Goodman P.H., Markram H.,1 Schurmann F. Component-Based Extension Framework for Large-Scale Parallel Simulations in NEURON. Frontiers in Neuroinformatics, 3:1-12, 2009.

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[4] London M., Häusser M. Dendritic computation. Annu Rev Neurosci. 28:503-32, 2005.

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[6] Silver A. Neuronal arithmetic. Nature Reviews Neuroscience 11, 474-489, 2010.

[7] Van Geit W., Gevaert M., Chindemi G., Rossert C., Courcol J. D., Muller E. B., Markram H. (2016). BluePyOpt: Leveraging open source software and cloud infrastructure to optimise model parameters in neuroscience. Frontiers in Neuroinformatics, 10.

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T3 Simulation of large-scale neural networks

Room B.003, 15/07/2017, 09:00 - 17:00

Sacha J. van Albada, Julich Research Centre and JARA, Germany

Jonas Stapmanns, Julich Research Centre and JARA, Germany

This tutorial starts with an introduction to large-scale neuronal networks, giving examples of existing models and identifying some challenges these networks pose for modeling and simulation. This is followed by an introduction to the NEural Simulation Tool (NEST [1]), shedding light on its design principles, which address challenges for large-scale simulations. An overview of the features of NEST is provided, also touching upon advanced properties of neuronal networks like gap-junctions [2]. To familiarize participants with the basic usage of NEST, some simple networks are programmed in hands-on exercises. Next, the tutorial explains how NEST enables parallel simulations via both distributed and threaded computations. Threaded simulations are demonstrated on a cortical microcircuit model [3]. Finally, the tutorial provides an introduction to the NEST Modeling Language (NESTML [4]). In this final hands-on part of the tutorial, the participants learn how to create neuron models in NEST using NESTML.

The tutorial does not assume any prior knowledge of NEST. However, it is recommended that participants install NEST on their laptops beforehand [5]. Furthermore, it is recommended to have VirtualBox installed and to have at least 4 GB of free memory available.

References

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[4] Plotnikov D., Rumpe B., Blundell I., Ippen T., Eppler J.M., Morrison A., 2016. NESTML: a modeling language for spiking neurons. arXiv preprint arXiv:1606.02882.

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T4 Modeling and analysis of extracellular potentials

Room B.004, 15/07/2017, 09:00 - 12:00

Gaute T. Einevoll, Norwegian University of Life Sciences & University of Oslo, Norway
Espen Hagen, Dept. of Physics, 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 [1,3,4]. 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 [5-7], MUAs [8] and LFPs, both from single neurons [9] and populations of neurons [8,10,11],
- LFPy (LFPy.github.io) [12], a versatile tool based on Python and the NEURON simulation environment [13] (www.neuron.yale.edu) for calculation of extracellular potentials around neurons, and
- new results from applying the biophysical forward-modeling scheme to predict LFPs from comprehensive point-neuron network models, in particular Potjans and Diesmann's model of the early sensory cortical microcircuit using hybridLFPy [14,15] will be presented.

References

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[12] H Lindén et al., Front Neuroinf 7:41 (2014)

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T5 Neuroscience data analysis

Room K.101, 15/07/2017, 13:30 - 17:00

Arvind Kumar, KTH Royal Institute of Technology, Sweden
Michael Denker, Julich Research Centre, Germany

In this tutorial we will explain the theory and practical issues associated with some of the most common tools to analyse spiking activity. Specifically, we will focus on the estimation of firing rate, spike train irregularity, pairwise and higher order correlations, trial-by-trial variability and co-variability, spectrum, dimensionality reduction and estimation (e.g. Gaussian factor analysis). The tutorial will be split in two parts.

In the first part we will provide the theoretical background behind the analysis methods and interpretation of the results. In the second part we will demonstrate how various tools from neuroinformatics, in particular the Python libraries Neo and Elephant, work together in building up robust and reproducible analysis workflows. In addition, we will discuss practical issues related to the analysis methods and interpretation of the results. All through the tutorial we will focus on the spiking activity but most of the methods can be generalized to study other neural data.

References

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T6 Neuroinformatics Resources for Computational Modellers

Room B.004, 15/07/2017, 13:30 - 17:00

Padraig Gleeson, University College London, UK
Andrew P. Davison, French National Center for Scientific Research, France

Neuroinformatics resources are becoming an essential part of computational investigations in neuroscience. A movement towards making data and software freely available to the community means that more and more experimental datasets, general purpose analysis tools and infrastructure for computational modelling and simulation are available for computational neuroscientists to help build, constrain and validate their models. This tutorial will give an overview of the range of neuroinformatics resources currently available to the community. The first half will give a brief introduction to a number of these under the headings: Experimental datasets; Structured data from literature; Analysis tools; Simulation environments; Model sharing; Computing infrastructure; Open source initiatives. The second half of the tutorial will involve hands on exercises where multiple resource will be accessed, data transformed and analysed and new models executed. Note that this tutorial will focus on neuroinformatics resources for cell and network modelling, and not cover the wide range of neuroimaging or genetics databases.

Invited Presentations

Sue Denham *School of Psychology, Faculty of Health and Human Sciences, Plymouth University, Plymouth, Devon, UK*

K1 – Auditory scene analysis: support and challenges for predictive coding

Perception seems so simple. I look out of the window to see houses, trees, people walking past, the sky above, the grass below. I hear birds in the trees, cars going past, the distant sound of an alarm. The world is full of objects that make their presence known to me through my senses – what could be more simple? Yet the efficacy of perceptual experience hides a host of questions for which we do not yet have the answers. Information reaching our senses is generally incomplete, ambiguous, distributed in space and time and not neatly sorted according to its source, so a key function of our perceptual systems is to discover the likely causes of our sensations. Perception as inference or hypothesis testing, formalised in the predictive coding theory, offers an attractive framework for exploring these issues. From this perspective, regularities or patterns provide perceptual systems with some traction, allowing the formation of expectations and a basis for decomposing the world into discrete objects. But in the dynamic world which we inhabit, object representations must be similarly dynamic, and need to form and dissolve, dominate and yield, in a way that facilitates veridical perception. In this talk I will discuss auditory scene analysis in the context of predictive coding using experimental data, exemplar models, and the phenomenon of perceptual multistability.

Panayiota Poirazi *Institute of Molecular Biology and Biotechnology (IMBB), Foundation for Research and Technology-Hellas (FORTH), Heraklion, Crete, Greece*

K2 – Information coding with dendrites: lessons from computational models

The goal of this presentation is to provide a set of predictions generated by biophysical and/or abstract mathematical models regarding the role of dendrites in information processing, learning and memory across different brain regions. Towards this goal I will present modelling studies from our lab – along with supporting experimental evidence – that investigate how dendrites may be used to facilitate the learning and coding of both spatial and temporal information at the single cell, the microcircuit and the neuronal network level. I will briefly present early work on how the dendrites of individual CA1 pyramidal neurons may allow a single cell to act as a 2-stage neural network classifier [1], thus massively increasing the storage capacity of the neural tissue [2]. I will then discuss how such dendritic nonlinearities may enable stimulus specificity in individual PFC pyramidal neurons during working memory [3] and underlie the emergence of sustained activity at the single cell and the microcircuit level [3,4]. The role of dendrites in memory phenomena will be assessed using circuit models of the Dentate Gyrus implementing pattern separation [5,6] as well as hippocampal models capable of learning associative memories and linking them across time [7]. This presentation aims to highlight how dendrites are likely to serve as key players in different memory functions.

References:

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Erik De Schutter *Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan*

K3 – Molecular models of the early and late phases of bidirectional plasticity at cerebellar synapses

Synaptic plasticity at the parallel fiber to Purkinje cell synapse has been studied extensively, both experimentally and computationally. The initial focus was on long-term depression (LTD) evoked by concurrent parallel fiber and climbing fiber activation, but more recently experimental studies have emphasized the behavioral importance of long-term potentiation (LTP) triggered by exclusive parallel fiber activation. Expression of these forms of plasticity is based on changes in the number of AMPA receptors in the postsynaptic density (PSD), LTD leading to a decrease and LTP to an increase. As such, this plasticity is bidirectional and can be described as the outcome of a competition by opposing processes. Through studies of hippocampal plasticity we have come to understand the importance of all aspects of the AMPA receptor cycle in bidirectional synaptic plasticity, with LTD increasing both diffusion out of the PSD and endocytosis of receptors and LTP favoring insertion of receptors that diffuse to the PSD. Moreover, the endosomal cycle is quite important because most endocytosed AMPA receptors are rapidly recycled to the postsynaptic membrane. Calcium influx is always the first step in synaptic plasticity, but this influx is brief compared to the tens of minutes required to reach the maximum change in synaptic strength. For cerebellar LTD it is well established that the calcium signal activates a MAP-kinase based positive feedback loop that is essential for the early phase of LTD. We have built a completely new molecular model of bidirectional cerebellar plasticity that replicates experimental findings, including the dual role of nitric oxide in LTP and LTD. LTD requires activation of the MAP-kinase based positive feedback loop and this activation is controlled by CaM kinase. An emergent property of the model is an automatic shutdown of the positive feedback loop, corresponding to the end of the early phase. In a second, simpler model, we have explored how the early phase can transition into a stable late phase by simple manipulations of the endosomal cycle. Unfortunately, experimental data on these processes is less complete, particularly about possible spatial restriction to single spines.

Karl Friston *Wellcome Trust Centre for Neuroimaging, Institute of Neurology*
University College London,
London, UK

K4 – I am therefore I think

This overview of the free energy principle offers an account of embodied exchange with the world that associates neuronal operations with actively inferring the causes of our sensations. Its agenda is to link formal (mathematical) descriptions of dynamical systems to a description of perception in terms of beliefs and goals. The argument has two parts: the first calls on the lawful dynamics of any (weakly mixing) ergodic system – from a single cell organism to a human brain. These lawful dynamics suggest that (internal) states can be interpreted as modelling or predicting the (external) causes of sensory fluctuations. In other words, if a system exists, its internal states must encode probabilistic beliefs about external states. Heuristically, this means that if I exist (am) then I must have beliefs (think). The second part of the argument is that the only tenable beliefs I can entertain about myself are that I exist. This may seem rather obvious; however, it transpires that this is equivalent to believing that the world – and the way it is sampled – will resolve uncertainty about the causes of sensations. We will consider the implications for functional anatomy, in terms of predictive coding and hierarchical architectures, and conclude by looking at the epistemic behaviour that emerges using simulations of active inference.

Contributed Talks

F1 Mixture processing in a biophysical model of the early olfactory system of honeybees

Ho Ka Chan*, Thomas Nowotny

School of Engineering and Informatics, University of Sussex, Brighton, UK

In their natural environment, Insects often encounter complex mixtures of odors in their natural environment. It is an important open question whether and how the processing of complex mixtures of multi-component odors differs from that of simpler mixtures or single components. To approach this question, we built a full-size model of the early olfactory system of honeybees, which predicts responses to both single odorants and mixtures. The model is designed so that olfactory response patterns conform to the statistics derived from experimental data [1] for a variety of its properties. It also takes into account several biophysical processes at a minimal level, including processes of chemical binding and activation in receptors, and spike generation and transmission in the antennal lobe network. We verify that key findings from other experimental data not used in building the model [2-4] are reproduced in it. In particular, we replicate the strong correlation among receptor neurons and the weaker correlation among projection neurons observed in experimental data [1,2] and show that this decorrelation is predominantly due to inhibition by interneurons. By simulation and mathematical analysis of our model, we demonstrate that the chemical processes of receptor binding and activation already lead to significant differences between the responses to mixtures and those to single component stimuli. On average, the response latency of olfactory receptor neurons at low stimulus concentrations is reduced (See Figure 1A) and the response patterns become less variable across concentrations (See Figure 1B) as the number of odor components in the stimulus increases. These effects are preserved in the projection neurons. Our results provide hints that the early olfactory system in insects may be particularly efficient in processing mixtures, which corresponds well to the observation that chemical signaling in nature predominantly utilizes mixtures.

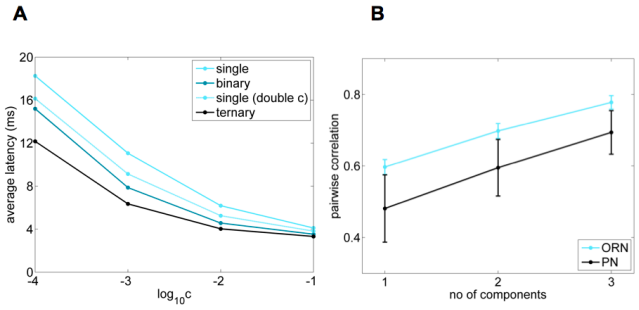

Figure 1: A. The average response latency decreases with the number of components in the odor stimulus. The effect is most significant when the stimulus concentration is low. B. The pairwise correlation, averaged over all ORNs, between the response patterns at low and high concentration increases with the number of components in the odor stimulus.

Acknowledgements
This work was supported by HFSP, RGP0053/2015 and EPSRC, EP/J019690/1.

References
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F2 Heterogeneous layers stabilize propagation of a multiplexed spike signal in a feedforward network

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Feedforward networks are ubiquitous structures in neural systems and have been studied in many contexts such as models for signal transmission [1,2], architectures for rich information processing [3], etc. However, most studies have ignored an important property commonly observed in real feedforward networks: neurons in one layer have contrasting characteristics from those in other layers. For example, the cerebellar granule cells are tiny and relatively simplistic neurons while their postsynaptic targets, the Purkinje cells, are much bigger, complex, and therefore have very different intrinsic properties. What would be the role of such layer-to-layer differences in neural circuits?

Here we address this question by simulation of a model feedforward network, inspired by a recent experimental study on the Drosophila olfactory system [4]. In this model, all the adjacent layers have Morris-Lecar neurons with different excitability types from each other and therefore different computational functions. If one layer has cells with class I excitability, which behave like integrators of inputs, neurons in the adjacent layer are of class III, which act as coincidence detectors [5], and vice versa.

We found that spikes from one layer evoked a response in next layer neurons better when they had the same excitability type. However, in a deep feedforward network, this caused gradual accumulation of signal distortion, leading to the undesirable responses in deep layers that all the neurons either fired synchronously or became silent, as seen in classical studies (e.g., [1]). On the other hand, the network with heterogeneous layers demonstrated a novel signal transformation property as observed in [4] (Fig. 1A), and showed stable propagation of a signal into deep layers with a preserved temporal fidelity and spike count (Fig. 1B, C). We analyzed the result by using a phase space method in [1] and showed how mixing different coding schemes enables this feature (Fig. 1C). We conclude that heterogeneous layers in feedforward neural networks can be a mechanism for optimal information transfer.

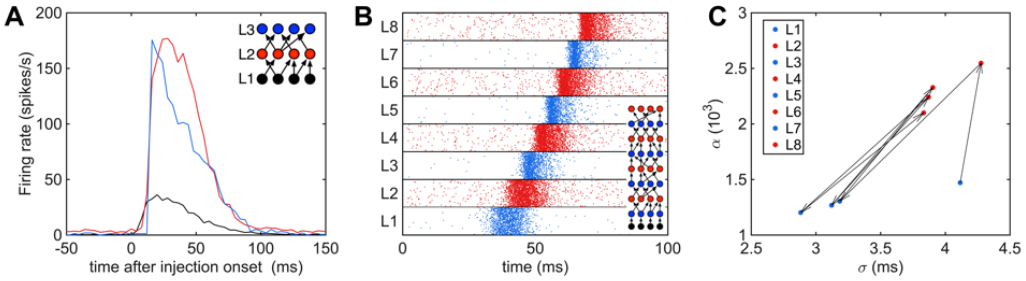

Figure 1: A. Firing rate of input (black, L1), integrator (red, L2), and coincidence detector (blue, L3) neurons. Note that a peak of L3 firing precedes that of L2, as observed in [4]. B. Stable spike propagation in a network with many heterogeneous layers. C. Layer-to-layer change in the SD of spike times and spike count of B.

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F3 Modeling grid fields instead of modeling grid cells

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Grid cells are neurons found in the rodent medial entorhinal cortex. They take their name from their astonishing firing patterns: grid cells are active specifically in certain regions of physical space, called grid fields, that form a triangular grid tesselating the space explored by the animal. While experiments have been investigating the geometrical properties of grid fields [1], computationalists have tried to explain them by neural network models. However, these models still fail to account for some of the experimental results, in particular how two distinct grid patterns are integrated when two compartments are merged into one (Wernle et al, in preparation).

We take a different approach: instead of modelling grid cells, we directly model single grid fields as point objects interacting with each other and with the environment's borders (see Figure 1A). This description is motivated by the way grid patterns are naturally considered as geometrical objects. We thus consider a system of interacting objects evolving as colloidal particles on a substrate [2]. First we consider only grid fields from one grid cell, then we add coupling between several cells. We simulate the system with varying forms and intensity of the interactions. The simplicity of the model allows us to test many such possibilities and their outcome in several 'experimental' setups.

We show that under certain conditions the model does reproduce the behavior of experimental grid fields (see Figure 1B). These conditions imply repulsion between fields, the involvement of a large number of fields, interaction between grid cells and with the walls. We are able to reproduce observed data from experiments in merged environments. We can also make predictions for setups not tested experimentally yet. The question that then naturally arises is how to connect our description at the level of grid fields to models at the level of grid cells. We show how our grid-field model puts constraints on models of the underlying grid cells. Conversely, we discuss how existing grid-cell models can be described at the level of grid fields.

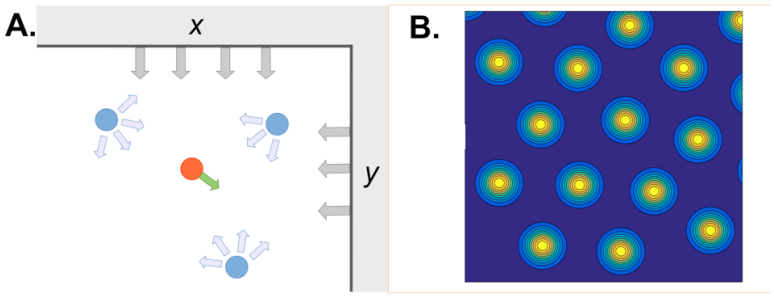

Figure 1: General idea of grid field modeling. A. Schematic representation of the model. A given grid field (red) feels the influence of other grid fields (blue) as well as the borders (grey) plus a viscosity force (green). B. Example of a resulting pattern in a square box, converted into a firing rate map.

In conclusion, tackling the issue of grid patterns from a grid-field perspective provides new insights on their formation. Beyond grid cells, our work raises the question of the ultimate purpose of a model and the subtle interplay between description and explanation.

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O1 Impact of axon initial segment geometry on excitability

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In most vertebrate neurons, action potentials are triggered at the distal end of the axon initial segment (AIS). They are then transmitted to the soma where they are regenerated and further propagated in the dendritic tree. The AIS position and length can be altered by changes in electrical activity, suggesting a strong link between AIS geometry and excitability. We studied theoretically the influence of AIS geometry on the somatic threshold for AP initiation. For this purpose, we solved the cable equation with appropriate boundary conditions in a cylindrical axon model. Our theoretical analysis shows that the somatic threshold depends logarithmically on the surfacic sodium conductance density and that increasing either the AIS length or the AIS start position lowers the threshold. We confirmed our prediction with numerical simulations in a more detailed neuron model. Our analysis suggests that either a longer or a more distal AIS increases excitability, which supports a current hypothesis that the AIS is preferably isolated from the large capacitance of the soma. Secondly, we examined how the AIS geometry influences the peak axonal current that is transmitted to the soma at spike initiation. Again we used cable analysis to study this current in a two-cylinder model that represents the main geometrical features of a thick-tufted layer 5 pyramidal neuron. Our analysis shows that in order to obtain somatic spikes with a given speed, the AIS position should be proportional to the diameter of the apical dendrite raised to the -3/2. We confirmed this theoretical result with numerical simulations of a more detailed model. In addition, correlation analysis of layer 5 pyramidal neurons morphology confirms this theoretical prediction [1]. Our previous analyses suggest that the AIS geometry is finely tuned for successful spike transmission to the soma. More generally, neural systems tend to be efficient in their use of resources [2], which suggests that AIS geometry might also be optimized for minimal energy consumption. As the energy consumption at subthreshold voltages is proportional to the number of channels, we asked whether there exists an AIS geometry that minimizes the total number of sodium channels. For this purpose, we used variational techniques to calculate the AIS geometry that minimizes total Na conductance, for a given spike threshold and axonal current.

Conclusion
Our theoretical analysis shows that AIS geometry has a strong impact on several aspects of excitability including energy consumption, which suggests that the AIS morphology is functionally tuned and possibly optimized.

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O2 Can integrate-and-fire models simulate robust neuromodulation?

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By controlling the state of neuronal populations, neuromodulators ultimately affect behaviour. A key neuromodulation mechanism is the alteration of neuronal excitability via the modulation of ion channel expression. This type of neuromodulation is normally studied via conductance-based models, but those models are computationally challenging for large-scale network simulations needed in population studies. Integrate-and-fire models provide a computationally advantageous alternative, but such models are only partially successful in robustly capturing modulation between firing patterns.

In this work, we propose a modelling framework that extracts the qualitative properties of neuromodulation to produce neuromodulable and computationally efficient neuron models. Our framework is based on dynamic I-V curves, i.e. instantaneous I-V curves in a certain timescale [1]. These dynamic I-V curves make the connection between qualitative conductance-based models and integrate-and-fire models: how a change in ion channel conductance can be related to a change of dynamic I-V curves and subsequently to a parameter change in the reduced integrate-and-fire model. We focus on the modulation between tonic firing and bursting as an example. We argue that this modulation crucially relies on the co-regulation of two points of high sensitivity (i.e. excitability) in two distinct timescales. The points of high sensitivity are local extrema in the I-V curves and correspond to an exact balance of positive and negative feedback. Those signatures have a direct correlate in the fast-slow phase portraits: a hysteretic V-nullcline in the presence of one (fast) balance, and a mirrored hysteresis in the presence of both a fast and a slow balance [2]. The classical quadratic integrate-and-fire model captures the fast balance, but does not account for the slow one.

The simple idea underlying the proposed multi-quadratic integrate-and-fire model (MQIF) is to allow for several distinct balance points in an integrate-and-fire model. An integrate-and-fire model with two balance points is shown to robustly capture the neuromodulation between spiking and bursting, opening novel computational avenues for large-scale simulation of neuromodulated populations. The robustness and modulation properties of this integrate-and-fire model are in sharp contrast to those of existing (generalised) integrate-and-fire models, which lack the slow excitability.

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O3 Sholl analysis predicted by dendrite spanning fields

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Sholl analysis has been an important technique in dendritic anatomy for over sixty years [1]. In counting the number of dendritic branches at a given distance from the soma, the Sholl intersection profile is often taken as a crucial measure of dendritic complexity; it has been used in a broad range of applications, from estimating the expected number of possible synapses [2], to evaluating the changes in structure induced by pathologies [3].

We have shown that Sholl intersection profiles can be predicted by two more basic measures: the domain spanned by the dendritic arbor and the angular distribution of how far dendritic segments deviate from a direct path to the soma (Figure 1C). The first measure is principally determined by axon location and hence microcircuit structure [4]; the second arises from optimal wiring [5]. These two measures allow Sholl analysis to be given a more functional interpretation across all of its applications.

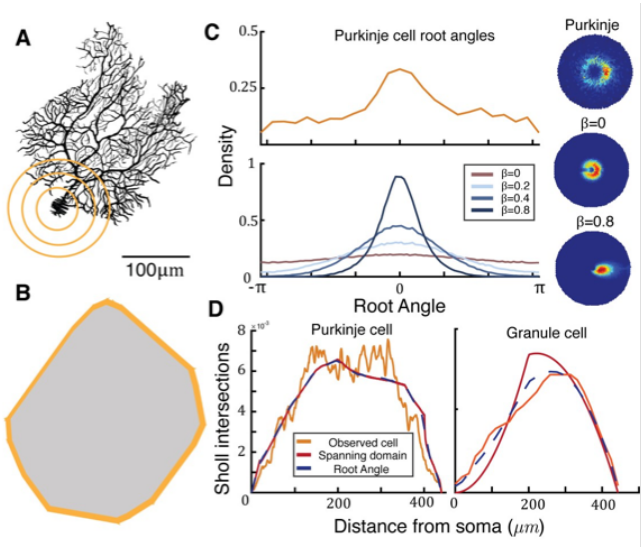

Figure 1: The dendrite spanning field predicts the Sholl intersection profile of a Purkinje cell. A. Rat Purkinkje cell [6] and schematic of Sholl analysis: the number of times the dendrite intersects with a gold arc gives the value of the Sholl intersection profile at that radius. B. The spanning field of the above cell. C. Root angle distributions and (inset) joint angular and euclidean connection probabilities for the Purkinje cell (top) and artificial dendrites with different balances between wiring and delay costs (bottom). D. Sholl intersection profiles for rat Purkinje cell (left) and mouse dentate gyrus granule cell [7] (right): observed (gold), predicted by just the spanning field (red), and predicted by the spanning field and root angles (blue dashed).

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O4 Flexible Bayesian inference for complex models of single neurons

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Characterizing the input-output transformations of single neurons is critical for understanding neural computation. Single-neuron models have been extensively studied, ranging from simple phenomenological models to complex multi-compartment neurons. However, linking mechanistic models of single-neurons to empirical observations of neural activity has been challenging. Statistical inference is only possible for a few neuron models (e.g. GLMs), and no generally applicable, effective statistical inference algorithms are available: As a consequence, comparisons between models and data are either qualitative or rely on manual parameter tweaking, parameter-fitting using heuristics or brute-force search [1]. Furthermore, parameter-fitting approaches typically return a single best-fitting estimate, but do not characterize the entire space of models that would be consistent with data (the posterior distribution).

We overcome this limitation by presenting a general method to infer the posterior distribution over model parameters given observed data on complex single-neuron models. Our approach can be applied in a 'black box' manner to a wide range of single-neuron models without requiring model-specific modifications. In particular, it extends to models without explicit likelihoods (e.g. most single-neuron models). We achieve this goal by building on recent advances in likelihood-free Bayesian inference [2]: the key idea is to simulate multiple data-sets from different parameters, and then to train a probabilistic neural network which approximates the mapping from data to posterior distribution.

We illustrate this approach using single- and multi-compartment models of single neurons: On simulated data, estimated posterior distributions recover ground-truth parameters, and reveal the manifold of parameters for which the model exhibits the same behaviour. On in-vitro recordings of membrane voltages, we recover multivariate posteriors over biophysical parameters, and voltage traces accurately match empirical data. Our approach will enable neuroscientists to perform Bayesian inference on complex neuron models without having to design model-specific algorithms, closing the gap between biophysical and statistical approaches to single-neuron modelling.

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O5 Learning to read out predictive information in early visual processing

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To generate appropriate behavior, the brain must predict the future state of the world from past sensory information. Taking the salamander visual system as an example, at the minimum such predictions need to compensate for the 50-80 ms processing time of the retina [1] as well as the time for a motor response to be generated. Making these predictions requires leveraging the spatiotemporal structure of the natural world, a computation that is performed efficiently at the first stage of visual processing, in populations of retinal ganglion cells [2]. Neurons downstream of the retina infer predictions about object motion from the firing of their inputs, but to do so, downstream cells must learn to read out predictive information from the retinal activity.

More concretely, stimulus predictive information in a sensory population is defined as the mutual information of particular patterns of spiking across retinal ganglion cells (RGCs) with the future stimulus [2]. We consider the output of a downstream model neuron that receives weighted inputs from several RGCs. By constructing moving-bar dynamics that contain both predictable and stochastic motion, we can visualize the predictive information in readout spiking as the difference between the prior stimulus distribution (Figure 1A, gray) and the spike-triggered stimulus distribution: the larger the difference, the more informative the spike. In this example, the readout neuron was informative of the future stimulus (Figure 1A), but most other readouts were not (not shown). Even for an experimenter with a well-controlled sensory input, finding this optimal readout in the space of all possible readouts is difficult. In more realistic circumstances, the organism must make predictions about the future state of complex natural stimuli from the retinal spiking activity alone (Figure 1B).

Here we address whether biologically plausible learning rules can find readout weights that transform RGC input into predictive downstream output. Input activity from the RGCs was previously recorded in the salamander retina in response to a natural movie (Figure 1B). We first show that internal predictive information, the information that the readout has about its own future input, is correlated with stimulus predictive information, so that becoming more predictive of its inputs drives the readout neuron to encode more information about the future stimulus. Starting from a set of random weights connecting the RGCs to the readout neuron, we allow the weights to evolve via spike timing-dependent plasticity. Across many groups of RGCs, we find that learned readouts convey 80% of the possible predictive information for groups of four cells, but only 30% for groups of ten cells. This decrease reflects a compressibility limit of predictive information and suggests an optimal pooling size for cells downstream from retina.

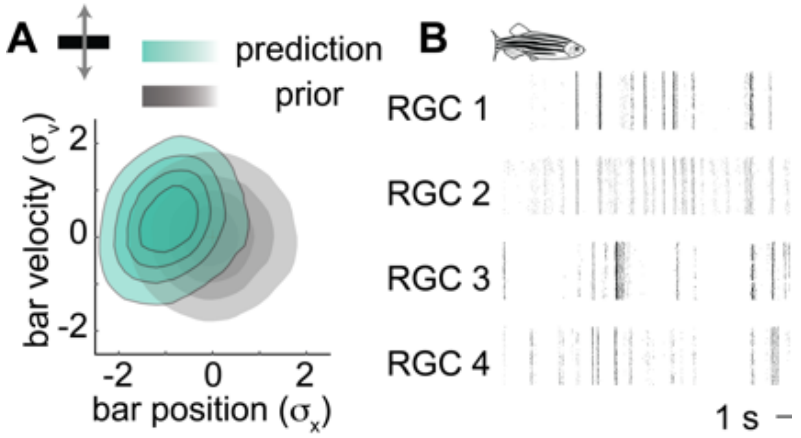

Figure 1: A. Spike-triggered average of future stimulus position and velocity for a particular readout of population spiking activity with high predictive information. B. Raster plots for simultaneously recorded retinal ganglion cells (RGCs) in response to a naturalistic movie featuring swimming fish. These are used to drive learning simulations.

Acknowledgements

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O6 Closed-loop estimation of retinal network sensitivity reveals signature of efficient coding

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According to the theory of efficient coding, sensory systems are adapted to represent natural scenes with high fidelity and at minimal metabolic cost. Testing this hypothesis for sensory structures performing non-linear computations on high dimensional stimuli is still an open challenge. Here we develop a method to characterize the sensitivity of the retinal network to perturbations of a stimulus. Using closed-loop experiments, we explore selectively the space of possible perturbations around a given stimulus. We then show that the response of the retinal population to these small perturbations can be described by a local linear model. Using this model, we computed the sensitivity of the neural response to arbitrary temporal perturbations of the stimulus, and found a peak in the sensitivity as a function of the frequency of the perturbations. Based on a minimal theory of sensory processing, we argue that this peak is set to maximize information transmission. Our approach is relevant to testing the efficient coding hypothesis locally in any context where no reliable encoding model is known.

Acknowledgements
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O7 Learning Quantal Parameters through Expectation-Maximization

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Large synapses, i.e the neuromuscular junction (NMJ) or the calyx of Held, have been invaluable model synapses that have significantly advanced the field of synaptic transmission. No generative model approach can faithfully retrieve quantal parameters from synapses with a large number of release sites (N). Here we propose an expectation maximization (EM) method that is based on particle smoothing (PS) to extract quantal parameters from large N synapses. In contrast to an existing EM-based approach [1], using Baum-Welch (BW) which scales with a complexity of N^4 and hence cannot retrace quantal parameters of synapses with hundreds of release sites, our method is independent of N and therefore suitable for large synapses. First, our model was validated on synthetic data. As shown in figure 1, all parameters $\Theta = N, p, q, \sigma, \tau$ were faithfully retrieved. Next, we applied the model to the *Drosophila* NMJ, which is predicted to harbor hundreds of release sites. The model predicted quantal parameters that are in line with parameters predicted by two empirical approaches (variance-mean analysis and cumulative amplitude analysis of postsynaptic currents). In contrast to these two techniques, which require data recorded under conditions of high release probability (p), our method is independent of p or stimulation protocol. Given the genetic tractability of this synapse, our theoretical approach is expected to help linking quantal parameters to molecular function.

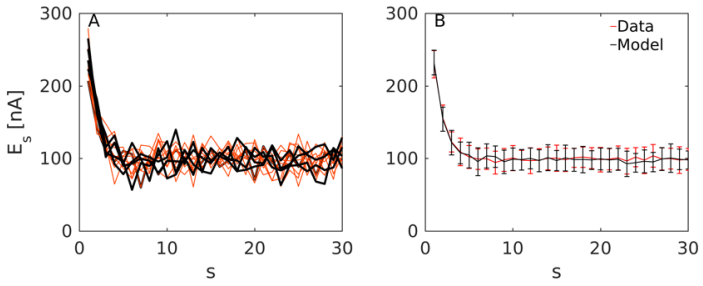

Figure 1: A. Postsynaptic currents at the *Drosophila* NMJ, 50 trains of 30 presynaptic action potentials at 60 Hz compared with model generated data from the fitted parameters at each stimulation step s; number of release sites $N = 710$, release probability $p = 0.44$, quantal content $q = 0.74$ nA , background noise $\sigma = 13.22$ nA and refilling time constant $\tau = 59$ ms. B. Comparison of the mean and standard deviation.

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O8 Emergence of disparity selective neurons through spike-based learning from naturalistic stereoscopic datasets

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Models such as sparse coding [1] have shown that natural scene statistics can be used to predict basis units with Gabor-like receptive fields close to those observed in V1 simple-cells. Since the inputs to these models are natural images captured using a single camera, their outputs are monocular. Recently, attempts have also been made to exploit statistics of stereo-images of natural scenes [2]. The resulting bases units show binocular, Gabor-like receptive fields with population statistics close to those observed in V1. Although these models are able to replicate certain aspects of V1 binocular populations, they are either supervised, or mimic the result of learning from natural datasets, but not the process.

We propose a novel method of deriving monocular and binocular units through unsupervised learning from natural stereoscopic datasets using spike-timing-dependent-plasticity (STDP). Using the Hunter-Hibbard dataset [2], we first employed ON/OFF-center difference-of-Gaussian convolutions to mimic LGN responses (Figure 1.A). The responses were thresholded and converted to spike-latencies using a monotonically decreasing function. This ensured that the most activated units fired first, while the less active units fired late, or not at all. We then trained an STDP based neural network using 1x1 degree spatial pools from the aforementioned LGN layer. The network was composed of integrate-and-fire neurons and incorporated a lateral inhibition scheme. Finally, we characterized the receptive field in each eye by fitting Gabor functions. Our results (Figure 1.B) showed that most units developed Gabor-like receptive fields similar to those observed in V1 simple cells, with a continuum of ocular dominance from pure monocularity to perfect binocularity. In line with single-unit recordings in primates, disparity selectivity was principally observed along the horizontal dimension, where it ranges between -0.5°and 0.5°. Neurons also showed selectivity to vertical disparity, although it was less pronounced. When tested with phase-shifted sine gratings, the units also showed disparity-tuning curves similar to those observed in the cat visual system.

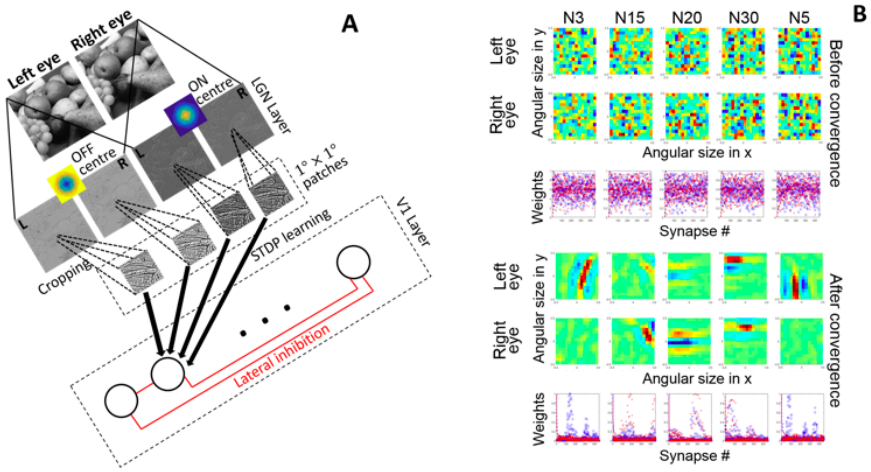

Figure 1: A. Schematic of the processing pipeline. B. Five representative neurons (one per column) before and after convergence. Rows 1,2: Left and right eye receptive fields before convergence; Rows 4,5: The corresponding receptive fields after convergence; Rows 3,6: Weights before and after convergence.

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O9 Cortical correlations support optimal sequence memory

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The brain processes time-varying input, but is it not known if its dynamical state is optimal for this task. Indeed, recurrent and randomly coupled networks of rate neurons display a rich internal dynamics near the transition to chaos [1], which has been associated with optimal information processing capabilities [2, 3, 4]. In particular, the dynamics becomes arbitrarily slow at the onset of chaos similar to critical slowing down. The interplay between time-dependent input signals, network dynamics, and the resulting consequences for information processing are, however, yet poorly understood.

We here present a completely solvable model that allows us to investigate the effect of time-varying input on the transition to chaos. We analytically obtain the phase diagram spanned by the coupling strength and the input amplitude: External drive shifts the transition to chaos to significantly larger coupling strengths than predicted by linear stability analysis. The intermediate regime is absent in time-discrete networks [5] and only exists in their more realistic time-continuous counterparts. This novel dynamical regime combines locally expansive dynamics with asymptotic stability. We investigate sequential memory [5] and analytically show that memory capacity is optimal within the novel regime. Because it is unclear if cortex operates in such a computationally beneficial regime, we develop a finite-size mean-field theory which relates the statistics of measured covariances to the statistics of connections, in particular the spectral radius of the connectivity matrix. The theory shows that the large dispersion of spike count covariances across pairs of neurons, observed in massively parallel recordings, is an indicator that cortex indeed operates close to the breakdown of linear stability (see Figure 1).

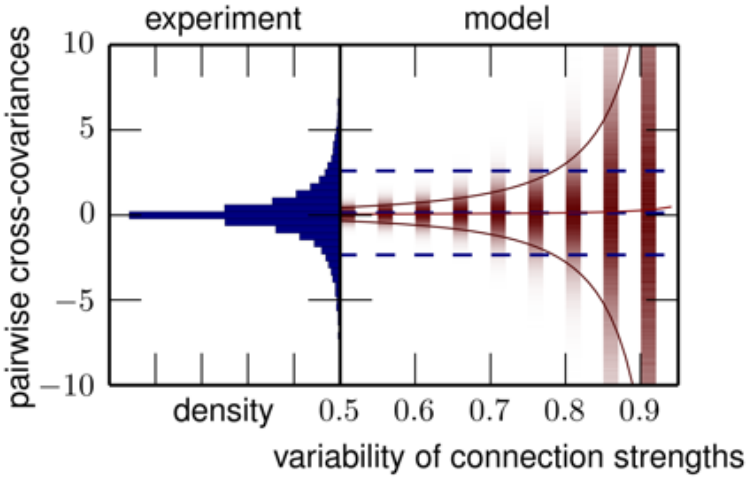

Figure 1: Distribution of spike count cross-covariances across neurons in macaque motor cortex. The low mean and large standard deviation (blue dashed horizontal lines) of experimentally observed cross-covariances between spike counts (left) are explained by a model network (right, shading indicates density of histogram) with a large spectral radius ($R \approx 0.9$) of the connectivity matrix. Red curves: analytical prediction for mean and standard deviation. Data from 155 neurons mostly located in layer 5 of macaque motor cortex (M1). Data courtesy of A. Riehle and T. Brochier.

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O10 Rats decisions flexibly integrate sensory information and recent history of outcomes

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Animal decisions not only reflect current sensory information but are also shaped by recent experience. There is however little understanding about the determinants of these history-dependent decision biases. We used rats in a novel two-alternative forced choice auditory discrimination task, in which the probability to repeat the previous stimulus category was varied in blocks of trials. Rats adapted to this environment by developing a strategy that capitalized on the serial correlations of the stimulus sequence: a bias towards repeating the same response built up after correct repetitions, and conversely an alternation bias developed after correct alternations. Strikingly, both repetition and alternation biases disappeared after an incorrect trial, irrespective of the number of previous correct trials performed previously.

A GLM analysis revealed that rats decisions in each trial relied on: (1) the current sensory stimulus; (2) a lateral bias towards (away from) the side of recently rewarded (unrewarded) responses on the last 5-10 trials, i.e. win-stay-lose-switch strategy; (3) a novel and strong transition bias that reinforced recent correct transitions (repetitions vs. alternations). Intriguingly the transition bias had no impact on choice after error trials. Subsequent analysis showed that the value of the bias was not reset but simply ignored after an error, and it was recovered after the first subsequent correct trial. Thus, the weight of the history-dependent transition bias could be flexibly and transiently put aside after error choices when possibly the reliability of the internal model was questioned. This nonlinear effect could not be captured by the GLM fitted to both correct and incorrect trials and was not present on the lateral bias, i.e. it was specific of the transition bias. We thus built a latent generative model of rats decisions, whereby lateral and transitions biases are updated at each trial, while the influence of the latter on current decisions is gated by a reward-dependent confidence signal. When fitted to the data, the model accounted quantitatively for all described behavioral effects: in particular, the absence of a transition bias after incorrect choices was due to a reset of the confidence signal. Because the value of the transition bias did not reset after errors but it kept the information about whether the animal would repeat or alternate, a single correct trial was sufficient to increase the confidence and recover the accumulated choice bias. Overall, we show that history-dependent biases in rodent perceptual choices reflect consistent strategic adaptations to behavioural outcomes.

O11 Nicotinic modulation of hierarchal inhibitory circuit control over resting state ultra-slow fluctuations in the prefrontal cortex: modeling of genetic modification and schizophrenia-related pathology

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The prefrontal cortex (PFC), key for higher order cognitive processes, exhibits spontaneous activity that is altered in schizophrenia [1]. Cortical acetylcholine (ACh) release modulates PFC activity via nicotinic acetylcholine receptors (nAChRs) [2] specifically expressed within a hierarchical circuit of inhibitory neurons within layer II/III [3]. Parvalbumin (PV) interneurons, expressing α7 nAChRs subunits [2], target pyramidal cells axosomaticaly, exerting divisive effects on their activity. Somatostatin (SOM) interneurons, expressing both α7 and β2 nAChRs subunits [2], target the dendrites of pyramidal cells, exerting substractive inhibition [4]. The α5 nAChRs subunits are expressed only by vasoactive intestinal polypeptide (VIP) interneurons, that preferentially inhibit the SOM cells. In vivo two-photon imaging showed that neural activity of PFC in mice is characterized by synchronous ultra-slow fluctuations, with alternating periods of high and low activity [5]. Genetic deletion of specific nAChRs subunits disrupted these ultra-slow fluctuations, leading to changes in synchrony and duration of activity states. Furthermore, mice expressing a human polymorphism in the α5 nAChRs subunits (α5SNP) associated with high risk for nicotine addiction and schizophrenia [6, 7], show reduced spontaneous activity in the PFC that is reversed by nicotine [3]. Using a circuit modeling approach, we studied the roles of distinct GABAergic interneurons in the generation of synchronous ultra-slow fluctuations. In order to study the effects of substractive vs. divisive inhibition on bistable dynamics in the pyramidal neuron, by the SOM and PV interneuron populations respectively, we used population firing rate modelling incorporating both mechanisms [8], and simulated the effects of nAChRs knock outs. With our model, we could fully account for the changes seen in resting state dynamics under the genetic modifications. We further predict that SOM interneurons play dominant role in the changes of activity-state structure seen in mutant mice, and in the restaration of activity to basal levels recorded in α5SNP mice under nicotine application.

Acknowledgements
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O12 The minimalistic mathematical model of the cerebral blood flow effects during cortical spreading depression

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Cortical spreading depression (CSD) is one of the most common abnormalities in biophysical brain functioning. We have proposed a minimalistic model that reproduces the main dynamical features of cortical spreading depression dynamics and takes into account CSD and cerebral blood flow (CBF) coupling. Despite the fact that there are many mathematical models describing the CSD, most of them do not take into consideration the role of redistribution of CBF. In contrast to previous modelling attempt [1] which was chosen as the template, we focus on the role of CBF redistribution during the formation and propagation of wave front. The flowchart of the developed model is shown in Figure 1. The model includes six dynamical variables: activator v and inhibitor w, extracellular potassium z, blood vessel radius r and upstream blood pressure p, and available neuron energy u (see Figure 1).

The main model features: (1) we have modified and extended the components of basic model [1] that stand for the energy balance; (2) the proposed model counts the relation between the extracellular potassium concentration and the radius of the nearby located blood vessel: we take into account the effect of spatial coupling (functional hyperemia) by means of weighted summation of vasodilatory driving force over some distance from neuron; (3) we propose a lumped description for hemodynamic spatial coupling, being the direct result of blood flow redistribution between different areas fed from the single upstream arterial vessel.

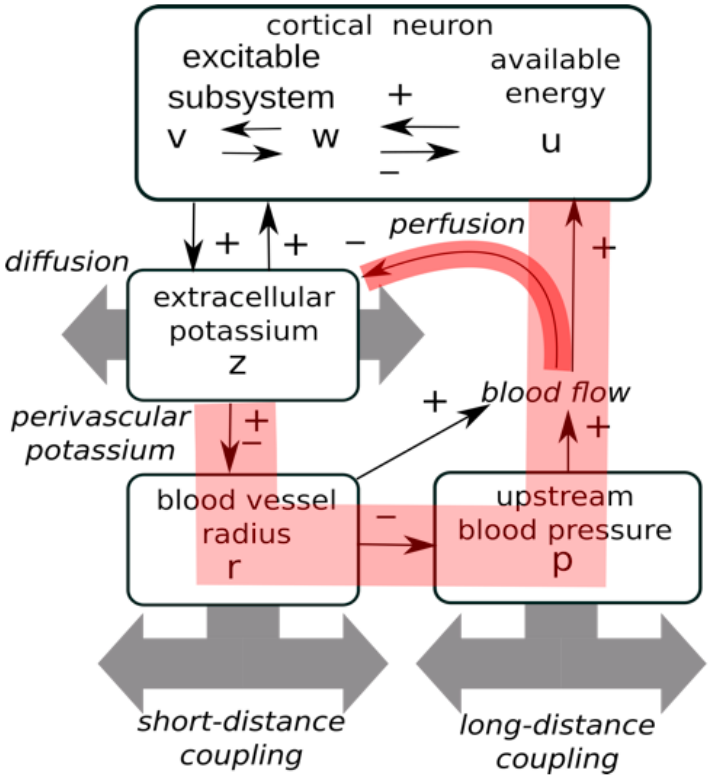

Figure 1: The schematic representation of flowchart of the developed model.

Based on the results of the numerical simulation we can conclude that the proposed model: (1) shows qualitatively reasonable results comparing with the experimental data: the uncorrelated noise-induced firing at rest; the persistent neuronal depolarization during the active phase of CSD; the depressed state afterwards, when model medium temporary losses the excitability and does not response on noisy stimuli; (2) reproduces main spatial patterns known for cortical spreading depression, migraine waves and spreading depolarization events observed in stroke and brain injuries; (3) predicts the formation of stationary dissipative Turing-like structures, formed due

to the substantially different type of spatial relation – tissue perfusion. The role of perfusion in the formation of the structures was elucidated.

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O13 Necessity for coherence in motor control

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The basic premise of this study is that the coherence of neural activity is required for the coordination of motor control. Motor control involves a number of brain centres, most notably the cortex, the basal ganglia, thalamus and cerebellum. How are messages coordinated between the different centres during complex movements is an open question. Following [1], we examined the hypothesis that different neural sub-populations follow a communication via coherence hypothesis. That is, for two neural sub-populations to communicate their activity must be coherent and therefore exhibit some form of mathematical synchronization.

As detailed in [2], we performed deep-brain measurements on patients undergoing treatment for Parkinson's disease (n=6) and dystonia (n=7). During a brief period after implantation of the electrodes, we were able to record the activity from either the sub-thalamic nucleus (STN) or the globus pallidus interna (GPi). These recordings constitute local field potential (LFP) recordings. Patients were asked to perform one cycle of wrist movement lasting approximately one second in duration. The movements were executed either as externally cued or through self-initiation. Simultaneous to local field recordings measured at either the STN or GPi, electroencephalographic signals (EEG) were recorded over the motor cortex. For LFP, recordings were processed by subtracting the activity from adjacent electrodes. EEG was recorded in a bipolar montage (either C3-Cz or C4-Cz). We believe that the activity we record is local in origin and not due to volume conduction, or due to the use of a common reference. Our results show that during movement, and only during movement, is there significant coupling between changes in the power of the activity with changes in coherence between the basal ganglia and the motor cortex. The changes can happen such that for beta band activity (20-30 Hz) both power/coherence is high pre and post movement, but low during course of movement. For gamma activity (30+ Hz), we observe the opposite: only during movement do we observe a coupling of increased power with increased levels of coherence either between GPi-cortex or STN-cortex. The coupling of power with coherence is not artifactual.

To better understanding the origins of these findings, we need to develop suitable mathematical models of coupled neural ensembles. We have been extending the Kuramoto model of coupled oscillators for application to this problem. Two distinct neural ensembles (in the basal ganglia and in the cortex) have neurons that are each interconnected. Moreover, the two ensembles are further connected to each other through additional links. What we can show is that an increase in power in either ensembles will lead to increased amplitude/phase coherence between the two ensembles just as found experimentally. This thus provides a first model of motor coordination between cortex and basal ganglia. Establishing the necessity for coherence in motor coordination suggests new strategies for neuromodulation similar to how functional electrical stimulation works to restore peripheral motor function.

Acknowledgements
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O14 Dissecting gamma phase and amplitude-specific information routing in V4 of macaque during selective attention

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Communication through coherence (CTC) postulates that stimulus information transmission is enhanced between oscillating neural populations in a favorable phase relationship, and suppressed otherwise. For example, in the case of visual cortical gamma-band synchronization during selective attention, V1 spikes arriving to V4 during its excitability peaks should be much more likely to elicit further spikes, resulting in effective signal gating; V1 spikes arriving during excitability troughs should fail or at least be less effective in evoking further activity. Further, it has been observed that average gamma power increases with attention, however, this increase appears to occur in bursts, rather than a constant oscillation. If the CTC hypothesis holds, one should expect descriptive gamma phase and amplitude dependent modulations in stimulus information routing in V4.

To explore this idea, we analyzed neural data from a previous study [1], recorded from V4 superficial layers in macaques performing a visual spatial attention task. The task required the animals to attend one of two dynamic stimuli over an extended time period. Crucially, each stimulus was superimposed with its own fluctuating luminance signature, irrelevant to the behavioral task. This allowed us to quantify the information content I of each stimuli conveyed by the physiological signal, by computing spectral coherence between each stimuli's luminance signal and V4 activity. To assess modulation effects at multiple population scales, we analyzed both LFP and spiking activity. Using gamma-band activity extracted from LFP, we dissected both LFP and spiking neural activity into phase/amplitude-specific components. We then computed the information contribution of each stimulus to these components, giving us the opportunity to assess phase/amplitude signal gating effects.

The results show that information routing is modulated by the gamma phase for both LFP and spiking activity. In LFP, we found the information routing at excitability peaks I_{peak} is significantly higher than at excitability troughs I_{trough} for both attended and non-attended stimuli (Figure 1A). We did not see this effect for spikes, which still show significant gamma phase dependence but without a preference for a specific phase across recording sessions. Comparing the stimuli content during high gamma activity $I_{high\gamma}$ against low gamma activity $I_{low\gamma}$, we found that the spiking activity exhibits significant gating increase for the attended stimulus and decrease for the non-attended stimulus (Figure 1B), however, we do not find this effect in the LFP. In summary, our study confirms basic predictions on the nature of selective information processing, namely its modulation in dependence on phase and amplitude of LFP gamma activity. Surprisingly, consistent phase modulation was only found in LFPs, while consistent amplitude modulation was only seen in spiking activity, indicating that the mechanisms implementing CTC are not yet fully understood. In particular, our results strongly motivate a refinement of current CTC models, requiring an approach encompassing different levels of complexity capable of reproducing local spiking and global population activity from different laminar sources.

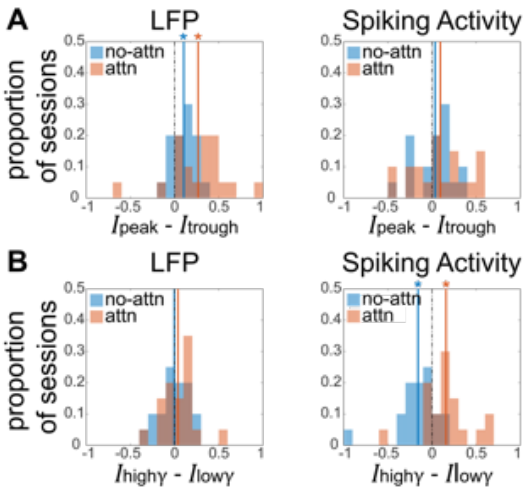

Figure 1: A. Peak vs trough γ phase info routing. B. High vs low γ amplitude info routing.

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O15 Structure-Function Relationships via Neural Field Theory

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Patterns of brain activity are observed to be highly conserved across states of arousal, and between task and non-task conditions. This strongly suggests that these are natural modes (eigenmodes) of the brain, which are excited in different ways under different circumstances. Neural field theory (NFT), which averages over brain microstructure, is ideally suited to deriving brain eigenmodes and interpreting them in terms of underlying physiology. It also provides means of systematically interrelating structure and function via these eigenmodes.

Here, NFT is used to predict the eigenmodes of the continuous cortical surface, including interhemispheric connections. For comparison, eigenmodes of a discrete cortical connection matrix are calculated by standard matrix procedures. Mode energies and symmetry properties are used to constrain interhemispheric conductivities and physiological properties of the cortex. Eigenmodes are then used to derive underlying effective and functional connectivities from system transfer functions and two-point correlations of background activity, respectively.

Neural field eigenmodes are shown to occur in a hierarchy closely related to that of the eigenmodes of a sphere, with added symmetries induced by bihemispheric structure. A close correspondence is also found with the eigenmodes of an anatomical connection matrix, confirming the validity of the neural field approach. The results demonstrate that the brain is in a near-critical state, consistent with estimates from electroencephalographic spectra. It is found that each hemisphere receives near-balanced inputs, with approximately 15 percent of net inputs coming from the contralateral hemisphere, 73 percent from the ipsilateral one, and 12 percent from the environment, meaning that it is in a highly instrospective state. Most activity is predicted to be in symmetric modes, in accord with experiment.

NFT allows structure and activity to be unequivocally interrelated, including the correlations used to define functional connectivity matrices. Eigenmode decomposition of these matrices enables underlying effective connectivities to be systematically derived from functional connectivities, and vice versa, and related to resulting activity patterns. This means that relatively easily observed correlations can be used to infer both average structure and the strengths of effective connectivities that it supports in a noninvasive manner.

In summary, physiologically-based NFT thus explains and unifies multiple phenomena relating to structure, function, and activity via eigenmodes. This allows analysis of activity and structure in terms of the natural dynamic modes of the system, rather than ones that are defined via statistical signal analyses that do not incorporate physiology.

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O16 Dynamic Operations of Hierarchically Interacting Canonical Microcircuits

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Research on canonical microcircuits conceptualizes findings of the recursive occurrence of neural populations and coupling patterns in vertically and horizontally structured divisions (i.e. cortical columns) of the cerebral cortex [1]. The profound description and examination of the link between canonical architectures and the associated functionality promises a better understanding of higher level functions which emerge from the interaction of canonical microcircuits. Fundamental for this interaction is the embedding canonical microcircuits in hierarchical networks [2], mediating both bottom-up and top-down signals to specific neuronal populations. Here, computational studies can help to formulate hypotheses about constitutive mechanisms, which are experimentally identifiable in the neural substrate.

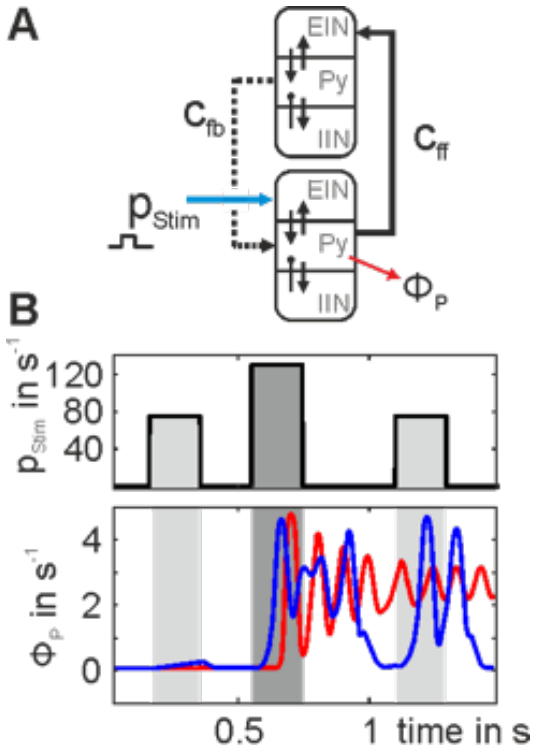

Figure 1: A. Adaptive dynamical shift of a perceptual threshold in a hierarchical configuration of two interacting neural mass models, mimicking canonical microcircuits. B. A bottom-up target input (light grey) excites the lower area only after previous application of a priming stimulus (dark grey).

We use a neural mass model [3], where a pyramidal cell population (Py) receives negative feedback from an inhibitory interneuron population (IIN) and positive feedback via a secondary excitatory population of interneurons (EIN), representing neurons in layer IV. We systematically apply transient afferent inputs, modeled by pulses of various magnitude and duration, as bottom-up signals to the EIN or as top-down signals to the Py [2] and monitor the behavior of the Py. These response behaviors are classified as: a) nonresponsive for sub-threshold transient deflections, b) transfer for supra-threshold transient deflections, and c) memory for sustained supra-threshold deflections and are mapped to the stimulation parameter range.

Single-channel stimulations, either bottom-up (to EIN) or top-down (to Py), lead to differential response behaviors, where strong and long bottom-up stimulations are preferably stored (memory behavior), in contrast to top-down signals, which predominantly show transient deflections. In a concomitant stimulation, constant top-down input modulates the modelÕs sensitivity to pulsed bottom-up stimulation in favor of the memory response behavior. We employ this modulatory influence in a hierarchical network (Fig. 1A) comprising two canonical microcircuits to show a conceivable neural mechanism for the dynamic adaptation of a perceptual threshold. In this configuration, a target stimulus is not able to excite a perceptual area, unless a priming stimulus tunes the networkÕs sensitivity.

The differential response behaviors to top-down and bottom-up stimuli indicate the functional role of separate input channels in canonical microcircuits. Exemplarily, we show one constitutive operation emerging from interacting microcircuits, but expect many more mechanisms relevant in cognitive disciplines like language or memory, such as stimulus selection or structure building computations. Further, the present results in the hierarchical setup demand a further evaluation in light of predictive coding where important findings of neural communication have been put forward.

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O17 Learning structure of 3D objects with cortical columns

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The neocortex is organized in cellular layers. Connections between layers run mostly perpendicular to the surface of the neocortex, which suggests a columnar pattern of activation across layers. The cells in some layers also send their axons across long distances parallel to the surface of the neocortex, which suggests a laminar pattern of activation across multiple columns. The vertical and horizontal spread of axons is a ubiquitous feature of all neocortical regions.

In this study, we propose a network model that utilizes both intra-column and cross-column connections for robust object learning and recognition (Figure 1). The model consists of a set of cortical columns, where each cortical column processes a different subset of the sensory input space. An object consists of a set of component features at particular locations on the object. Each cortical column learns an object by forming feedforward connections from its component features to a set of active neurons in a different cellular layer. After learning, sensation of a sequence of object features leads to activations of the corresponding neural population representing the object.

Since features can be shared among multiple objects, information received by a single cortical column is often ambiguous. The model uses auto-associative connections to integrate many sensations over time and can converge onto unique object representations once sufficient feature are sampled. The recognition speed and accuracy can be improved by simultaneously considering multiple cortical columns with lateral connections, where each column learns feedforward connections independently and learns cross-column lateral connections according to Hebbian rules. The lateral inputs target distal dendritic segments. Although they are not strong enough to directly activate a neuron, neurons with both lateral input and feedforward input will fire earlier and prevent other neurons from responding [1]. The cross-columnar connections bias each column to form a representation that is consistent with the partial knowledge of all the interconnected columns. We show that objects can be recognized faster and that each cortical column can store more objects by using cross-column connections. The model is consistent with a large body of anatomical and physiological evidence and provides a number of predictions that can be tested in future experiments.

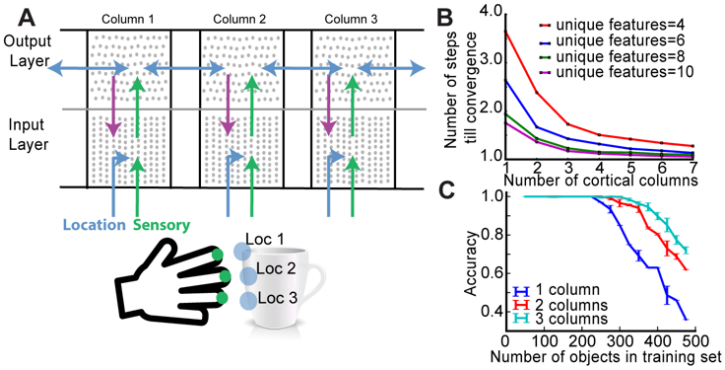

Figure 1: A. We consider the problem of object recognition with a set of cortical columns. Each column receives sensory input from a different sensor (e.g., different finger). A first layer of the network transforms the raw sensory input into sparse distributed representations that corresponds to object features. The second layer receives feedforward inputs from the first layer. It recognizes an object by converging onto a stable activation pattern through lateral connections. B. The recognition speed increases as a function of column number. C. Retrieval accuracy of object during testing vs. the number of learned objects. More objects can be learned with networks with more cortical columns.

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O18 Influence of network topology on spreading of epileptic seizure

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In partial epilepsy, seizures originate in a local network, the so-called epileptogenic zone, before recruiting other close or distant brain regions. Correctly delineating the epileptogenic and the propagation zone is essential for successful resective surgery. In particular, the stereotaxic EEG (SEEG) is used to edge the resection zone. Nevertheless, the propagation pathways of epileptic seizures are still largely unknown. We utilize a specific dynamical model for epilepsy, the Epileptor model [1], to predict the recruitment network given the seizure origins and the structural brain connectivity. Thus, we try to understand the role played by the topology in constraining the recruitment process and we suggest a paradigm for epileptic surgery that relies on minimal invasiveness and maximum effectiveness. In particular, we schematize the brain network dynamics in terms of neural mass models able to captures the details of the autonomous slow evolution of interictal and ictal phases; these mass models are coupled among them and the coupling terms model the effective presence of nerve pathways and fibers among different brain regions [2]. In this framework it is possible to identify the minimal number of local disconnections of the epileptogenic zone that are necessary to stop seizure propagation via the application of linear stability analysis and, therefore, to define the optimal set of links to be cut in order to stop seizure propagation (see Figure 1). In order to demonstrate the potential use of this framework in practice, we apply our methods to structural connectivity matrices derived from patients affected by partial epilepsy. In all cases a partial disconnection, that counts for the resection of few pathways, is sufficient to stop seizure activity in the brain. Therefore we demonstrate that seizure spreading is thus supported and enhanced by the underlying topology and that a disconnection procedure, if well addressed, can become a fruitful procedure to improve the success rate of epilepsy surgery.

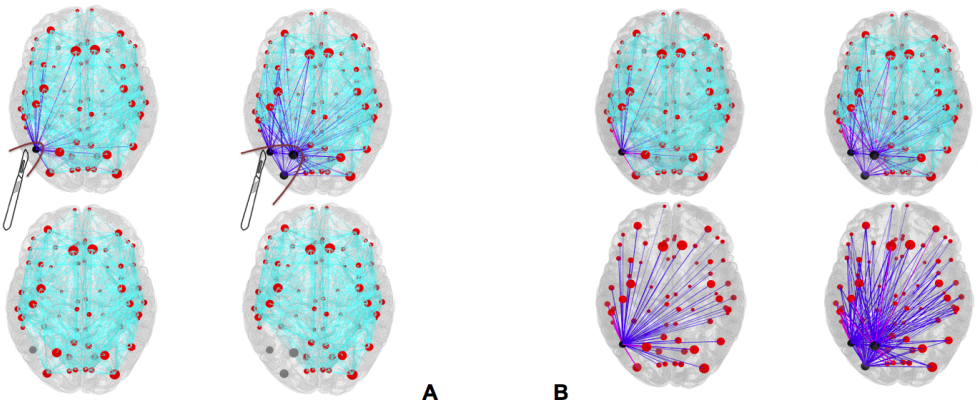

Figure 1: A: Standard resection technique, where the entire epileptogenic zone (EZ) is removed during surgical operation. Blue links represent the outgoing connections of the EZ and are completely removed during the current surgical procedures. B: Lesioning depicts the minimal number of links that are sufficient to be removed (magenta) in order to stop the seizure, versus the total number of outgoing links from the EZs (blue) that are removed during the resection of an entire EZ. Cyan links represent in both panels the full connectivity of the network.

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O19 A model-based approach for detecting multiple change points in multivariate spike count data

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Department of Theoretical Neuroscience, Bernstein Center for Computational Neuroscience, Central Institute of Mental Health, Medical Faculty Mannheim, Heidelberg University, Germany

Neural data often consist of multiple single unit recordings in the form of spike count time series. These time series are often highly nonstationary, where statistical moments, such as firing rates, vary to potentially encode features of the experimental paradigm, like changes in external input or different task phases. Changes in the firing rates may be sudden or gradual, and their time scale and onset may reflect information regarding neural computations, such as learning [1] or the accumulation of sensory evidence [2].

Here we develop an approach for detecting and parametrising multiple changes in multivariate spike count data within the statistical framework of State Space Models (SSM) [3]. The model assumes a nonlinear, nonstationary, autoregressive Gaussian process that captures the underlying latent neural dynamics. However, given their discrete, nonnegative nature, assumptions of normality are not guaranteed to produce consistent estimates of spike count statistical moments. Instead, the Gaussian process generates spike counts by a Poisson observation function. Both latent trajectories in phase space and latent model parameters, in addition to observation model parameters, are estimated by a 3-stage Expectation-Maximisation (EM) procedure [4]. The latter relies on Newton's method [5] to maximise, under constraints, a global Laplace approximation [6] of spike-count data's log-likelihood, given the SSM and its parameters. The dimensionality of the latent model equals the number of unknown nonstationary events, termed change points, and is selected by a cross-validation procedure. Observations, on the other hand, are generally of a much higher dimension than the latent dynamics. Due to this substantial dimensionality reduction [7], latent trajectories, thus, offer a parsimonious representation of the most relevant features in neural dynamics.

The estimation procedure is first tested on simulated data, to assure that the latent states and model parameters are correctly identified in comparison to the ground truth. As a real data example, the model is fitted to multiple single unit recordings from rat medial prefrontal cortex neurons during an operant rule switching task. The resulting reconstruction of the underlying dynamics will allow matching the neural correlates of learning to their behavioral counterpart, by relating behavioral changes to population-wide change points, as estimated by the model.

Acknowledgements
The work was funded by the German Research Foundation (DFG) (SPP1665 / DU 354/8-1) and through the German Ministry for Education and Research (BMBF) via the e:Med framework (01ZX1314E). The authors thank Dr. Florian BŠahner for providing the prefrontal cortex data.

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O20 Geppetto: an open source visualisation and simulation platform for neuroscience

Matteo Cantarelli[1]*, Adrian Quintana[2,4], Boris Marin[4], Matt Earnshaw[4], Padraig Gleeson[4], Robert Court[3], Robert A McDougal[6], R Angus Silver[4], Salvador Dura-Bernal[5], Stephen Larson[1], William W Lytton[5], and Giovanni Idili[1]

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[2]*EyeSeeTea Ltd., London, UK*
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[4]*Department of Neuroscience, Physiology and Pharmacology, University College London, London, UK*
[5]*State University of New York Downstate Medical Center, Brooklyn, NY, USA*
[6]*Yale University, New Haven, CT, USA*

Geppetto (geppetto.org) is an open-source web-based platform to explore and simulate neuroscience data and models. The platform, originally designed to support the simulation of a cell-level model of C. elegans as part of the OpenWorm project [1], has grown into a generic framework suitable for various neuroscience applications, offering out of the box solutions for data visualisation, integration and simulation. Geppetto is today used by Open Source Brain (opensourcebrain.org) (Figure 1.A), to explore and simulate computational neuroscience models described in NeuroML version 2 with a variety of simulators and by the Virtual Fly Brain (virtualflybrain.org) (Figure 1.B) to explore and visualise anatomy (including neuropil, segmented neurons and gene expression pattern data) and ontology knowledge base of *Drosophila melanogaster*. Geppetto is also being used to build a new experimental UI for the NEURON simulation environment [2][3] (Figure 1.C) based on Python and Jupyter. WormSim (wormsim.org) (Figure 1.) embeds Geppetto to let users explore dynamic mechanical and electrophysiological models of *C. elegans* produced by the OpenWorm project. Geppetto is capable of reading and visualising experimental data in the NWB format (nwb.org) to allow experimental and computational neuroscientists to share and compare data and models using a common platform. Geppetto is freely available, well documented and has an active user community. Interested potential users can try out the latest version of the platform at live.geppetto.org.

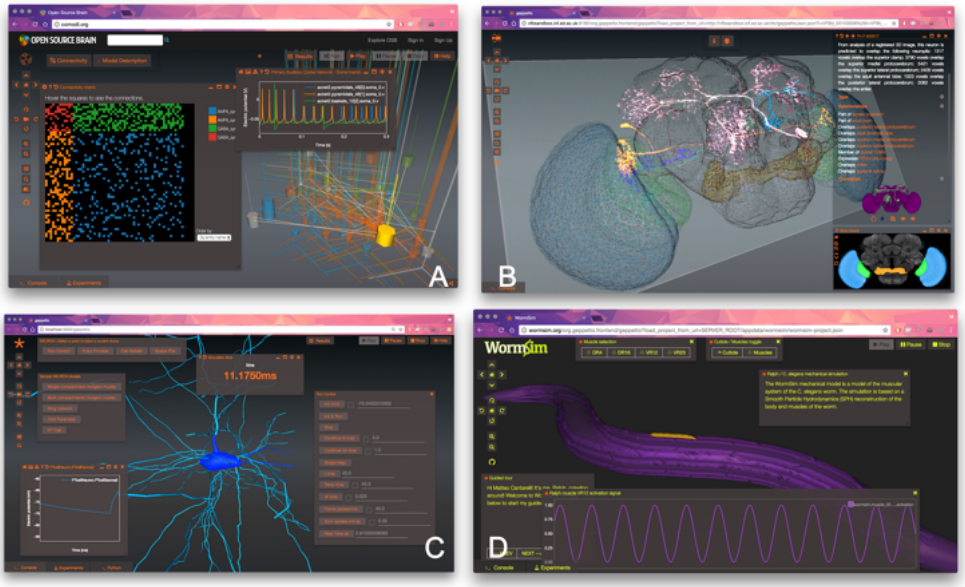

Figure 1: Gepetto in different deployments.

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O21 Position is coherently represented during flickering instabilities of place-cell cognitive maps in the hippocampus

Lorenzo Posani[1]*, Simona Cocco[1], Karel Ježek[2], and Rémi Monasson[1]

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[2] *Laboratory of Experimental Neurophysiology, Biomedical Center, Charles University, Prague, Czech Republic*

Place cells in hippocampus exhibit sharp spatially-related firing fields, which are formed when the animal explores new environments and are retrieved, as memories, each time the rat is placed back in those specific settings. Knowledge of the environment-specific set of place fields (map) allows for the application of Bayesian statistics to infer the position of the rodent from neuronal activity (Figure 1B, 1C). Likewise, functional-connectivity models, based only on neural correlations, i.e. with no knowledge of place fields or position, can identify the expressed map as a function of time (Figure 1A) [1]. We apply both these inference procedures to CA3 recordings from a recent "teleportation" experiment [2], in which instantaneous switches between the identity of two familiar environments trigger the instability of the recalled memory state, which flickers back and forth between the two corresponding maps (Figure 1A, 1E). Our analysis shows that the rat position is not accurately inferred during the unstable periods, under conventional approach relying on brain processing only the external input information (i.e. environment cues, Figure 1B, 1D: red curve). However, if the position is inferred using the template reflecting the decoded inner state of the network, the position error is significantly reduced, reaching values comparable to the stable conditions (Figure 1C, 1D: blue curve). Results suggest that position is robustly encoded in CA3, even during periods of conflict or ambiguity in the input information resulting in global map changes on fast dynamical time scales.

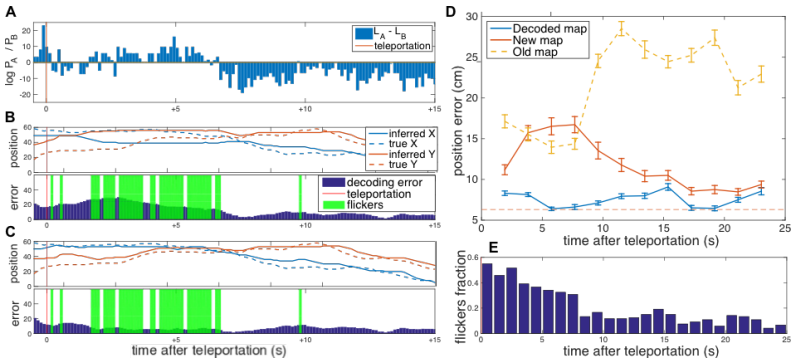

Figure 1: Position inference during flickering instabilities. A. decoded environment (log-likelihood difference) as a function of time after a teleportation in CA3. Note the flickering dynamics in the 0-5 sec interval. B. Inferred vs. real positions of the animal; place fields corresponding to light conditions were used for the inference. Freely-moving rat in a 60x60 cm box. C. same as B with position inferred using the place fields associated to the decoded map (sign of ΔL in panel A). D. positional errors averaged over 15 teleportation events; dashed line indicates the level of error for stable conditions (no light switches). E. fraction of flickering time bins (ΔL-decoded map differs from light conditions) as a function of time after the light switch.

Acknowledgements
This work was partially supported by the HFSP RGP0057/2016 project.

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Workshops

W1 Neuronal Oscillations: Mechanisms and Functionality

Room K.202, Wed and Thur 9:00 to 18:00

Horacio G Rotstein, New Jersey Institute of Technology
Frances Skinner, Krembil Research Institute
Vassilis Cutsuridis, University of Lincoln

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.

An additional goal is to discuss what we mean by an explanation in the context of this workshop. To this end, speakers will be encouraged to address this issue from the perspective of Aristotle's four causes (efficient, material, formal and final causes). Please see 'What is computational neuroscience? (XVI) What is an explanation?'.

Speakers:

- Frances Skinner (Krembil Research Institute, Canada) "Theta oscillations in the hippocampus: generation mechanisms"
- John White (Boston University, USA) "Synaptic contributions to the theta rhythm in the isolated hippocampal formation"
- Marianne Bezaire (Boston University, U.S.A.) "Spontaneous theta oscillations arise in a detailed, large-scale model of the rodent hippocampal CA1 subfield"
- Vassilis Cutsuridis (University of Lincoln, U.K.) "Memory formation and replay in the hippocampal CA1 microcircuit"
- Jose Guzman (IST, Austria) "The synaptic microcircuit of pattern completion in the hippocampal CA3 network"
- Leonid Rubchinsky (Indiana University Purdue University Indianapolis, USA) "Temporal patterns on neural synchrony: observations, mechanisms, and functions"
- Dan Levenstein (NYU, USA) "Synchronized neocortical dynamics of the NREM slow oscillation: from mechanism to function"
- Francesco Battaglia (Donders Centre for Neuroscience, Radboud Universiteit Nijmegen, The Netherlands) "Oscillatory interaction between hippocampus and prefrontal cortex during memory consolidation"
- Marlene Bartos (University of Freiburg, Germany) TBA
- Christoph Borgers (Tufts University, USA) "Some thoughts on the effects of synchrony"
- Carmen Canavier (LSU Health Sciences Center, USA) "Different gamma mechanisms coexist in the same excitatory/inhibitory network architecture"
- Mark Cunningham (University of Newcastle, U.K.) "Mechanisms underlying the generation of human neocortical gamma frequency oscillations"
- Jeremie Lefebvre (University of Toronto, Canada) TBA
- Adrien Peyrache (McGill University, Canada) "Oscillatory dynamics in the limbic thalamo-cortical network reveal subcortical information flow to and from the hippocampus"
- Horacio Rotstein (New Jersey Institute of Technology, USA) "A conceptual framework for the study of resonance in neuronal systems"

- Ausra Saudargiene (Neuroscience Institute of the Lithuanian University of Health Sciences & Vytautas Magnus University, Kaunas, Lithuania) TBA
- Bijan Pesaran (New York University, USA) "Neural coherence supports functional inhibition during movement coordination"

W2 Methods of Information Theory in Computational Neuroscience

Room C.101, Wed and Thur 9:00 to 18:00

Joseph T. Lizier, University of Sydney
Viola Priesemann, Max Planck Institute for Dynamics and Self-organisation
Justin Dauwels, Nanyang Technological University
Taro Toyoizumi, RIKEN Brain Science Institute
Alexander G Dimitrov, Washington State University
Lubomir Kostal, Academy of Sciences of the Czech Republic
Michael Wibral, Goethe University, Frankfurt

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.

For an up to date list of talks and schedule please see http://bit.ly/cns2017itw

Speakers:

- Selin Aviyente (Michigan State University) “Directed information: application to EEG during cognitive control”
- Lionel Barnett (University of Sussex) “Information transfer in continuous and discrete time”
- Karl Friston (University College London) “Active inference and artificial curiosity”
- Renaud Jolivet (University of Geneva) “Energy-efficient information transfer at synapses”
- Lubomir Kostal (Academy of Sciences of the Czech Republic) “Reference frame independence as a constraint on the mutual information decomposition”
- Joseph T. Lizier (The University of Sydney) “An estimator for transfer entropy between spike trains”
- Daniele Marinazzo (University of Ghent) “Synergetic and redundant information flow detected by unnormalized Granger causality: application to resting state fMRI”
- Jil Meier (Delft University of Technology) “The epidemic spreading model and the direction of information flow in brain networks”
- Viola Priesemann (Max Planck Institute for Dynamics and Self-organization, Goettingen) TBA
- Adrià Tauste (Universitat Pompeu Fabra) “Directed information flow within the thalamo-cortical network”
- Tatjana Tchumatchenko (Max Planck Institute for Brain Research, Frankfurt) “Information coding of mean and variance modulating signals in cortical neurons”
- Taro Toyoizumi (RIKEN Brain Science Institute) “A local learning rule for independent component analysis”
- Raul Vicente (University of Tartu) TBA
- Plus additional contributed talks ...

W3 Recent Methods and Analyses for Large-scale Neuronal Population Recordings

Room C.102, Wed and Thur 9:00 to 18:00

Michela Chiappalone, Istituto Italiano di Tecnologia, Genova
Valentina Pasquale, Istituto Italiano di Tecnologia, Genova
Pierre Yger, Institut de la Vision, INSERM, Paris

Understanding how assemblies of neurons encode information requires recording large populations of cells in the brain. In recent years, progress in population calcium imaging and multichannel electrophysiology opened the possibility to record from hundreds or even thousands of neurons simultaneously. While these techniques offer unprecedented chances to monitor large neural circuits, they also push for the design of new algorithms to gather and process information from such high-dimensional datasets.
This two-day workshop will gather leading experimentalists and theoreticians to discuss latest computational methods and analyses used to process such large-scale neuronal population recordings, both in vivo and in vitro. Focusing on high-density electrophysiology and calcium imaging, it will review recent advances in neuroinformatics research, including spike sorting techniques and characterization of neural assemblies' spatio-temporal activity. It will be a unique opportunity to address various questions such as:

- How to enhance the robustness of new algorithms identifying spikes, and/or design a proper validation framework ensuring the quality of the data?
- How to detect neural assemblies' activity and correlations both in space and time, and possibly link them to sensory perception and behavior?
- What are the links, from a signal processing point of view, between calcium imaging and high density electrophysiology recordings?

Speakers:

- Matthias Hennig (University of Edinburgh, Scotland) "Spike sorting for large scale multielectrode arrays: efficient methods and lessons learnt"
- Felix Franke (ETH Zurich, Switzerland) "How prewhitening can improve spike sorting performance"
- Nick Steinmetz (University College London, UK) "Recording large, distributed neuronal populations with Neuropixels electrode arrays in behaving mice"
- Pierre Yger or Olivier Marre (Institut de la Vision, France) "Towards online accurate spike sorting for thousands of channels"
- Thomas Deneux (UNIC, CNRS, France) "Spike inference from calcium signals: MLspike algorithm and general perspectives"
- Marius Pachitariu (University College London, UK) "Kilosort and Suite2p: robust and scalable frameworks for neural activity extraction in large-scale recordings"
- Stephen J. Eglen (University of Cambridge, UK) "Detecting pairwise correlations in high-density recordings: open science in action"
- Adrien Peyrache (McGill University, Canada) "Millisecond synchrony in the thalamo-cortical network of the brain's navigation system: a mechanism for efficient information transmission?"
- George Dimitriadis (Sainsbury Welcome Centre, UK) "Understanding large-scale neural recordings: Ground truth data sets and the T-sne visualizations tool"
- Gaute Einevoll (NMBU, Norway) "Biophysical modeling of benchmarking data for validation of methods for analysing electrophysiological data"
- Yannick Bornat (IMS Bordeaux, France) "Low latency hardware computing to use electrode array inputs in closed loop experiments"
- Ulisse Ferrari (Institut de la Vision, France) "Closed-loop estimation of retinal network sensitivity reveals signature of efficient coding"
- Valentina Pasquale (Istituto Italiano di Tecnologia, Italy) "Measuring similarity of endogenous and evoked activity patterns in cultured cortical networks"

- Sonja Grün (Forschungszentrum Jülich, Germany) “Analysis of massively parallel spike data for higher-order correlations”
- Arno Onken (Istituto Italiano di Tecnologia, Italy) “Matrix and tensor factorizations for analyzing neural population activity”
- Paolo Bonifazi (Ikerbasque, Bilbao, Spain) “Sparse synchronizations and neuronal network failures: astrocytes replacement recovers global synchronizations in Atm-deficient cerebellar circuits in vitro”

W4 **New Advances in Theoretical Tools for the Study of Large-scale Neural Systems**

Room K.101, Wed 9:00 to 18:00 and Thur 9:00 to 12:30

Simona Olmi, Institute of Complex Systems- CNR
David Angulo-Garcia, Aix-Marseille University
Benjamin Lindner, Humboldt University Berlin

New advances in mathematical and computational neurosciences require the development of mathematical tools able to explain the dynamical evolution observed at different spatiotemporal scales. Our idea is to focus on the specific issue of meso/macroscopic dynamical behaviours in neural systems, given their relevance for population coding and computation. This workshop aims at discussing some of the most recent analytical techniques and mathematical tools used to derive the evolution of neural populations and its emergent dynamics, with the hope of understanding how features of meso/macroscopic systems such as local dynamics, heterogeneity, noise and topology shape their response. With this workshop we expect to bridge the gap between models and data and to further shed light on the inter-relation between structure, dynamics and function of the brain circuitry by studying the transitions between different collective states.

Speakers:

- Olivier Faugueras (INRIA and LJAD, France) “Coping with correlations in the analysis of the thermodynamic limit of neuronal networks”
- Ernest Montbrió (Universitat Pompeu Fabra, Spain) “Firing rate equations require a spike synchrony mechanism to correctly describe fast oscillations in inhibitory networks”
- Alex Roxin (Campus de Bellaterra, Barcelona, Spain) “Microscopic and macroscopic states in networks of recurrently coupled spiking neurons”
- Srdjan Ostojic (Ecole Normale Supérieure, Paris, France) “From dynamics to computations in recurrent random networks with low-rank connectivity structure”
- Maurizio Mattia (Istituto Superiore di Sanità, Italy) “Low-dimensional dynamics of cortical networks explaining slow-wave activity and its transition to the asynchronous state.”
- Tilo Schwalger (Ecole polytechnique fédérale de Lausanne, Switzerland) “Mesoscopic dynamics of interacting neural populations of spiking neurons”
- Boris Gutkin (Ecole Normale Supérieure, Paris, France) “Phase response curves for emergent network oscilations”
- Tatyana Sharpee (Salk Institute for Biological Studies, CA) “Dynamics of large-scale recurrent networks”
- Raffaella Burioni (University of Parma, Italy) “Chaos and correlated avalanches in excitatory neural networks with synaptic plasticity”
- Magnus Richardson (University of Warwick, United Kingdom) “Negative-feedback control of cortical activity by the neuromodulator adenosine”
- Marc de Kamps (University of Leeds, United Kingdom) TBA
- Davide Bernardi (Bernstein Center for Computational Neuroscience Berlin, Germany) “Optimal detection of single-cell stimulation in large random networks of integrate-and-fire neurons”
- David Angulo-Garcia (University of Aix-Marseille, France) “Lazarus effect: mechanism of neuron’s deactivation and reactivation in sparse heterogeneous inhibitory neuronal networks”
- Simona Olmi (Weierstrass Institute Berlin,Germany) “Exact firing time statistics of neurons driven by discrete inhibitory noise”

W5 **Theoretical Neuroscience in the Human Brain Project**

Room K.201, Wed 9:00 to 18:00

Michele Giugliano, Universiteit Antwerpen
Alain Destexhe, Centre National de la Recherche Scientifique (CNRS)
Viktor Jirsa, Aix-Marseille University

This workshop gathers in an open and interactive forum, some of the Principal Investigators of the Theoretical Neuroscience pillar (SP4) of the Human Brain Project. SP4 provides novel mathematical descriptions for multi-scale representations of the brain and its components, from cellular to network levels. We propose to focus this workshop on how microscopic processes in the brain express themselves parametrically on a higher level of organisation, ranging from populations of neurons, entire brain areas to the whole-brain networks. Individual talks will address and discuss the following research questions:

- How can mean-field models achieve a direct faithful integration between mesoscopic and macroscopic signals (e.g. LFP, EEG, fMRI)?
- How can building blocks, including different signals of the brain, be incorporated into simplified descriptions of dendrites, generic models, and synaptic plasticity?
- What is the state-of-the art of large-scale models of the whole brain?
- Which do recent advances in modelling synaptic plasticity and memory tell about computational properties of the neocortex?
- How close is our community to the modelling of the whole-brain?

Speakers:

- Alain Destexhe (UNIC, CNRS, Gif sur Yvette, and European Institute for Theoretical Neuroscience, Paris) “Welcome note and Introduction”
- Gaute Einevoll (Norvergian University of Life Sciences, Ås, Norway) TBA
- Olivier Faugeras (Inria MathNeuro & TOSCA Teams, Sophia Antipolis, France) TBA
- Michele Giugliano (Universiteit Antwerpen (Belgium) “The dynamical response properties of cortical neurons”
- Moritz Helias (Research Centre Juelich, Germany) “Towards a field theory for neuronal networks”
- Viktor Jirsa (Institut de Neuroscience des Systemes, Marseille, France) “Translational neuroscience: from bifurcations to personalized medicine”
- Marc de Kamps (University of Leeds, UK) TBA
- Marja-Leena Linne (Tampere University of Technology, Finland) TBA
- Sacha van Albada (Jülich Research Centre, Jülich, Germany) “Spiking dynamics and inter-area interactions in a supercomputational model of cortex”
- Nicole Voges (Jülich Research Centre, Jülich, Germany) “Breaking the complexity barrier of analysis by reproducible workflows”
- Gorka Zamora-López (Center for Brain and Cognition at Universitat Pompeu Fabra, Spain) “Relation between structural and functional brain connectivities: lessons learned and future plans within HBP”

W6 Computational and Experimental Advances in Cerebellum Research

Room K.102, Wed 9:00 to 18:00

Erik De Schutter, Okinawa Institute of Science and Technology
Yunliang Zang, Okinawa Institute of Science and Technology

With the improvement of experimental techniques, like in vivo patch-clamp recording and calcium imaging, we have gained a deeper understanding of information processing in the cerebellum. However, experiment driven computational modeling is still an indispensable tool to explore the implications of these findings. The purpose of this workshop is to foster an active dialogue between experimentalists and modelers about cerebellar physiology and function. Sufficient time will also be reserved to discuss how modeling and experiments can provide interesting data relevant to each other.

Both experimental and computational work at the level of cerebellar single cell and network studies are included in the workshop.

Speakers:

- Arnd Roth (UCL, London, UK) “Untangling cerebellar circuits with scanning electron microscopy and focused ion beam milling”
- Alessandro Barri (Institut Pasteur, Paris, France) “Temporal processing in the cerebellar cortex enabled by dynamical synapses”
- Coffee break
- Philippe Isope (CNRS, Strasbourg, France) “How presynaptic short term dynamics influence Purkinje cell discharge in the cerebellum”
- Mario Negrello (Erasmus MC, Rotterdam, Netherland) “The origin of complex spike synchrony”
- Ian Duguid (University of Edinburgh, Edinburgh, UK) “Purkinje cell dendritic responses during self-paced locomotion”
- Yunliang Zang (OIST, Okinawa, Japan) “Voltage- and branch-dependent complex spike responses in Purkinje neurons”
- Brandon Stell (CNRS, Paris, France), “In vivo imaging of Purkinje cell simple spikes”
- Paul Chadderton (Imperial College London, London, UK) “Cerebellar processing of kinematic signals during active whisking”

W7 **Principles and Applications of Extracellular Potentials**

Room K.203, Wed 9:00 to 18:00

Michiel Remme, Humboldt University Berlin
Torbjoern Ness, Norwegian University of life Sciences
Gaute Einevoll, Norwegian University of life Sciences - University of Oslo

Electrical signals from the cortical surface of animals were recorded as early as 1875. The high-frequency part (above ~ 500 Hz) of the recorded potentials provides information about the spiking activity of neurons located around the electrode, whereas the low-frequency part, the â€˜local field potentialâ€™ (LFP), was found more difficult to interpret. Recently, the interest in LFPs has undergone a resurgence. Key reasons are the growing capacity for streaming continuous data from multiple electrodes and the development of multicontact electrodes for high-density recordings across areas and laminae. Further, the LFP captures key integrative synaptic processes that cannot be measured by observing the spiking activity of a few neurons alone. The LFP is also a promising signal for steering neuroprosthetic devices and for monitoring neural activity in human recordings because they are more easily and stably recorded in chronic settings than are spikes. The goal of the workshop is to provide a resume of the advances in understanding the generation of extracellular potentials through theoretical and experimental approaches as well as on the consequences (e.g., ephaptic interactions) and the applications of such signals (e.g., neuroprosthetic devices).

Speakers:

- Ad Aertsen (University of Freiburg) “Decoding motor cortex activity at multiple scales”
- Costas Anastassiou (Allen Institute for Brain Science) “Brain dynamics and associated electric fields during physiological and pathological activity”
- Florian Aspart (Technical University of Berlin) “Frequency dependent polarization of pyramidal cells models due to weak extracellular fields”
- Gaute Einevoll (Norwegian University of Life Sciences) “What can we learn from local field potentials (LFPs)?”
- Joshua Goldwyn (Ohio State University) “Generators of field potentials and (possible) ephaptic interactions in the auditory brainstem”
- Sonja Grün (Research Centre Jülich, Aachen University) “Spatial and temporal LFP-LFP and spike-LFP relationships”
- Paula Kuokkanen (Humboldt University Berlin) “Extracellular ITD potential and spike contributions in barn owl’s nucleus laminaris”
- Alberto Mazzoni (Scuola Superiore Sant’Anna) “Predicting risk attitude in conflictual economic tasks from subcortical local field potentials”
- Arno Onken (Italian Institute of Technology) “Application of mixed vine copulas to model jointly neural spikes and local field potentials”
- Bartosz Teleńczuk (Centre National de la Recherche Scientifique) “Contributions of inhibitory and excitatory neurons to the focal LFP in human and monkey”

W8 Fingerprints and Applications of Brain Dynamics Estimated from Neuroimaging Data

Room K.103, Wed 9:00 to 18:00

Matthieu Gilson, University Pompeu Fabra
Tim van Hartevelt, Oxford

The functioning of the brain relies on detailed interactions between specialized neuronal subsystems, implementing joint segregation and integration of information such as sensory stimuli, memory tokens and intentions. Nowadays, neuroimaging techniques (fMRI, EEG, MEG, etc.) provide indirect measurements of the neuronal activity at the whole-brain level. Recent efforts have focused on extracting fingerprints of the measured brain dynamics to discriminate between tasks, conditions (e.g., sleep vs. awake) or individuals. For example, given a dynamic network model, whole-brain effective connectivity describes the interaction scheme between regions for each condition, which can be quantitatively compared. The goal of this workshop is to review both data-analysis methods and model-based approaches that have attacked this problem.

Abstracts available here: matthieugilson.eu/workshop_CNS2017.html

Speakers:

- Henrique Fernandes (U Aarhus, Denmark) “Brain fingerprints of structural connectivity in health and disease”
- Dante Mantini (KU Leuven, Belgium) “Detecting large-scale brain networks using high-density electroencephalography”
- Emily Finn (NIMH, Bethesda, USA) “Can we manipulate brain state to emphasize individual differences in functional connectivity?”
- Anish Mitra (U Washington, St Louis, USA) “Structured temporal sequences in spontaneous human brain activity”
- Demian Battaglia (INSERM, Marseille, France) TBA
- Joana Cabral (Oxford U, UK) “Spontaneous switching between states of functional connectivity relates to cognitive performance in healthy older adults”
- Karl Friston (UCL, London, UK) “Dynamic causal modelling and network discovery”
- Vicente Pallares (U Pompeu Fabra, Barcelona, Spain) “Whole-brain effective connectivity from fMRI resting-state data discriminates between individuals”
- Thomas Bolton (EPFL, Lausanne, Switzerland) “Shedding light on resting-state dynamic functional network interactions by sparse coupled hidden Markov models”

W9 Emerging Models in Scientific Communication and Discussion

Room K.201, Thur 9:00 to 18:00

Romain Brette, Institut de la Vision, Paris

The academic publishing system is undergoing large changes towards a more open process, including the increasing use of preprints, open access and open data repositories. This move is especially important for computational and theoretical neuroscience, which require the availability of empirical data and model code. Several recent experiments aim at opening the scientific discussion itself, where not only the article but also the reaction of the community is published. Different models are being experimented; anonymous or signed reviews; invited or spontaneous; led by authors or editors. It has also been suggested that the social web (e.g. reddit, stackexchange) might provide relevant models.

In this workshop, we will explore emerging open models in academic publishing, with speakers presenting concrete experiments. Ample room will be reserved for discussion, in particular as it relates to concrete projects for the computational neuroscience community.

Speakers:

- Romain Brette (Vision Institute, Paris), “Decoupling peer review and editorial selection”
- Paola Masuzzo (Ghent U, Belgium), “Do you speak open science?”
- Stephen Eglen (Cambridge U, UK, “Encouraging code and data sharing in neuroscience”
- Nicolas Rougier (Neurodegeneratives Diseases Institute, Inria, Bordeaux, France), “ReScience: Reproducible science is good. Replicated science is better.”
- Brandon Stell (CNRS, Paris), “PubPeer, the online journal club”
- Thomas Ingraham (F1000 Research), “Reforming and modernizing wasteful and antiquated practices in academic publishing”
- Frances Skinner (Krembil Research Institute, Canada), “eLife from a computational neuroscience insider’s perspective”
- Thierry Galli (Institut Jacques Monod, Paris), “ASAPbio: accelerating science and publication in biology’

W10 Reaction-diffusion Modeling for Neurobiology

Room K.203, Thur 9:00 to 18:00

Robert McDougal, Yale University
William W Lytton, SUNY Downstate
Avrama Blackwell, George Mason

Methods developed for Computational Systems Biology are finding increasing use in Computational Neuroscience to understand the details of molecular cascades that influence neuron electrical activity – many and likely most voltage-sensitive ion channels and ligand sensitive channels (synapses) are modulated by such cascades. Additionally, examination of metabolomics requires consideration of the role of ATP in the functioning of cells for applications to a variety of brain diseases. This workshop on reaction-diffusion modeling will provide an introduction to the different types research questions being addressed using reaction-diffusion modeling. It will also identify the various technical approaches and bottlenecks encountered in addressing reaction-diffusion problems – stochastic vs deterministic simulation, simulation at 1D, 2D and 3D, tetrahedra vs cubic arrays, difficulties of coupling to membrane mechanisms and challenges of parallelization.

Speakers:

- William W Lytton (SUNY Downstate) “Reaction-diffusion – foundations of multiscale modeling for the nervous system”
- Jim Schwaber (Thomas Jefferson) “Multiscale models of schizophrenia: gene networks to information in neuronal network”
- Marja-Leena Linne (Tampere University of Technology) “Model order reduction techniques with applications to describing reaction kinetics in neuronal and glial cells”
- Ekaterina Brocke (KTH Royal Institute of Technology) “Numerical discretization schemes for co-simulation of coupled electrical - chemical systems”
- Davide Lillo (Marseille) “Slow variables of epileptiform activity: metabolic candidates and computational properties”
- Joanna Jedrzejewska-Szmek (George Mason) “NeuroRD as an approach for large scale modeling of neuronal signaling pathways.”
- Erik De Schutter (OIST) “Mesh based neuron modeling using STEPS: fully integrated stochastic molecular and electrophysiological simulation in 3D”
- Robert A McDougal (Yale) “Using NEURON to incorporate reaction-diffusion into cellular and network models”

W11 Recent Developments in Epilepsy Modeling

Room K.103, Thur 9:00 to 18:00

Wim van Drongelen, The University of Chicago
Stephan A. van Gils, University of Twente

Epilepsy is a chronic disease of the CNS characterized by the occurrence of seizures. It affects 1% of the people worldwide, and a significant proportion of the affected population does not respond to anticonvulsant drugs. This limited success of anticonvulsant treatment is, in part, due to our limited understanding of the underlying mechanisms that are responsible for the pathological behavior.

Translational research can play an important role in the unravelling of the mechanisms that may be responsible. As more and better experimental data become available, it is important to be able to integrate these data with modeling approaches in order to test hypotheses and to improve insight and produce more individualized models.

In this workshop a number of active researchers in the field come together to discuss their latest results ranging from computational models on different scales to statistical methods to evaluate the use of biomarkers.

Speakers:

- Wim van Drongelen (U Chicago) “A recipe for seizures and a possible "pacebreaker""
- Stephan van Gils (U Twente) “The cross-scale effects of neural interactions during human neocortical seizure activity"
- Marc Goodfellow (U Exeter) “The role of networks in seizure generation"
- Geertjan Huiskamp (U Medical Center Utrecht) and Jurgen Hebbink (U Twente) “Networks of early and delayed responses to single pulse electrical stimulation of the cortex"
- Viktor Jirsa (U Marseille) “On nature of seizure dynamics"
- Bill Lytton (Downstate Medical Center) “Multiscale modeling of epilepsy: opportunities for drug discovery"
- Stiliyan Kalitzin (SEIN) “Reconstructive computational modelling for identifying epileptic networks in neurophysiological data"
- Wytze Wadman (U Amsterdam) “Ionic homeostasis in epilepsy and the balance between excitation and inhibition"
- Fabrice Wendling (U Rennes 1) “Novel stimulation protocols for probing neural network excitability: from computational modeling to clinical application"

W12 Neuroscience Gateway: Enabling Developers and Users to Utilize Open High Performance Computing Resources for Large Scale Simulations

Room K.101, Thur 14:00 to 18:00

Amit Majumdar, University of California San Diego, La Jolla
Subhashini Sivagnanam, University of California San Diego, La Jolla
Ted Carnevale, Yale University

The US National Science Foundation (NSF) funded Neuroscience Gateway (NSG) catalyzes computational neuroscience research by lowering the administrative and technical barriers that make it difficult for researchers to access open supercomputer resources for large scale simulations and data processing. It provides free and open access via a web portal and programmatically to supercomputers and time on the supercomputers is acquired via the peer reviewed process of the Extreme Science and Engineering Discovery Environment in the US. It has been in operation since early 2013, it has over 450 registered users. For the 2017 calendar year alone NSG was awarded 10,000,000 core hours on various supercomputers in the US. NSG already has large number of tools and software (NEURON, PGENESIS, NEST, BRIAN, PyNN, MOOSE, Freesurfer, R, Octave, Matlab etc.), libraries (BluePyOpt, CARLsim, Tensorflow etc.) and pipelines (The Virtual Brain Pipeline etc.). NSG is open to any user from anywhere in the world. Developers (of tools, libraries, and pipelines) and users utilize NSG extensively. This workshop will bring together both the users and the developers of tools/libraries/pipelines associated with the NSG for discussion of tools, software and research where HPC resources are utilized for neuroscience.

Speakers:

- Amit Majumdar, Subhashini Sivagnanam (UC San Diego), Ted Carnevale (Yale University) “Introduction to the Neuroscience Gateway”
- Salvador Dura-Bernal, William W Lytton (SUNY Downstate), Samuel A Neymotin (Brown U) “Parallel simulation of NEURON-based large scale network models”
- M Migliore, CA Lupascu, LL Bologna, R Migliore (Institute of Biophysics, National Research Council, Palermo, Italy) “Interaction of the Neuroscience Gateway with the Brain Simulation Platform of the European Human Brain Project: practical examples”
- Padraig Gleeson (University College London) “Using models from the Open Source Brain repository on the NSG portal infrastructure”
- Alexandar Peyser (Jülich Supercomputing Centre, Institute for Advanced Simulation, Forschungszentrum Jülich) “Towards exascale computing in neuroscience: NEST, NestMC and TVB”
- Christina M. Weaver (Franklin & Marshall College) “Modeling the effects of aging and neurodegeneration on cortical and striatal neurons”
- Marianne Bezaire (Boston University) “Full-scale detailed modeling of a hippocampal CA1 network using the Neuroscience Gateway ”

W13 Cortical Function: Towards Understanding and Developing Integrative Theories

Room K.102, Thur 14:00 to 18:00

Hamish Meffin, The University of Melbourne
Anthony Burkitt, The University of Melbourne

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. Recent advances have uncovered much about the cerebral cortex, with its 2-4mm thick sheet of neurons having a consistent anatomical structure consisting of six well-characterised layers and network connectivity. This workshop aims to look at what progress has been made in understanding how the cortex functions and what general integrative principles underlie how it works and enable capabilities as diverse as sensory perception, control of voluntary motor activity and high-level cognitive functions.

Speakers:

- Marcus Diesmann (Institute of Neuroscience and Medicine, Research Centre JÃ¼lich , Germany) “A brain-scale model of macaque visual cortex at cellular and synaptic resolution”
- Jorge Mejias (Center for Neural Science , New York University, USA) “Large-scale models of cortical dynamics: neural communication and cognitive computations”
- Subutai Ahmad (VP Research Numenta, USA) “Why the neocortex has layers and columns, a theory of learning 3D models of the world”
- Stefan Mihalas (Allen Institute for Brain Science, USA) “Cortical circuits implement optimal context integration and its gating”

W14 Postdoc Career Workshop

Room K.102, Thur 9:00 to 12:30

Joanna Jedrzejewska-Szmek, University of Warsaw

Computational neuroscience is a diverse, international and interdisciplinary community, which allows for diverse and challenging career paths. This workshop is intended to provide postdocs and students in computational neuroscience an opportunity to interact with panel of mentors with diverse careers in research and industry. Mentors will discuss their own experiences, talk about different professional paths and funding opportunities, working abroad, and give advice how to survive in both 'fat' and 'lean' funding periods. The panel of mentors will also answer questions about available career choices, their advantages and disadvantages, and relative importance of skills, work experience and teaching.

Speakers:

- Piotr Franaszczuk (US Army Research Laboratory Human Research and Engineering Directorate)
- Eugene Izhikevich (Brain Corporation)
- Malin Sandström (International Neuroinformatics Coordinating Facility (INCF))
- Eleni Vasilaki (University of Sheffield)
- Christina Weaver (Franklin & Marshall College)

Posters

Poster Listing

Sunday Posters
Posters P1 – P104

P1 **Potential functions of different temporal patterns of intermittent neural synchronization**

Leonid Rubchinsky[1,2⋆], Sungwoo Ahn[3]

[1] *Department of Mathematical Sciences, Indiana University Purdue University Indianapolis, Indianapolis, IN, USA*
[2] *Stark Neurosciences Research Institute, Indiana University School of Medicine, Indianapolis, IN, USA*
[3] *Department of Mathematics, East Carolina University, Greenville, NC, USA*

P2 **NestMC: A morphologically detailed neural network simulator for modern high performance computer architectures**

Wouter Klijn[1], Benjamin Cumming[2], Stuart Yates[2], Vasileios Karakasis[3], and Alexander Peyser[1⋆]

[1] *Jülich Supercomputing Centre, Forschungszentrum Jülich, Jülich, Germany*
[2] *Future Systems, Swiss National Supercomputing Centre, Zürich, Switzerland*
[3] *User Engagement & Support, Swiss National Supercomputing Centre, Lugano, Switzerland*

P3 **Automatically generating HPC-optimized code for simulations using neural mass models**

Marmaduke Woodman[1], Sandra Diaz-Pier[2⋆], and Alexander Peyser[2]

[1] *Institut de Neurosciences des Systèmes, Aix Marseille Université, Marseille, France*
[2] *Simulation Lab Neuroscience, Forschungszentrum Jülich, Jülich, Germany*

P4 **Conjunction or co-activation? A multi-level MVPA approach to task set representations**

James Deraeve[1⋆], Eliana Vassena[2], and William Alexander[1]

[1] *Department of Experimental Psychology, Ghent University, Ghent, Belgium*
[2] *Donders Center for Cognitive Neuroimaging, Radboud University, Nijmegen, Netherlands*

P5 **Understanding Adaptation in Human Auditory Cortex with Modeling**

David Beeman[1⋆], Pawel Kudela[2], Dana Boatman-Reich[3,4], and William Anderson[2]

[1] *Department of Electrical, Computer, and Energy Engineering1, University of Colorado, Boulder, CO, USA*
[2] *Department of Neurosurgery, Johns Hopkins School of Medicine,Baltimore, MD, USA*
[3] *Department of Neurology, Johns Hopkins School of Medicine,Baltimore, MD, USA*
[4] *Department of Otolaryngology, Johns Hopkins School of Medicine,Baltimore, MD, USA*

P6 **Silent and bursting states of Purkinje cell activity modulate VOR adaptation**

Niceto Luque[1,2,3⋆], Francisco Naveros[4], Richard Carrillo[4], Eduardo Ros[4], and Angelo Arleo[1,2,3]

[1] *INSERM, U968, Paris, France*
[2] *Sorbonne Universités, UPMC University Paris 06, UMR_S 968, Institut de la Vision, Paris, France*
[3] *CNRS, UMR_7210, Paris, France*
[4] *Department of Computer Architecture and Technology, University of Granada (CITIC), Granada, Spain*

P7 The “convis” framework: Population Simulation of the Visual System with Automatic Differentiation using theano

Jacob Huth[1⋆], Timothee Masquelier[2], and Angelo Arleo[1]

[1]*Sorbonne Universités, UPMC Univ Paris 06, INSERM, CNRS, Institut de la Vision, Paris, France*
[2]*CERCO UMR5549, CNRS, University Toulouse, France*

P8 Why does neural activity in ASD have low complexity: from a perspective of a small-world network model

Koki Ichinose[1⋆], Jihoon Park[1], Yuji Kawai[1], Junichi Suzuki[1], Hiroki Mori[2], and Minoru Asada[1]

[1]*Department of Adaptive Machine Systems, Osaka University, Osaka, Japan*
[2]*Department of Computer Science, University of Cergy-Pontoise, Cergy-Pontoise, France*

P9 Phase-locked mode prediction with generalized phase response curve

Sorinel A Oprisan⋆, Dave I Austin

Department of Physics and Astronomy, College of Charleston, Charleston, SC, USA

P10 Neural Field Theory of Corticothalamic Prediction and Attention

Tahereh Babaie[1,2⋆], Peter Robinson[1,2]

[1]*School of Physics, Faculty of Science, University of Sydney, Sydney, Australia*
[2]*Center of Excellence for Integrative Brain Function, Australian Research Council, Australia*

P11 Top-down dynamics of cortical pitch processing explain the emergence of consonance and dissonance in dyads

Alejandro Tabas[1,2⋆], Martin Andermann[3], André Rupp[3], and Emili Balaguer-Ballester[2,4]

[1]*Max Planck Institute for Human Cognitive and Brain Sciences, Saxony, Leipzig, Germany*
[2]*Dept. of Computing and Informatics. Faculty of Science and Technology, Bournemouth University, UK*
[3]*Biomagnetism Section, Heidelberg University, Baden-Württemberg, Germany*
[4]*Bernstein Centre for Computational Neuroscience Heidelberg-Mannheim, Heidelberg University, Germany*

P12 Modeling sensory cortical population responses in the presence of background noise

Henrik Lindén[1⋆], Rasmus K. Christensen[1], Mari Nakamura[2], and Tania R. Barkat[2]

[1]*Center for Neuroscience, University of Copenhagen, Copenhagen, Denmark*
[2]*Brain and Sound Lab, Department of Biomedicine, Basel University, Basel, Switzerland*

P13 Cortical circuits from scratch: A metaplastic rule for inducing lognormal firing rates in a cortical model

Zachary Tosi[1⋆], John Beggs[2]

[1]*Cognitive Science, Indiana University, Bloomington, IN, USA*
[2]*Physics, Indiana University, Bloomington, IN, USA*

P14 Investigating the effects of horizontal interactions on RGCs responses in the mice retina with high resolution pan-retinal recordings

Davide Lonardoni[1⋆], Fabio Boi[1], Stefano Di Marco[2], Alessandro Maccione[1], and Luca Berdondini[1]

[1]*Neuroscience and Brain Technology Department, Fondazione Istituto Italiano di Tecnologia, Genova, Italy*
[2]*Scienze cliniche applicate e biotecnologiche, Università dell’Aquila, L’Aquila, Italy*

P15 Calcium base plasticity rule can predict plasticity direction for a variety of stimulation paradigms

Joanna Jedrzejewska-Szmek[1⋆], Daniel Dorman[1,2], and Kim Avrama Blackwell[1,2]

[1] *Krasnow Institute, George Mason University, Fairfax, VA, USA*
[2] *Bioengineering Department, George Mason University, Fairfax, VA, USA*

P16 Unstructured network topology begets privileged neurons and rank-order representation

Christoph Bauermeister[1,2⋆], Hanna Keren[3,4], and Jochen Braun[1,2]

[1] *Institute of Biology, Otto-von-Guericke University, Magdeburg, Germany*
[2] *Center for Behavioral Brain Sciences, Magdeburg, Germany*
[3] *Network Biology Research Laboratory, Technion - Israel Institute of Technology, Haifa, Israel*
[4] *Department of Physiology, Technion - Israel Institute of Technology, Haifa, Israel*

P17 X047 Finer parcellation reveals intricate correlational structure of resting-state fMRI signals

Joao Vicente Dornas⋆, Jochen Braun

Institute of Biology, Otto von Guericke University, Magdeburg, Saxony-Anhalt, Germany

P18 Modelling human choices: MADeM and decision-making

Eirini Mavritsaki[1,2⋆], Silvio Aldrovandi[1], and Emma Bridger[1]

[1] *Department of Psychology, Birmingham City University, Birmingham, UK*
[2] *School of Psychology, University of Birmingham, Birmingham, UK*

P19 The interplay between synaptic plasticity and firing rate adaptation sharpens response dynamics with visual learning

Sukbin Lim[1⋆], Nicolas Brunel[2,3]

[1] *Neural and Cognitive Sciences, NYU Shanghai, Shanghai, China*
[2] *Department of Neurobiology, University of Chicago, Chicago, Illinois, USA*
[3] *Department of Statistics, University of Chicago, Chicago, Illinois, USA*

P20 Adaptation and inhibition control the pathologic synchronization in the model of a focal epileptic seizure.

Anatoly Buchin[1,2⋆], Clifford Charles Kerr[3], Anton Chizhov[4,5], Gilles Huberfeld[6,7], Richard Miles[8], and Boris Gutkin[9,10]

[1] *Department of Physiology and Biophysics, University of Washington, Seattle, WA, USA*
[2] *Allen Institute for Brain Science, Seattle, WA, USA*
[3] *SUNY Downstate Medical Center, New York City, NY, USA*
[4] *Computational Physics Laboratory, Ioffe Institute, St Petersburg, Russian Federation*
[5] *Sechenov Institute of Evolutionary Physiology and Biochemistry, St Petersburg, Russian Federation*
[6] *Pitié-Salpêtrière Hospital, University Pierre and Marie Curie, Paris, France*
[7] *Inserm U1129 Infantile Epilepsies and Brain Plasticity, Paris Descartes University, Paris, France*
[8] *Cortex and Epilepsy Group, Brain and Spine Institute, Paris, France*
[9] *Department of Cognitive Neuroscience, Group for Neural Theory, École Normale Supérieure, Paris, France*
[10] *Center for Cognition and Decision Making, NRU Higher School of Economics, Moscow, Russian Federation*

P21 Efficient and Effective Neural Activity Shaping for a Retinal Implant

Martin Spencer[1⋆], Hamish Meffin[1,2], Tatiana Kameneva[1], David B Grayden[1], and Anthony N Burkitt[1]

[1] *Department of Biomedical Engineering, University of Melbourne, Melbourne, Australia*
[2] *NVRI, Department of Optometry & Vision Sciences, University of Melbourne, Melbourne, Australia*

P22 Application of control theory to neural learning in the brain

Catherine Davey[1⋆], David B Grayden[1,2], and Anthony N Burkitt[1]

[1]*Department of Biomedical Engineering, University of Melbourne, Victoria, Australia*
[2]*Centre for Neural Engineering, University of Melbourne, Victoria, Australia*

P23 Modeling dynamic oscillations: A method of inferring neural behavior through mean field network models

Tao Liangyu[1⋆], Vineet Tiruvadi[1,2], Rehman Ali[4], Helen Mayberg[3], and Rob Butera[1]

[1]*Department of Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA, USA*
[2]*Department of Biomedical Engineering, Emory University, Atlanta, GA, USA*
[3]*Department of Psychiatry and Behavioral Sciences, Emory University, Atlanta, GA, USA*
[4]*Department of Electrical Engineering, Stanford University, Stanford, CA, USA*

P24 Synaptic strengths dominate phasing of motor neurons by a central pattern generator

Cengiz Gunay[1,2⋆], Anca Doloc-Mihu[1], Damon G Lamb[1,3], and Ronald L Calabrese[1]

[1]*Department of Biology, Emory University, Atlanta, GA, USA*
[2]*School of Science and Technology, Gerogia Gwinnett College, Lawrenceville, GA, USA*
[3]*Department of Neurology, Univ. Florida, Gainesville, FL, USA*

P25 PumpHCO-db: A database of half-center oscillator computational models for analyzing the influence of Na+/K+ pump on the bursting activity

Anca Doloc-Mihu⋆, Ronald Calabrese

Department of Biology, Emory University, Atlanta, GA, USA

P26 Encoding of memories: effective connectivity on the hippocampus and the role of inhibition in the information flow.

Victor J. Lopez-Madrona[1⋆], Fernanda S. Matias[2], Ernesto Pereda[3], Claudio Mirasso[4], and Santiago Canals[1]

[1]*Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas, Universidad Miguel Hernández, Sant Joan d'Alacant, Spain*
[2]*Instituto de Física, Universidade Federal de Alagoas, Maceió, Alagoas, Brazil*
[3]*Departamento de Ingeniería Industrial, Escuela Superior de Ingeniería y Tecnología, Universidad de La Laguna Avda. Astrofísico Fco. Sanchez, s/n, La Laguna, Tenerife, Spain*
[4]*Instituto de Física Interdisciplinar y Sistemas Complejos, CSIC-UIB, Campus Universitat de les Illes Balears, Palma de Mallorca, Spain*

P27 Extended generalized leaky integrate and fire neuron for cerebellum modeling

Alice Geminiani[1⋆], Alessandra Pedrocchi[1], Egidio Dangelo[2], and Claudia Casellato[1]

[1]*NEARLab, Dept. of Electronics, Information and Bioengineering, Politecnico di Milano, Milan, Italy*
[2]*Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy*

P28 Saccade Velocity Driven Oscillatory Networkmodel of Grid cells

Ankur Chauhan⋆, Karthik Soman, and Srinivasa Chakravarthy

Department of Biotechnology, Indian Institute of Technology Madras, Chennai, Tamilnadu, India

P29 Programmed cell death in substantia nigra due to subthalamic nucleus-mediated excitotoxicity: a computational model of Parkinsonian neurodegeneration

Vignayanandam Muddapu*, Srinivasa Chakravarthy

Bhupat and Jyoti Mehta School of Biosciences, Department of Biotechnology, IIT-Madras, Chennai, TN, India

P30 A novel approach for determining how many distinct types of neurons are in the Drosophila brain by sequencing neural structure

Chaochun Chuang*, Nan-Yow Chen

National center for high-performance computing, Taiwan

P31 Generating sequences in recurrent neural networks for storing and retrieving episodic memories

Mehdi Bayati[1,2]*, Jan Melchior[1], Laurenz Wiskott[1], and Sen Cheng[1,2]

[1] *Institut für Neuroinformatik, Ruhr-Universität Bochum, Bochum, Germany*
[2] *Mercator Research Group 'Structure of Memory', Ruhr-University Bochum, Bochum, Germany*

P32 Modeling replay and theta sequences in a 2-d recurrent neural network with plastic synapses

Amir Hossein Azizi[1]*, Kamran Diba[2], and Sen Cheng[1]

[1] *Institut für Neuroinformatik, Ruhr University Bochum (RUB), Bochum, Germany*
[2] *Psychology faculty, university of Wisconsin-Milwaukee, WI, USA*

P33 Biophysically detailed model of cortical activity in response to moving gratings

Elena Smirnova[1,2]*, Elena Yakimova[3], and Anton Chizhov[1,2]

[1] *Ioffe Institute, St. Petersburg, Russia*
[2] *Sechenov Institute of Evolutionary Physiology and Biochemistry of RAS, St. Petersburg, Russia*
[3] *Pavlov Institute of Physiology, St. Petersburg, Russia*

P34 NeuriteSLIM – Shrink the Neuro Fibers for Visualization the Connectome

Nan-Yow Chen[1]*, Chi-Tin Shih[2], and Chaochun Chuang[1]

[1] *High Performance Computing Division, National Center for High-Performance Computing, Taiwan*
[2] *Department of Applied Physics, Tunghai University, Taiwan*

P35 Identification of models of sensory neural circuits consisting of a nonlinear filter in series with a leaky integrate-and-fire neuron

Dorian Florescu, Daniel Coca*

Department of Automatic Control and Systems Engineering, University of Sheffield, Sheffield, UK

P36 Modelling fluctuations in resting-state functional connectivity in epilepsy

Julie Courtiol*, Spase Petkoski, and Viktor K Jirsa

Aix Marseille Univ, Inserm, INS, Institut de Neurosciences des Systèmes, Marseille, France

P37 Exact solutions to a Wilson-Cowan network of excitatory and inhibitory neurons whose dynamics is triggered by one single spike

Roberto Covolan*

Department of Neurology, State University of Campinas, Campinas, SP, Brazil

P38 Encoding variable cortical states with short-term spike patterns

Bartosz Telenczuk[1⋆], Richard Kempter[2], Gabriel Curio[3], and Alain Destexhe[1]

[1]Unité de Neurosciences, Information et Complexité, CNRS, 91198 Gif-sur-Yvette, France; European Institute for Theoretical Neuroscience, CNRS, Paris, France
[2]Institute for Theoretical Biology, Humboldt-Universität zu Berlin, Berlin, Germany
[3]Dept. of Neurology, Universitätsmedizin Charité, Berlin, Germany

P39 Cat Paw-shaking as a Transient Response to Sensory Input to Locomotion CPG

Jessica Parker[1⋆], Alexander Klishko[2], Boris Prilutsky[2], and Gennady Cymbalyuk[1]

[1]Neuroscience Institute, Georgia State University, Atlanta, GA, USA
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P40 Population Coding with Two-Dimensional Feature Maps in the Retina

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P41 A detailed computational reconstruction of the cerebellum granular layer network predicts large scale spatiotemporal dynamics of neuronal activity

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P42 A Biophysically Detailed Cerebellar Stellate Neuron Model Predicts Local Synaptic Interactions

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P43 Neuromodulation of Subgenual Cingulate Activity Localizable from EEG

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P44 Phase dynamics in a GO/NOGO finger tapping task

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P45 Mechanisms of focal seizure generation in a realistic small-network model with ionic dynamics

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P46 Pre-allocation of working memory modulates memory performance

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P47 Temporal dynamics of bistable perception reveals individual time window for perceptual decision making

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P48 Regularly structured retinal mosaics can induce structural correlation between orientation and spatial frequency maps in V1

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P49 Distinct role of synaptic and nonsynaptic plasticity in memory ensemble formation, allocation, and linkage

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P50 Frequency- and Location-Dependence of Auditory Influence on Human Visual Perception

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P51 Developmental model for ocular dominance column seeded from retinal

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P52 Reliability of effective connectivity from fMRI resting-state data: discrimination between individuals

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P53 Temporal dynamics of resting state networks on a whole-brain level

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P54 Non-parametric estimation of network connectivity using MVAR processes in multiunit activity

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P55 Dependence of Absence Seizure Dynamics on Physiological Parameters

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P56 NEST-SpiNNaker comparison of large-scale network simulations

Sacha J van Albada[1⋆], Andrew Rowley[2], Johanna Senk[1], Michael Hopkins[2], Maximilian Schmidt[1,3], Alan Stokes[2], David Lester[2], Steve Furber[2], and Markus Diesmann[1,4,5]

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P57 Temporal processing in the cerebellar cortex enabled by dynamical synapses

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P58 Emergence of perceptual invariances in biological sensory processing

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P59 A non-linear stochastic strategy to estimate synaptic conductances under the presence of subthreshold ionic currents.

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P60 Involvement of randomness in reinforcement learning

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P61 Modelling the impact of dendritic spine geometry on electrical and calcic signalling with the Finite Element Method

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P62 Resilience in dynamical neural networks with synaptic adaptation

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P63 Cell assemblies: a computational challenge

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P64 Reconstructing neural dynamics from experimental data using radial basis function recurrent neural networks

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P65 Layer V pyramidal cells as mediators of delta oscillations: Insights from biophysically detailed modeling and connections with schizophrenia genetics.

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P66 Biophysical modeling of single-neuron contributions to ECoG and EEG signals

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P67 Extracellular diffusion can introduce errors in current source density estimates

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P68 Estimation of metabolic oxygen consumption from optical measurements in cortex

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P69 Computing Brain Signals: Concurrent simulation of network activity, extracellular electric potentials and magnetic fields.

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P70 Integration of orientation and spatial frequency in a model of visual cortex

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P71 Performance-optimization guided distribution of attentional resources

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P72 Feature integration with critical dynamics in cortical subnetworks

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P73 Interneuronal contribution to state transition in the mouse neocortex

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P74 Embodiment, connectivity, and critical states in neural systems

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P75 A computational model of temporal processing in the human auditory cortex

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P76 The dependence of simulated local field potential (LFP) frequency content on local and long range connectivity

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P77 Pre-whitening as a means to improve dimensionality reduction and simplify clustering in spike-sorters for multi-electrode recordings

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P78 An integrative model explaining many functions of corticothalamic feedback

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P79 State-Dependent Control of Oscillatory Brain Dynamics

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P80 Switch of preference as a signature of heterogeneous excitability of neurons in the primate prefrontal cortex

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P81 Modeling of the perceptual dynamics of the perception of body motion

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P82 Modelling the effects of propofol on neuronal synchronization in network of interneurons

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P83 The dynamical response properties of in silico neurons from the Blue Brain Project digitally reconstructed neocortical microcircuitry

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P84 Self-Organized Balanced Spiking Neural Networks To Encode Natural Stimuli

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P85 Transiently attracting states in recurrent neural networks

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P86 Characterization of resting state dynamics in monkey motor cortex

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P87 Sharp wave ripples as propagating patterns emerging from spatially extended neural circuits

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P88 Macroscopic Phase-Resetting Curve of Spiking Neural Networks: Theory and Application

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P89 Semi-numerical method for computationally effective analysis of working memory models

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P90 Workflow for model building, parameter estimation and uncertainty analysis applied to calcium- and G-protein dependent subcellular signaling underlying synaptic plasticity

Parul Tewatia[1⋆], Olivia Eriksson[1,2], Andrei Kramer[2], Joao Santos[3], Alexandra Jauhiainen[4], Kim Avrama Blackwell[5], and Jeanette Hällgren Kotaleski[1,3]

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P91 The role of striatal feedforward inhibition in propagation of cortical oscillations

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P92 Electrical propagation on Cortical Connectome and Communicability

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P93 A cortical model for learning complex temporal structure in sensory streams

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P94 Conditions for traveling waves in spiking neural networks obtained from a rigorous mapping to a neural-field model

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P95 Temporal structure of synchrony and Unitary Events in periodically-driven balanced networks

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P96 Distributed correlations in motor cortex suggest virtually unstable linearized dynamics

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P97 Transition to chaos and short-term memory in driven random neural networks

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P98 Dynamics of cell assemblies in binary neuronal networks

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P99 A dynamic mean-field approach for the largest Lyapunov exponent of random neural networks

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P100 Microdraw: Online platform for the collaborative editing of cytoarchitectonic brain atlases

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P101 Single-compartment models of retinal ganglion cells with different morphologies

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P102 Credibility, Replicability, Reproducibility in Simulation for research and clinical application

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P103 Computational social interaction in reciprocity and empathic behavior as behavioral economics and risk tasking behavior

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P104 On the need for standardized real-time software technology in closed-loop neuroscience

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Monday Posters
Posters P105 – P209

P105 Discovering Connectivity Changes with rescaled Energy-Based Models

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P106 Fitting and analysis pipeline to build data-driven models of tonic and burst firing in thalamic neurons

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P107 A data-driven pipeline for digital reconstruction of somatosensory thalamic microcircuitry

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P108 Sensitivity analysis of somatic and dendritic features, parameters, and fitting error of biophysically detailed neuron models

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P109 Music gone crazy: neural oscillators to the rescue?

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P110 Bistability generates highly irregular spike trains with weakly fluctuated inputs

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P111 Big bang bifurcations structure the parameter space of a two-cell inhibitory network with synaptic depression.

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P112 Morphology and balance influences Dendritic mosaic formation.

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P113 Comparison between extracellular and intracellular stimulation

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P114 X106 Bifurcations in a temperature-dependent neural mass model reveal heterogeneous effect of focal cooling on epileptic discharges

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P115 Robust Transmission of Rate Coding in the Inhibitory Purkinje Cell to Cerebellar Nuclei Pathway in Awake Mice

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P116 A method to generate realistic artificial spike trains as inputs to biophysical neuron models: cerebellar mossy fibers as a case study

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P117 Serotonergic fiber densities may emerge from random walks

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P118 A taxonomy of seizures based on dynamics

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P119 Computational model for diffusion-induced bursting of biophysically realistic HH-type neuron: mathematical characterization

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P120 Phase-lags in large scale brain synchronization

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P121 Network dynamics after focal stimulation in a connectome-based network model of the mouse brain

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P122 What is the feasibility of estimating axonal conduction delays from micro-structural MRI?

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P123 Analysing the impact of sodium channels in Alzheimer's disease using a computational model

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P124 Models of brain design: is physics more important than evolutionary optimization?

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P125 Perceptual Attractors and Neural Confusions in Phoneme Manifolds

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P126 Network analysis of task-oriented neuroimaging data via multivariate information-theoretic measures

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P127 Optimal localist and distributed coding of spatiotemporal spike patterns through STDP and coincidence-detection

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P128 Muscle force potentiation induced by active dendrites of spinal motoneuron during locomotor-like movement

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P129 X180 Perceptual Mechanics of the Brian and the Free Energy Principle

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P130 Influence of handedness on the response inhibition in Stroop task: ERP study

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P131 Contribution of short-term plasticity of the bipolar-ganglion synapse to the activity both in the normal and the degenerating rd1 retina

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P132 Differential connectomics of the rat thalamus

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P133 X351 Nonuniform neural field modeling of nonlinear dynamics spreading

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P134 Excitatory-to-inhibitory plasticity for sequence learning

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P135 Experimental and modelling evidence for coaxial conduction in myelinated axons

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P136 GIMBL-Vis: A GUI-Based Interactive Multidimensional Visualization Toolbox for Matlab

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P137 Neural relativity principle

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P138 Disrupted cerebrum-cerebellum network in Schizophrenia revealed by network-based statist and graph theory

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P139 Computational behavioral analysis of acute psychosocial trauma reveals gradually increasing stress reactions in adult mice

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P140 Relationship between population sparse coding and short-term synaptic plasticity

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P141 The contribution of topology for inclusion of feedforward network and biased synaptic strength to the long-term memory effect in a cortical microcircuit

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P142 Propagation of spatio-temporally complex spike pattern in feedforward network of the barrel cortex: in vitro multi-electrode array and in silico neural network model study

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P143 Computational Geometry for the Simulation of Neural Circuits with Population Density Techniques

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P144 Neuron classification in the Stomatogastric ganglion using voltage-sensitive dye imaging and signal processing tools

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P145 Reconstructed attractors from optogenetics experiments

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P146 A Simple Parameter Landscape for Optimisation of Conductance-Based Models of Neurons

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P147 Neural Synchronization Through Electric Field Effects

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P148 How Spines Cross-talk: Compartmental Model of Heterosynaptic Plasticity

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P149 Determination of the spike-train power spectrum statistics in modular networks with mixtures of different excitatory and inhibitory populations

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P150 Optimal detection of single-cell stimulation in large random networks of integrate-and-fire neurons

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P151 Self-consistent power spectra from an iterative scheme for recurrent heterogeneous networks

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P152 Astrocyte-modulated synaptic plasticity in sensory cortex: A computational study

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P153 Up and down states statistics for Gamma oscillations

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P154 EDLUT: a real-time spiking neural network simulator for embodiment experiments

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P155 Embedded Ensemble Encoding — a hypothesis for reconciling cortical coding strategies

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P156 Multiscale modeling of ischemic stroke with the NEURON reaction-diffusion module

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P157 Accelerating NEURON reaction-diffusion simulations

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P158 Computation of invariant objects in the analysis of periodically forced neural oscillators

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P159 Computational model of spatio-temporal coding in CA3 with speed-dependent theta oscillation

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P160 The effect of progressive degradation of connectivity between brain areas on the brain network structure

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P161 A network architecture for comparing the behavior of a neurocomputational model of reward-based learning with human

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P162 Distributed plasticity in the cerebellum: how do cerebellar cortex and nuclei plasticity cooperate for learning?

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P163 Ising Model with conserved magnetization on the Human Connectome: implications on the relation structure-function in wakefulness and anesthesia

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P164 Multiscale Granger causality analysis by à trous wavelet transform

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P165 New (spectral) dynamic causal modeling scheme improves effective connectivity estimation within resting state networks in longitudinal data

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P166 Effective connectivity modulations of win-and loss feedback: A dynamic causal modeling study of the human connectome gambling task.

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P167 Modeling global brain dynamics in brain tumor patients using the Virtual Brain

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P168 Representation of Neuronal Morphologies

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P169 X034 Firing Rate Heterogeneity and Consequences for Stimulus Estimation in the Electrosensory System

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P170 KnowledgeSpace: a community encyclopedia linking brain research concepts to data, models and literature

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P171 Evaluating the computational capacity of a cerebellum model

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P172 Complexity of cortical connectivity promotes self-organized criticality

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P173 Attractor dynamics of cortical assemblies underlying brain awakening from deep anesthesia.

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P174 Are receptive fields in visual cortex quantitatively consistent with efficient coding?

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P175 Cholinergic Modulation of DG-CA3 microcircuit dynamics and function

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P176 Subthalamic nucleus low frequency fluctuations carry information about future economic decisions in parkinsonian gamblers

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P177 Data-driven computational modeling of CA1 hippocampal principal cells and interneurons

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P178 The interplay between basal ganglia and cerebellum in motor adaptation

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P179 Microscopic and macroscopic dynamics of neural populations with delays

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P180 Motivation signal in anterior cingulate cortex during economic decisions

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P181 A simple computational model of altered neuromodulation in cortico-basal ganglia dynamics underlying bipolar disorder

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P182 Theta/alpha coordination of pre-motor and parietal networks during free behavior in rats

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P183 Information theoretic approach towards identifying changes in cellular-level functional connectivity and synchrony across animal models of schizophrenia

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P184 Neural Suppression with Deep Brain Stimulation using a Linear Quadratic Regulator

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P185 Reinforcement learning for phasic disruption of pathological oscillations in a computational model of Parkinson's disease

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P186 Metrics for detection of delayed and directed coupling

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P187 Insurgence of network bursting events in formed neuronal culture networks: a computational approach

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P188 Brian2GeNN: Free GPU Acceleration for Brian 2 Users

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P189 Spike counts in the visual cortex consistently encode both stimuli and behavioral choices in a change-detection task.

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P190 Local topology of connectome stabilizes critical points in mean field model

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P191 How chaos in neural oscillators determine network behavior

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P192 STEPS 3: integrating stochastic molecular and electrophysiological neuron models in parallel simulation

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P193 A conductance-based model of cerebellar molecular layer interneurons

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P194 An Ultrasensitive ON/OFF Switch Mechanism Controls the Early Phase of Cerebellar Plasticity

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P195 The use of hardware accelerators in the STochastic Engine for Pathway Simulation (STEPS)

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P196 A model of CaMKII sensitivity to the frequency of Ca2+ oscillations in Cerebellar Long Term Depression

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P197 Exploring the response to climbing fiber input in Purkinje neurons by a new experimental data based model

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P198 Effects of network topology perturbations on memory capacity in a hippocampal place cell model

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P199 A NEST-simulated cerebellar spiking neural network driving motor learning

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P200 Spike-based probabilistic inference with correlated noise

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P201 Optimal refractoriness from a rate-distortion perspective

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P202 Towards online accurate spike sorting for hundreds of channels

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P203 Modeling orientation preference in the apical and basal trees of L2/3 V1 neurons

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P204 Dual recordings in the mouse auditory brainstem and midbrain reveal differences in the processing of vocalizations

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P205 Modelling of leg decoupling in the stick insect and its possible significance for understanding the workings of the locomotor system

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P206 Spatio-temporal dynamics of key signaling molecules in growth cones

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P207 A simulation of EMG signal generation following TMS

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P208 The effect of LTP, LTD and non-specific LTD on the Recognition of Sparse Noisy Patterns in Simplified and Detailed Purkinje Cell Models

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P209 Modeling causality of the smoking brain

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Tuesday Posters
Posters P209 – P314

P209 Modeling causality of the smoking brain

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P210 Modelling of calcium waves in astrocytic networks induced by neural activity

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P211 Simulated voltage clamp: Offline biophysical reconstruction of fast ionic currents in large cells with uncompensated series resistance

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P212 Representing and implementing cognitive sequential interactions

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P213 An integrated neuro-mechanical model of C. elegans locomotion

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P214 A computational approach to understanding functional synaptic diversity: the role of nanoscale topography of Ca2+ channels and synaptic vesicles

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P215 Is object saliency perceived different cross-culturally: A computational modelling study

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P216 NeuroNLP: a natural language portal for aggregated fruit fly brain data

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P217 Towards prediction of plasticity response to paired cTBS from resting state network connectivity

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P218 Mathematical Analysis of Transient "domino effect" like Brain Dynamics

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P219 Synchronized neocortical dynamics during NREM sleep

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P220 Accumulation process and multi-layer mechanisms of perceptual alternation in auditory streaming

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P221 The Necessity of Sleep and Wake: Synaptic Homeostasis via System-Level Plasticity and the Ascending Arousal System

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P222 Low- and high-mode waking states in the corticothalamic system

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P223 Closed-loop temporally structured light stimulation in weakly electric fish

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P224 Information-theoretic analysis of temporal code-driven stimulation applied to electroreception

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P225 Gain control mechanism based on lateral inhibition of antennal lobe improves pattern recognition performance under wide concentration variability

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P226 Maximum Relative Area as a Feature for Adaptability in ERP-based BCI Systems

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P227 Intrinsically stochastic neuron models for use in network simulations

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P228 Modeling action potential and network effects after site-directed RNA editing of sodium channels

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P229 Movement-related delta-theta synchronization in young and elderly healthy subjects

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P230 ePyNN: a low cost embedded system for simulating Spiking Neural Networks

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P231 Temporal structure of bilateral coherence in essential and physiological hand tremor

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P232 Detecting joint pausiness in parallel spike trains

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P233 A stochastic model relates responses to bistable stimuli to underlying neuronal processes

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P234 Function and energy consumption constrain biophysical properties of neurons - an example from the auditory brainstem

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P235 The Brain Simulation Platform of the Human Brain Project: collaborative web applications and tools for data-driven brain models

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P236 A Single Pyramidal-Cell and Network Computational Model of the Hippocampal CA3 Region

Sami Çelikok*, Eva M. Navarro-López, and Neslihan Serap Sengör

P237 Functional connectivity between prefrontal cortex and striatum showed by computational model

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P238 A spiking neural network model of basal ganglia-thalamocortical circuit with Brian2

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P239 Coordinate-transformation spiking neural network for spatial navigation

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P240 Micro-connectomics with cognitive task selectivity

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P241 Does reinforcement leaning explain zone-allocation behavior between two competing mice?

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P242 Optimal synaptic scaling emerges from Hebbian learning rules in balanced networks

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P243 Deciphering the contributions of oriens-lacunosum/moleculare (OLM) cells during local field potential (LFP) theta rhythms in CA1 hippocampus

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P244 Nonlinear optimal control of brain networks

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P245 An inhibitory microcircuit that amplifies the redistribution of somatic and dendritic inhibition

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P246 Learning grid cells in recurrent neural networks

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P247 A model of perceptual learning, biases, and roving

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P248 Presynaptic inhibition provides a rapid stabilization of recurrent excitation in the face of plasticity

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P249 A grid score for individual spikes of grid cells

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P250 Cortical circuits implement optimal integration of context

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P251 Neural cross-frequency coupling functions in the resting state with eyes open and eyes closed

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P252 Dissecting the total astrocytic potassium current in a computational model

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P253 Information rate of multiple synaptic release sites with separately released vesicles during short-term depression

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P254 Properties of recurrent networks at maximum capacity for storing sequences of network states

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P255 Modulation of epileptic activity in thalamo-cortical networks by input from the cerebellar nuclei

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P256 The effect of homeostatic structural plasticity on associative memory in a network with spike-time dependent inhibitory synaptic plasticity

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P257 The dependence of arithmetic operations on input location in cerebellar nucleus and cortical pyramidal neurons

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P258 A Framework for Automated Validation and Comparison of Models of Neurophysiological and Neurocognitive Biomarkers of Psychiatric Disorders

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P259 Synergetic and redundant information flow in dynamical systems: an operative definition based on prediction

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P260 Forming and Using Hierarchical Cognitive Maps: a Neural Network Model

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P261 Harmonic SSEP Spectra are Determined by Modulation of Population Firing Rate – a Modeling Study

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P262 Computational measure to account for erroneous neural deactivation when oxygen supply cannot meet metabolic demand in neuroimaging studies

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P263 Mapping large-scale brain networks using multivariate pattern analysis

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P264 Interplay between propagation delay and frequency of oscillation determines emergent structures of neuronal networks driven by triplet-based STDP

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P265 X078 Plasticity and network implications of a synaptic LPA-signalling pathway

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P266 Postsynaptic Activity-Dependent Synaptic Scaling Enables the Functional Organization of Memories

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P267 Input-dependent Synaptic Consolidation of Memory Representations

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P268 Why working memory is not a reservoir: the role of transient dynamics and attractors when processing unreliably timed inputs

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P269 Application of spike train synchrony measure Spike-contrast to quantify the effect of bicuculline on cortical networks grown on microelectrode arrays

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P270 Cortical states affect the optimal linear readout of network dynamics

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P271 Workflow, data format and tools to register neuron morphologies to a reference brain atlas

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P272 Simple models of closed-loop cortical-environment interactions

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P273 Encoding multiple spaces in grid-cells networks

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P274 Storage capacity of threshold-linear networks for gridlike continuous attractors

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P275 A network model of the turnover dynamics of excitatory and inhibitory synapses in cortex

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P276 Retinal prostheses from stimulation to seeing

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P277 Metabolic cost of neuronal oscillations

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P278 Multi-cluster structure and dynamics in networks of coupled phase oscillators through different classes of STDP profiles

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P279 Multi-scale network structure of macaque visual cortex: connectivity map, cortical architecture, and layer-specific pathways

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P280 The interaction of synaptic and structural plasticity in recurrent networks

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P281 Automatic calibration for hybrid circuits of living and artificial neurons

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P282 Role of asymmetry in shaping spiking-bursting activity of Central Pattern Generators

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P283 Rivalry with irregular spiking: resolving mutual inhibition and the balanced state

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P284 Interplay between inhibition and connectivity structure in driving synchronization and functional properties of neural networks

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P285 A mechanistic model of dopamine modulated learning in the olfactory system of Drosophila

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P286 Saliency-based Gaze Prediction based on the Neural Population for Integrating the Direction of Figure

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P287 Investigating the differences in ion channel properties between ON and OFF ganglion cells: a combination of modelling and optimization approach

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P288 Response reversal during top-down modulation in cortical circuits with multiple interneuron types

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P289 Cellular and Network Modeling of the Striatal Microcircuit in a Mouse Model of Huntington's Disease

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P290 Convolutional Neural Network-based Interictal Epileptiform Discharge Detection

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P291 Effects of Hebbian learning on networks of Kuramoto phase oscillators with time delay

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P292 Biophysical modelling of resting brain states and inhibitory synaptic plasticity

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P293 Temporal pattern recognition and control of animat foraging by evolving small networks of adaptive exponential integrate-and-fire neurons

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P294 Learning Continuous Attractor Neural Networks from Continuously Morphed Patterns

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P295 Learning Peri-saccadic Receptive Field Remapping in Lateral Intraparietal Area from Visual Experience

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P296 Axonal tree morphology dictates information coding

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P297 The Neuroscience Gateway Portal–High Performance Computing for Neuroscientists

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P298 Changes of electrophysiological neuronal properties in lithium-pilocarpine model of epilepsy

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P299 Depolarizing GABA leads to interneuron-based interictal discharges: experimental and mathematical models

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P300 Neural activity in distinct navigation modes of flying pigeons

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P301 The Role of the Receptive Field Structure in Neuronal Compressive Sensing Signal Processing

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P302 FuNS with E/I balance: critical dynamics maximize stability of neural networks

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P303 Neural oscillations modulate the network dynamics around E-I balance in memory consolidation

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P304 Cellular and network properties of interneuron networks dictate variable clustering patterns in both strictly inhibitory and E-I neural networks

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P305 Synaptic failure in functional network activity

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P306 Data-driven multiscale model of mouse M1 microcircuits

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P307 Membrane resonance and oscillation preferences of a multi-compartment model pyramidal neuron

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P308 Network cloning using DNA barcodes

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P309 Triads of synchronized theta cycles boost Cross-Frequency Coupling during novelty exploration

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P310 Simulations of synaptic integration in a detailed Purkinje cell model

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P311 A model for tactile stimuli processing in cuneate nucleus

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P312 A new method of system visualization of cognitive functioning for fMRI

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P313 Synaptic distribution predicts unitary LFP fields in the hippocampus and in the neocortex

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P314 Differential tuning of the low and high-frequency components of the neurophonic spectrum reveals the spike contribution of barn owl's nucleus laminaris neurons

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Appendix

Notes

Contributions Index

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

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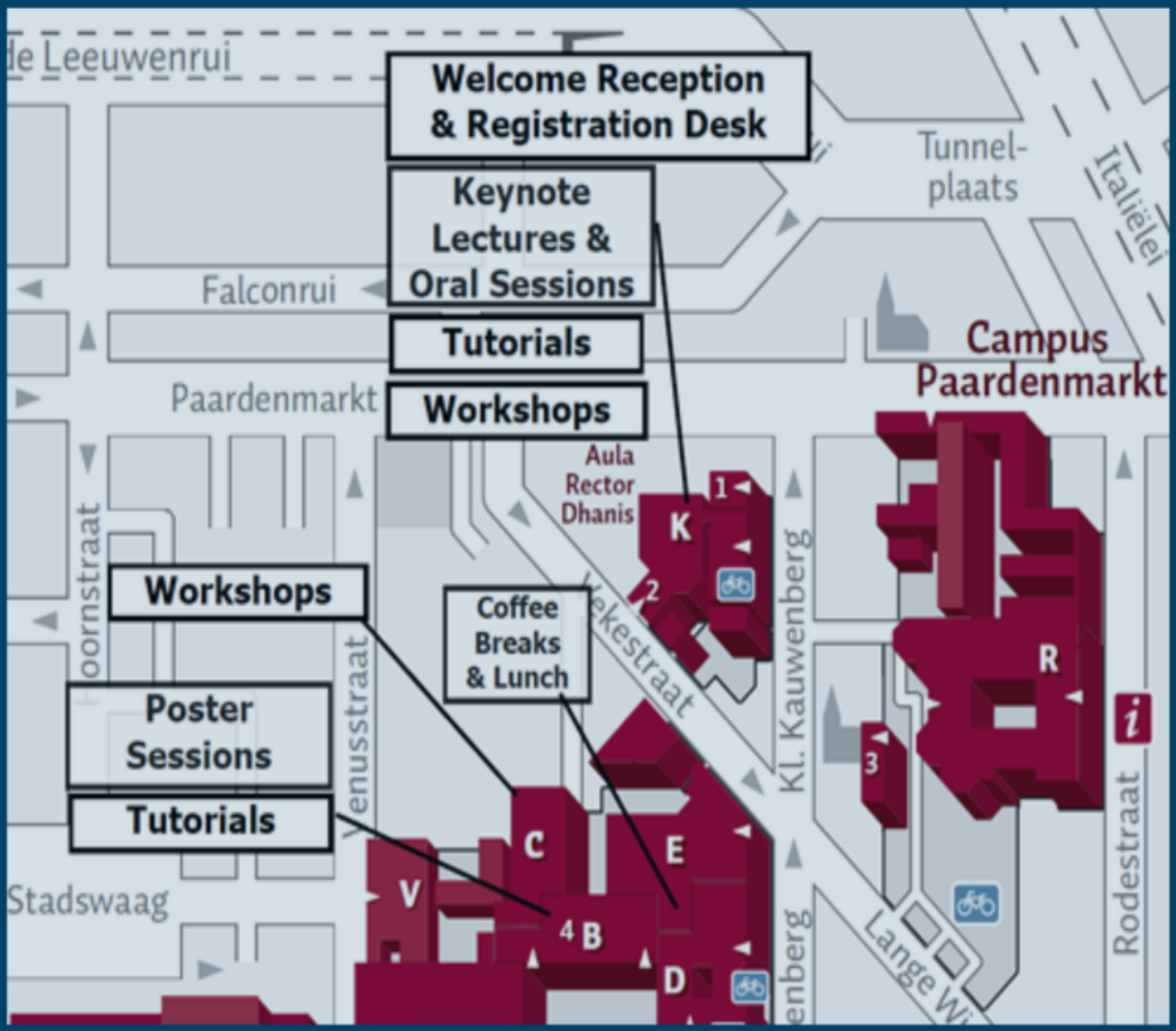

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