

Michael Wolfgang Reimann

<https://reimann.science>

Michael W. Reimann is a senior staff scientist and group leader of the Connectomics section of the Blue Brain Project at the EPFL, Switzerland. For his doctoral research he developed algorithms to derive microcircuit connectivity and study the emergence of microcircuit activity. He is one of the main contributors of digital microcircuit modeling and simulation efforts at Blue Brain. His research is focused on synaptic connectivity at all scales, how it is shaped by plasticity mechanisms and how this in turn determines brain function. He leads a group of eight PhD and postdoctoral researchers employing advanced simulation tools on petascale super-computing systems, and developing novel analyses, based on classical information theory and algebraic topology, to decipher neural structure & coding. They also lead an international collaborative effort in building a detailed model of a human cortical microcircuit.

PERSONAL DETAILS

<i>Birth</i>	December 30, 1981
<i>Nationality</i>	German
<i>Address</i>	EPFL - BBP, Campus Biotech, Ch. des Mines 9, CH-1202 Genève
<i>Phone</i>	
<i>Professional</i>	+41 21 69 31739
<i>Personal</i>	+41 789 27 21 50
<i>Mail</i>	
<i>Professional</i>	michael.reimann@epfl.ch
<i>Personal</i>	michael@reimann.science

EDUCATION

PhD in Neuroscience 2009-2014
École Polytechnique Fédérale de Lausanne
Advisors: Henry Markram and Sean Hill. *Thesis:* The In-Silico Neocortical Microcircuit: From Structure to Dynamics

MSc. in Bioinformatics 2005-2008
University of Tübingen / Max Planck Institute for Biological Cybernetics
Advisor: Heinrich H. Bülthoff, *Thesis:* Using inertial information alone to estimate linear self-displacement with varying durations of constant velocity

BSc. in Bioinformatics 2002-2005
University of Tübingen
Advisor: Uwe Ilg, *Thesis:* Mislocalization of stimuli shortly before the onset of a saccade

EXPERIENCE

Visiting Researcher 2023 Oct-Nov
Université de Montreal & Mila - Quebec AI Institute

Scientific lead: Open Brain Platform 2021-present
École Polytechnique Fédérale de Lausanne
Scientific lead of a project building an open web portal for brain modeling and in silico neuroscience

Group leader & Senior scientist

2018-present

École Polytechnique Fédérale de Lausanne

Leading a group of eight researchers (PhD and postdoc level) in their efforts to model and analyze rodent and human brain activity. Supervision of thesis work and independent research projects. Development and improvement of tools for modelling and analysis of massive datasets of neural activity.

Staff scientist

2014-2018

École Polytechnique Fédérale de Lausanne

Construction and improvement of detailed brain models, development of simulation parameterization and analysis tools, analysis of microconnectivity and circuit activity

Research assistant

2008-2009

University of Leipzig

Working on a project on the coordination and interdependence of eye movements, body movements and muscle activation in top gymnasts. Supervisor: Christoph von Laßberg

SUPERVISION

Former and graduated

2018-2023

Master and internship projects

• **Four** completed

PhD students, as thesis co-supervisor

• **One** graduated

PhD students, as group leader

• **One** graduated

Postdocs

• **Two** former

Currently

PhD students, as thesis co-supervisor

• **One** supervised

PhD students, as group leader

• **One** supervised

Postdocs

• **Six** supervised

TEACHING EXPERIENCE

Computational neuroscience course

2021

Neuromatch Academy (neuromatch.io), Mentor

Massive Open Online Learning: The multi-scale brain

2020

École Polytechnique Fédérale de Lausanne, Lecturer

Class: Introduction to the NEURON simulator

2013

École Polytechnique Fédérale de Lausanne, Lecturer

Class: Human Physiology

2011-2012

École Polytechnique Fédérale de Lausanne, Teaching Assistant

INVITED CONFERENCE PRESENTATIONS

Cosyne - workshops <i>Montréal, Canada</i> Invited speaker: "A data-driven model of a sensory cortex with inter-region interactions"	2023
The Neuroscience Summit <i>Neuroscience School of Advanced Studies, Switzerland</i> Invited speaker: "Research in High-Order Networks: The Future"	2022
Israeli Society for Neuroscience: Annual meeting <i>Virtual forum</i> Keynote lecturer	2021
Allen Frontiers: Multipurpose Models of Cortical Circuits <i>Seattle, USA</i> Invited speaker	2020
Bernstein Conference <i>Berlin, Germany</i> Invited workshop presentation: "Reliability amid noise and chaos & more - a use case for insights from brain circuit modelling"	2019
Allen Frontiers Symposium: Predicting Biology <i>Seattle, USA</i> Invited speaker	
Super Computing Frontiers Europe <i>Warsaw, Poland</i> Invited speaker	
Applied Algebraic Topology <i>Sapporo, Japan</i> Presentation: "Topological analysis of reconstructed neocortical microcircuitry and its electrical activity"	2017
3rd HBP School <i>Obergurgl, Austria</i> Presentation: "Reconstruction and Simulation of Neocortical Microcircuits"	2016
CNS <i>Jeju, South Korea</i> Invited Workshop presentation: "Reconstruction and Simulation of Neocortical Microcircuits"	
BMI Research days <i>Lausanne, Switzerland</i> Presentation: "An algorithm to predict the connectome of neural microcircuits"	
Workshop on Learning and Plasticity <i>Paris, France</i> Presentation: "Anatomical constraints for microcircuit plasticity"	

FUNDING

Fonds Catalyseurs - Fondation Courtois <i>100 000 \$ over two years</i> Notice of Intention submitted.	Applied
Funding to Blue Brain by the Swiss Federation	2018-present

Although not in my name, I profited from the grant in the form of salaries of my team members, discretionary travel funds for me and my team members, and discretionary computing time on the BB5 supercomputing system.

PROFESSIONAL SERVICES

Reviewer

2022

Provided peer reviewing of submissions to the the Cosyne 2023 conference

Reviewer

2016-present

Provided peer reviewing services for the following publishers:

- PLOS journals (Public library of Science)
- Neuroinformatics (Springer)
- Cerebral Cortex (Oxford Academic)
- Nature journals (Nature Research)
- Science Advances (AAAS)
- Frontiers Journals (Frontiers)

Seminars and workshops

2019-present

- Co-organizer of the **BlueBrain Seminar Series** that resulted in 13 leading experts in a variety of fields to present their work at Campus Biotech (or virtually).
- Co-organizer of the (2021) online workshop: **Human Cortex Microcircuit Models**.

PUBLICATIONS - SUMMARY

Citations

• 2764

h-index

• 16

i10-index

• 17

First authored

• 8 peer reviewed & 1 preprint

Senior authored

• 3 peer reviewed & 4 preprint

Co-authored

• 8 peer reviewed & 2 preprint

PUBLICATIONS - PEER REVIEWED

- Iavarone, E., Simko, J., Shi, Y., **Reimann, M. W.**, et al. Thalamic control of sensory processing and spindles in a biophysical somatosensory thalamoreticular circuit model of wakefulness and sleep. **Cell Reports** (2023) doi: 10.1016/j.celrep.2023.112200
- Guyonnet-Hencke, T. & **Reimann, M. W.** A parcellation scheme of mouse isocortex based on reversals in connectivity gradients. **Network Neuroscience** (2023) doi: 10.1162/netn.a_00312
- Roussel, Y., Verasztó, C., Rodarie, D., Damart, T., **Reimann, M. W.**, Ramaswamy, S., Markram, H., Keller, D. Mapping of morpho-electric features to molecular identity of cortical inhibitory neurons. **PLOS Comp. Biol.** (2022) doi: 10.1371/journal.pcbi.1010058
- Rodarie, D., Verasztó, C., Roussel, Y., **Reimann, M. W.**, Keller, D., Ramaswamy, S., Markram, H., Gewaltig, M-O. A method to estimate the cellular composition of the mouse brain from heterogeneous datasets. **PLOS Comp. Biol.** (2022) doi: 10.1371/journal.pcbi.1010739
- **Reimann, M. W.**, Riihimaki, H., Smith, J. P., Lazovskis, J., Pokorny, C., Levi, R. Topology of synaptic connectivity constrains neuronal stimulus representation, predicting two complementary coding strategies. **PLOS One** (2022) doi: 10.1371/journal.pone.0261702.

- Newton, T.H., Abdellah, M., Muller, E., **Reimann, M. W.**, Schürmann, F., and Markram, H. In silico voltage-sensitive dye imaging reveals the emergent dynamics of cortical populations. **Nat. Comm.** (2021) doi: 10.1038/s41467-021-23901-7.
- Ecker, A., Romani, A., Saray, S., Kali, S., Migliore, M., Falck, J., Lange, S., Mercer, A., Thomson, A. M., Muller, E., **Reimann, M. W.**, Ramaswamy, S., Data-driven integration of hippocampal CA1 synaptic physiology in silico. **Hippocampus** (2020) doi:10.1002/hipo.23220
- Nolte, M., **Reimann, M. W.**, Impact of higher-order network structure on emergent cortical activity. **Network Neurosc.** (2020) doi:10.1162/netn.a_00124
- **Reimann, M. W.** et al. A null model of the mouse whole-neocortex micro-connectome. **Nat. Comm.** 10 (2019). doi:10.1038/s41467-019-11630-x
- Nolte, M., **Reimann, M. W.**, King, J. G., Markram, H. & Muller, E. B. Cortical Reliability Amid Noise and Chaos. **Nat. Comm.** 10, (2019). doi:10.1038/s41467-019-11633-8
- Ramaswamy, S., Muller, E., **Reimann, M. W.**, Markram, H. Microcircuitry of the neocortex. Handbook of Brain Microcircuitry (2nd edition). Oxford University Press (2018). ISBN: 9780190636111
- **Reimann, M. W.** et al. Cliques of Neurons Bound into Cavities Provide a Missing Link between Structure and Function. **Front. Comput. Neurosci.** 11, (2017).
- **Reimann, M. W.**, Horlemann, A.-L., Ramaswamy, S., Muller, E. B. & Markram, H. Morphological Diversity Strongly Constrains Synaptic Connectivity and Plasticity. **Cereb. Cortex** (2017).
- Gal, E., **Reimann, M. W.** et al. Rich cell-type-specific network topology in neocortical microcircuitry. **Nat. Neurosci.** (2017). doi:10.1038/nn.4576
- Ramaswamy, S., **Reimann, M. W.** et al. The neocortical microcircuit collaboration portal: a resource for rat somatosensory cortex. **Front. Neural Circuits** 9, (2015).
- Markram, H. [...], **Reimann, M. W.** et al. Reconstruction and Simulation of Neocortical Microcircuitry. **Cell** 163, 456492 (2015).
- **Reimann, M. W.**, King, J. G., Muller, E. B., Ramaswamy, S. & Markram, H. An algorithm to predict the connectome of neural microcircuits. **Front. Comput. Neurosci.** 9, (2015).
- **Reimann, M. W.** et al. A biophysically detailed model of neocortical Local Field Potentials predicts the critical role of active membrane currents. **Neuron** 79, (2013).

PUBLICATIONS - PREPRINT

- Bolaños-Puchet, S., Teska, A., **Reimann, M. W.** Enhancement of brain atlases with region-specific coordinate systems: flatmaps and barrel column annotations. BiorXiv (2023) doi: 10.1101/2023.08.24.554204
- Ecker, A., Egas Santander, D., Abdellah, M., Blanco Alonso, J., Bolaños-Puchet, S., Chindemi, G., Isbister, J. B., King, J. G., Kumbhar, P., Magkanaris, I., Muller, E. B., **Reimann, M. W.** Long-term plasticity induces sparse and specific

synaptic changes in a biophysically detailed cortical model. BiorXiv (2023) doi: 10.1101/2023.08.07.552264

- Isbister, J. B., Ecker, A., Pokorny, C., Bolaños-Puchet, S., Egas Santander, D., [...] & **Reimann, M. W.** Modeling and Simulation of Neocortical Micro- and Mesocircuitry. Part II: Physiology and Experimentation. BiorXiv (2023) doi: 10.1101/2023.05.17.541168
- Ecker, A., Egas Santander, D., Bolaños-Puchet, S., Isbister, J. B., **Reimann, M. W.** Cortical cell assemblies and their underlying connectivity: an in silico study. BiorXiv (2022) doi: 10.1101/2023.02.24.529863
- **Reimann, M. W.**, Bolaños-Puchet, S., Courcol, J.-D., Egas Santander, D., et al. Modeling and Simulation of Neocortical Micro- and Mesocircuitry. Part I: Anatomy. BiorXiv (2022) doi: 10.1101/2022.08.11.503144
- Amsalem, O., King, J., **Reimann, M. W.** et al. Dense Computer Replica of Cortical Microcircuits Unravels Cellular Underpinnings of Auditory Surprise Response. BiorXiv (2020) doi: 10.1101/2020.05.31.126466. Under review
- Rössert, C., **Reimann, M. W.** et al. Automated point-neuron simplification of data-driven microcircuit models. ArXiv Prepr. ArXiv160400087

PATENTS

- **US Patent 9,165,244:** Structural to functional synaptic conversion.
- **US Patent 11,615,285:** Generating and identifying functional subnetworks within structural networks.

SKILLS

<i>Languages</i>	German (mother tongue), English (fluent) Japanese (advanced), French (basic)
<i>Programming Software</i>	Python, java, c++, hoc MATLAB, L ^A T _E X, Illustrator, Photoshop, Word & Excel numpy, scipy, pandas, sklearn, keras, matplotlib, seaborn & dash
<i>Analytical</i>	Independent research, statistical & topological data analysis, dimensionality reduction techniques.
<i>Inter- personal Neuroscience</i>	Team leadership, scientific communication, public speaking. Single cell and network modeling, micro- & macro-connectomics, multiple spike trains analysis, synaptic transmission & plasticity
<i>Mathematics</i>	Information theory, coding theory, algebraic topology, algebra, calculus
<i>Machine learning</i>	Deep and classic machine learning techniques, convolutional and sequence models.
<i>Other skills</i>	High performance computing, photography

REFERENCES

Dr. Eilif B. Muller - Principal Investigator

*Architectures of Biological Learning Lab, CHU Sainte-Justine Research Centre, Montreal;
Quebec Artificial Intelligence Institute*

Former supervisor and frequent collaborator. Contact: eilif.muller@umontreal.ca

Prof. Henry Markram

Laboratory of neural microcircuits & Blue Brain Project, EPFL, Switzerland

Current supervisor. Contact: henry.markram@epfl.ch

Prof. Ran Levi

Chair in Mathematical Sciences at the University of Aberdeen

Frequent collaborator. Contact: r.levi@abdn.ac.uk

Prof. Kathryn Hess

Laboratory for topology and neuroscience, EPFL, Switzerland

Frequent collaborator. Contact: kathryn.hess@epfl.ch