

# Michael Beyeler

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## EDUCATION

- **PhD in Computer Science** · Computational Neuroscience 2012 – 2016  
*University of California, Irvine*  
Dissertation: "Cortical neural network models of visual motion perception for decision-making and reactive navigation", May 2016.  
Advisors: JL Krichmar (Cognitive Sciences), N Dutt (Computer Science)  
Committee members: C Fowlkes (CS), D Ramanan (CS), TM D'Zmura (CogSci)
- **MS in Biomedical Engineering** · Bioelectronics 2009 – 2011  
*ETH Zurich, Switzerland*
- **BS in Electrical Engineering** · Micro- and Optoelectronics 2005 – 2009  
*ETH Zurich, Switzerland*

## ACADEMIC APPOINTMENTS

- **Postdoctoral Fellow** · Department of Psychology 2016 – present  
*University of Washington (I Fine, GM Boynton, A Rokem)*
- **Research Assistant** · Brain-Inspired Computing Group 2015  
*IBM Research – Almaden (D Modha)*
- **Research Assistant** · Department of Robots & Assistive Systems 2013  
*Fraunhofer Institute IPA (F Mirus, A Verl)*
- **Graduate Student Researcher** · Department of Computer Science 2012 – 2016  
*University of California, Irvine (JL Krichmar, N Dutt)*
- **Junior Specialist** · Department of Cognitive Sciences 2011 – 2012  
*University of California, Irvine (JL Krichmar, N Dutt)*
- **Research Assistant** · Institute for Biomedical Engineering 2010  
*ETH Zurich, Switzerland (J Vörös)*

## SELECTED HONORS & AWARDS

- NIH K99 Pathway to Independence Award, *National Eye Institute (NEI)* 2018 – present
- Platform Presenter: *Eye & Chip World Congress on Artificial Vision* 2017
- Presenter's Travel Award: *Computational & Systems Neuroscience (COSYNE)* 2017
- Innovation in Neuroengineering & Data Science Postdoctoral Fellowship: *Gordon & Betty Moore Foundation, Alfred P. Sloan Foundation, Washington Research Foundation (WRF)* 2016 – 2018
- GPU Seed Grant: *NVIDIA Corporation* 2016
- Best Student Talk Award: *Neurorobotics workshop, IEEE ICRA* 2014
- Chair's Fellowship for Outstanding PhD Applicants: *University of California, Irvine* 2012 – 2016

## MENTEE AWARDS

### Graduate Students

- Ezgi I. Yücel: Innovation in Neuroengineering Graduate Fellowship, *WRF* 2017 – present

**GRANTS & FUNDING***Total: \$254,882*

- NIH K99 EY-029329 Pathway to Independence Award (\$244,882) 2018 – present
- Amazon Web Services (AWS) Cloud Credits for Research (\$10,000) 2017 – 2018

**ACADEMIC MENTORING****Graduate Students**

- Ezgi I. Yücel, PhD Student, Psychology, *University of Washington* 2017 – present

**Undergraduate Students**

- Ji Min Park, Research Assistant, Psychology, *University of Washington* 2017 – 2018  
thereafter: MD Student, *Pennsylvania State University Medical School*
- Saideep Gupta, Research Assistant, Cognitive Sciences, *University of California, Irvine* 2015 – 2016  
thereafter: Head of Web Development, *Wing AI*
- Stanislav Listopad, Research Assistant, Cognitive Sciences, *University of California, Irvine* 2014 – 2016  
thereafter: PhD Student, *University of California, Irvine*

**ACADEMIC ACTIVITIES****Editing**

- Review Editor: *Frontiers in Neurorobotics* 2017 – present

**Committees**

- Postdoctoral Representative: Research Advisory Board, *University of Washington* 2017 – present
- Neuronline Community Leader: *Society for Neuroscience* 2016 – 2017

**Workshops**

- Co-organizer: Recent Computational Advances in Neuroengineering, *COSYNE* 2018

**Ad-Hoc Reviewing · Conferences***publons.com/author/1188259/michael-beyeler*

Computational & Systems Neuroscience (COSYNE) · Design, Automation and Test in Europe (DATE) · IEEE International Conference on Intelligent Robots and Systems (IROS) · IEEE International Symposium on Circuits and Systems (ISCAS) · Scientific Computing with Python (SciPy)

**Ad-Hoc Reviewing · Journals**

ACM Journal on Emerging Technologies in Computing Systems (JETC) · Frontiers in Neurorobotics · Frontiers in Neuroscience · IEEE Transactions on Cybernetics · IEEE Transactions on Neural Networks and Learning Systems (TNNLS) · Journal of Computational Neuroscience · Journal of Neural Engineering · Journal of Vision · Neural Networks · Neurocomputing · PLoS Computational Biology · PLoS ONE · Sensors · Vision Research

**PUBLICATIONS***scholar.google.com/citations?user=1CDDZSIAAAAJ***Refereed Conference Publications**

- C6 **M Beyeler** (*accepted*, 2019). Biophysical model of axonal stimulation in epiretinal visual prostheses. *IEEE EMBS Conference on Neural Engineering (NER)*, San Francisco, CA.
- C5 T-S Chou\*, HJ Kashyap\*, J Xing, S Listopad, EL Rounds, **M Beyeler**, N Dutt, JL Krichmar (2018). CARLsim 4: An open source library for large scale, biologically detailed spiking neural network simulations using heterogeneous clusters. *IEEE International Joint Conference on Neural Networks (IJCNN)*, Rio de Janeiro, Brazil. (\*equal contribution). Code: [github.com/UCI-CARL/CARLsim4](https://github.com/UCI-CARL/CARLsim4). **Best Student Paper Nominee.**

- C4 **M Beyeler**, GM Boynton, I Fine, A Rokem (2017). pulse2percept: A Python-based simulation framework for bionic vision. *Scientific Computing with Python Conference (SciPy)*, p.81–88.  
Code: [github.com/uwescience/pulse2percept](https://github.com/uwescience/pulse2percept).
- C3 **M Beyeler\***, KD Carlson\*, T-S Chou\*, N Dutt, JL Krichmar (2015). CARLsim 3: A user-friendly and highly optimized library for the creation of neurobiologically detailed spiking neural networks. *IEEE International Joint Conference on Neural Networks (IJCNN)*, Killarney, Ireland. Code: [github.com/UCI-CARL/CARLsim3](https://github.com/UCI-CARL/CARLsim3). (\*equal contribution)
- C2 **M Beyeler**, F Mirus, A Verl (2014). Vision-based robust road lane detection in urban environments. *IEEE International Conference on Robotics and Automation (ICRA)*, Hong Kong, China.
- C1 **M Beyeler\***, F Stefanini\*, H Proske, CG Galizia, E Chicca (2010). Exploring olfactory sensory networks: simulations and hardware emulation. *IEEE Biomedical Circuits and Systems conference (BioCAS)*, Paphos, Cyprus. (\*equal contribution) **Best Student Paper Nominee**.

### **Refereed Journal Articles**

- J4 **M Beyeler**, N Dutt, JL Krichmar (2016). 3D visual response properties of MSTd emerge from an efficient, sparse population code. *Journal of Neuroscience* 36(32): 8399–8415.
- J3 **M Beyeler**, N Oros, N Dutt, JL Krichmar (2015). A GPU-accelerated cortical neural network model for visually guided robot navigation. *Neural Networks* 72: 75–87.
- J2 **M Beyeler**, M Richert, ND Dutt, JL Krichmar (2014). Efficient spiking neural network model of pattern motion selectivity in visual cortex. *Neuroinformatics*, 1–20.
- J1 **M Beyeler**, ND Dutt, JL Krichmar (2013). Categorization and decision-making in a neurobiologically plausible spiking network using a STDP-like learning rule. *Neural Networks* 48C: 109–124.

### **Refereed Reviews and Perspectives**

- R2 **M Beyeler\***, EL Rounds\*, KD Carlson, N Dutt, JL Krichmar (in press). Neural correlates of sparse coding and dimensionality reduction. *PLOS Computational Biology*. (\*equal contribution)
- R1 **M Beyeler**, A Rokem, GM Boynton, I Fine (2017). Learning to see again: Biological constraints on cortical plasticity and the implications for sight restoration technologies. *Journal of Neural Engineering* 14(5). **Featured cover article**.

### **Invited Publications**

- I1 KD Carlson, **M Beyeler**, N Dutt, JL Krichmar (2014). GPGPU accelerated simulation and parameter tuning for neuromorphic applications. *Asia and South Pacific Design Automation Conference (ASP-DAC)*, Suntec, Singapore.

### **Manuscripts Under Review and Preprints**

- M4 **M Beyeler**, A Rokem, GM Boynton, I Fine (in preparation). Model-based analysis of optimal electrode placement for epiretinal visual prostheses.
- M3 **M Beyeler** (under review, *Front Neurosci*). On the potential role of retinal sheet transplants for sight restoration. *OSF Preprints*, doi:10.31219/osf.io/temqd.
- M2 BW Brunton, **M Beyeler** (under review, *Curr Op Neurobiol*). Data-driven models in human neuroscience and neuroengineering.
- M1 **M Beyeler**, D Nanduri, JD Weiland, A Rokem, GM Boynton, I Fine (under review, *Sci Rep*). A model of ganglion axon pathways accounts for percepts elicited by retinal implants. *bioRxiv* 453035, doi: 10.1101/453035. Data: [osf.io/dw9nz](https://osf.io/dw9nz). Code: [github.com/VisCog/ArgusShapes](https://github.com/VisCog/ArgusShapes).

### **US Patent Applications**

- P2 R Appuswamy, **M Beyeler**, P Datta, MD Flickner, DS Modha (2018). Long short-term memory (LSTM) on spiking neuromorphic hardware. US Patent App 15/434,672.
- P1 **M Beyeler**, ND Dutt, JL Krichmar (2017). Sparse and efficient neuromorphic population coding. US Patent App 15/417,626.

## Books

- B3 **M Beyeler** (2017). Machine Learning for OpenCV. *Packt Publishing Ltd.*, Birmingham, UK, 382 pages, ISBN 978-178398028-4. **Also available in Korean, Japanese, and as a video course.**  
Code: [github.com/mbeyeler/opencv-machine-learning](https://github.com/mbeyeler/opencv-machine-learning).
- B2 J Howse, P Joshi, **M Beyeler** (2016). OpenCV: Computer Vision Projects with Python. *Packt Publishing Ltd.*, Birmingham, UK, 558 pages, ISBN 978-178712549-0.
- B1 **M Beyeler** (2015). OpenCV with Python Blueprints. *Packt Publishing Ltd.*, Birmingham, UK, 230 pages, ISBN 978-178528269-0. Code: [github.com/mbeyeler/opencv-python-blueprints](https://github.com/mbeyeler/opencv-python-blueprints).

## Contributed Presentations and Abstracts

- A28 **M Beyeler**, D Nanduri, JD Weiland, A Rokem, GM Boynton, I Fine (2018). Optimizing stimulation protocols for prosthetic vision based on retinal anatomy. *Annual Meeting of the Organization of Computational Neuroscience (CNS)*, Seattle, WA. (poster)
- A27 **M Beyeler**, EL Rounds, KD Carlson, N Dutt, JL Krichmar (2018). Sparse coding and dimensionality reduction in the brain. *Annual Meeting of the Organization of Computational Neuroscience (CNS)*, Seattle, WA. (poster)
- A26 T-S Chou, HJ Kashyap, J Xing, S Listopad, EL Rounds, **M Beyeler**, N Dutt, JL Krichmar (2018). CARLsim 4: An open source library for large scale, biologically detailed spiking neural network simulation using heterogeneous clusters. *Annual Meeting of the Organization of Computational Neuroscience (CNS)*, Seattle, WA. (oral)
- A25 **M Beyeler**, D Nanduri, JD Weiland, A Rokem, GM Boynton, I Fine (2018). Optimizing stimulation protocols for prosthetic vision based on retinal anatomy. *Annual Meeting of the Vision Sciences Society (VSS)*, St. Pete's Beach, FL. (poster)
- A24 **M Beyeler**, EI Yucel, A Rokem, GM Boynton, I Fine (2018). Optimizing stimulation protocols for prosthetic vision based on retinal anatomy. *Computational and Systems Neuroscience (COSYNE) workshops*, Breckenridge, CO. (oral)
- A23 **M Beyeler**, A Rokem, GM Boynton, I Fine (2018). Modeling the perceptual experience of retinal prosthesis patients. *UWIN Neural Computation and Engineering Connection (NCEC)*, Seattle, WA. (oral)
- A22 EL Rounds, **M Beyeler**, KD Carlson, N Dutt, JL Krichmar (2017). Sparse coding and dimensionality reduction in cortex. *47th Annual Meeting of the Society for Neuroscience (SfN)*, Washington, DC. (poster)
- A21 HJ Kashyap, T-S Chou, EL Rounds, S Listopad, **M Beyeler**, N Dutt, JL Krichmar (2017). CARLsim4: A C++ library for the design, simulation, and parameter tuning of biologically detailed spiking neural networks on high performance clusters. *47th Annual Meeting of the Society for Neuroscience (SfN)*, Washington, DC. (poster)
- A20 **M Beyeler**, A Rokem, GM Boynton, I Fine (2017). Reverse-engineering optimized stimulation protocols in epiretinal prosthesis patients. *The Eye & the Chip*, Detroit, MI. (oral, **Platform Presentation**)
- A19 GM Boynton, A Rokem, **M Beyeler**, J Dorn, NC Sinclair, MN Shivdasani, MA Petoe, R Hornig, I Fine (2017). Efficient and scalable measurements of sensitivity for high resolution electrode arrays. *The Eye & the Chip*, Detroit, MI. (poster, **Best Poster Award**)
- A18 **M Beyeler**, N Dutt, JL Krichmar (2017). A sparse coding model of MST can account for human heading perception in the presence of eye movements. *European Conference on Visual Perception (ECVP)*, Berlin, Germany. (poster)
- A17 **M Beyeler**, GM Boynton, I Fine, A Rokem (2017). pulse2percept: A Python-based simulation framework for bionic vision. *Python in Science Conference (SciPy)*, Austin, TX. (oral, [youtube.com/watch?v=KxsNAa-P2X4](https://youtube.com/watch?v=KxsNAa-P2X4))
- A16 **M Beyeler**, A Rokem, GM Boynton, I Fine (2017). Modeling the perceptual experience of retinal prosthesis patients. *Annual Meeting of the Vision Sciences Society (VSS)*, St. Pete's Beach, FL. (oral)
- A15 **M Beyeler**, A Rokem, GM Boynton, I Fine (2017). Modeling the perceptual experience of retinal prosthesis patients. *Computational and Systems Neuroscience (COSYNE)*, Salt Lake City, UT. (poster)

- A14 **M Beyeler**, M Richert, N Oros, N Dutt, JL Krichmar (2016). GPU-accelerated real-time simulation of information processing in early visual cortex. *UWIN Neural Computation and Engineering Connection (NCEC)*, University of Washington, Seattle, WA. (poster)
- A13 **M Beyeler**, N Dutt, JL Krichmar (2016). Efficient coding of optic flow can account for MSTd visual response properties. *46th Annual Meeting of the Society for Neuroscience (SfN)*, San Diego, CA. (poster)
- A12 **M Beyeler**, M Richert, N Oros, N Dutt, JL Krichmar (2016). GPU-accelerated real-time simulation of information processing in early visual cortex. *The Eye & the Chip*, Dearborn, MI. (poster)
- A11 **M Beyeler**, M Richert, N Oros, N Dutt, JL Krichmar (2016). A cortical neural network model of visual motion perception for decision-making and navigation. *23rd Joint Symposium on Neural Computation (JSNC)*, University of California, Los Angeles (UCLA), Los Angeles, CA. (poster)
- A10 **M Beyeler**, M Richert, N Oros, N Dutt, JL Krichmar (2016). A cortical neural network model of visual motion perception for decision-making and navigation. *Computational and Systems Neuroscience (COSYNE)*, Salt Lake City, UT. (poster)
- A9 **M Beyeler**, KD Carlson, T-S Chou, N Dutt, JL Krichmar (2015). An optimized library for the design, simulation, and parameter tuning of biologically detailed spiking neural networks. *45th Annual Meeting of the Society for Neuroscience (SfN)*, Chicago, IL. (poster)
- A8 **M Beyeler**, KD Carlson, T-S Chou, N Dutt, JL Krichmar (2015). CARLsim 3: A user-friendly and highly optimized library for the creation of neurobiologically detailed spiking neural networks. *IEEE International Joint Conference on Neural Networks (IJCNN)*, Killarney, Ireland. (oral)
- A7 **M Beyeler**, KD Carlson, T-S Chou, N Dutt, JL Krichmar (2015). CARLsim 3: A user-friendly and highly optimized library for the creation of neurobiologically detailed spiking neural networks. *22nd Joint Symposium on Neural Computation (JSNC)*, University of Southern California (USC), Los Angeles, CA. (poster)
- A6 **M Beyeler**, M Richert, N Oros, N Dutt, JL Krichmar (2014). A cortical spiking neural network model for visually guided robot navigation. Neurobiologically Inspired Robotics workshop, *IEEE International Conference on Robotics and Automation (ICRA)*, Hong Kong, China. (oral, **Best Student Talk Award**).
- A5 **M Beyeler**, F Mirus, A Verl (2014). Vision-based robust road lane detection in urban environments. *IEEE International Conference on Robotics and Automation (ICRA)*, Hong Kong, China. (oral)
- A4 **M Beyeler**, M Richert, JM Nageswaran, ND Dutt, JL Krichmar (2014). Large-scale spiking neural network model of visual motion processing. *21st Joint Symposium on Neural Computation (JSNC)*, University of California, Irvine (UCI), Irvine, CA. (poster)
- A3 **M Beyeler**, M Richert, JM Nageswaran, ND Dutt, JL Krichmar (2014). Large-scale spiking neural network model of visual motion processing. *Dynamics of Multifunction Brain Networks MURI Winter School*, University of California, San Diego (UCSD), San Diego, CA. (oral)
- A2 **M Beyeler**, M Richert, JM Nageswaran, ND Dutt, JL Krichmar (2013). Large-scale spiking neural network model of visual motion processing. *44th Annual Meeting of the Society for Neuroscience (SfN)*, San Diego, CA. (poster)
- A1 **M Beyeler**, ND Dutt, JL Krichmar (2013). Spiking neural network model of visual pattern recognition and decision-making using a stochastic STDP learning rule. *20th Joint Symposium on Neural Computation (JSNC)*, California Institute of Technology (Caltech), Pasadena, CA. (poster)

## INVITED TALKS

- T11 Biologically inspired algorithms for restoring vision to the blind. *Department of Cognitive Sciences, University of California*, Irvine, CA, Apr 2019.
- T10 Biologically inspired algorithms for restoring vision to the blind. *Department of Computer Science, Duke University*, Durham, NC, Mar 2019.
- T9 Biologically inspired algorithms for restoring vision to the blind. *Department of Computer Science, University of California*, Santa Barbara, CA, Jan 2019.
- T8 Modeling the perceptual experience of retinal prosthesis patients. *Center for Applied and Translational Sensory Science (CATSS), University of Minnesota*, Minneapolis, MN, Feb 2018.

- T7 A GPU-accelerated cortical neural network model for visually guided robot navigation. *Cluster of Excellence in Cognitive Interaction Technology (CITEC), Bielefeld University, Germany, Aug 2017.*
- T6 3D visual response properties of MSTd emerge from an efficient, sparse population code. *Center for Perceptual Systems, University of Texas, Austin, TX, Jul 2017.*
- T5 Restoring vision to the blind: The challenge of sight recovery technologies. *UW Medicine Eye Institute, University of Washington, Seattle, WA, Feb 2017.*
- T4 Pulse trains to percepts: The challenge of sight recovery technologies. *Second Sight Medical Products Inc., Sylmar, CA, November 2016.*
- T3 A cortical neural network model for perceptual decision-making and visually guided robot navigation. *Department of Psychology, University of Washington, Seattle, WA, Dec 2015.*
- T2 TrueNorth implementation of long short-term memory. *IBM Research, San Jose, CA, Aug 2015.*
- T1 A cortical spiking neural network model for visually guided robot navigation. *Qualcomm Technologies Incorporated, San Diego, CA, Nov 2014.*

## TEACHING ACTIVITIES

### Selected Guest Lectures

2015 – present

- BIOEN-460: Neural Engineering, *undergraduate* (UW)
- PSYCH-508: Core Concepts in Perception, *graduate* (UW)
- PSYCH-552: Seminar in Behavioral Neuroscience, *graduate* (UW)
- NRSC-490 Advanced Topics in Neuroscience, *undergraduate* (U Pouget Sound)
- CS-171 Introduction to Artificial Intelligence, *undergraduate* (UC Irvine)
- PSYCH-268R Cognitive Robotics, *undergraduate* (UC Irvine)
- PSYCH-268A Computational Neuroscience, *undergraduate* (UC Irvine)

### Certified Software Carpentry Instructor

2017 – present

*eScience Institute, University of Washington*

*Seattle, WA*

- Teaching Python, shell, Git, and software engineering skills to scientists and engineers (all levels) at boot-camps and in online sessions. Developing new instructional content.

### Teaching Assistant

2015 – 2016

*Department of Computer Science, UC Irvine*

*Irvine, CA*

- CS-143A: Principles of Operating Systems, *undergraduate*
- CS-171: Introduction to Artificial Intelligence, *undergraduate*

## COMMUNITY INVOLVEMENT & PUBLIC OUTREACH

- Volunteer: *Lighthouse Foundation for the Blind, Inc.* 2018 – present
- Volunteer: *IEEE Robotics and Automation Society* 2014 – 2016
- Volunteer: *Mathobotix "Bytes and Bots" K-12 Summer Camp* 2013 – 2014

## PROFESSIONAL ASSOCIATIONS

- IEEE Engineering in Medicine and Biology Society (EMBS) 2018 – present
- Organization for Computational Neurosciences (OCNS) 2018 – present
- Vision Sciences Society (VSS) 2017 – present
- Society for Neuroscience (SfN) 2013 – present

## REJECTIONS & FAILURES

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### Academic & Professional

- Tenure-track positions (R1): 31 applications, 23 no answers, 6 explicit rejections 2018 – 2019
- EPFL Neuroscience Graduate program: rejected 2013

### Grants & Awards

- Burroughs Wellcome Award at the Scientific Interface (CASI): semifinalist 2018
- IJCNN Travel Award: not awarded 2015
- NVIDIA Graduate Fellowship: not awarded 2013, 2014, 2015
- Microsoft Research Fellowship: not awarded 2013

### Workshops

- VSS workshop proposal: rejected 2019

### Scientific Peer Review

- M4, *OSF Preprints*: rejected from 1 journal 2019
- M2, *Sci Rep*: rejected from 5 journals 2018
- M1, *PLOS Comp Bio*: rejected from 3 journals 2017
- COSYNE abstract: rejected 2015, 2018