

MICHAEL BEYELER

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EDUCATION

Ph.D. in Computer Science <i>University of California, Irvine</i>	Sep 2012 – Jun 2016 GPA: 3.96 / 4.0
M.Sc. in Biomedical Engineering <i>ETH Zurich, Switzerland</i>	Sep 2009 – Nov 2011 GPA: 5.36 / 6.0
B.Sc. in Electrical Engineering <i>ETH Zurich, Switzerland</i>	Oct 2005 – Feb 2009 GPA: 4.51 / 6.0

PROFESSIONAL APPOINTMENTS

Postdoctoral Fellow in Neuroengineering and Data Science <i>Vision+Cognition Group (Profs. I. Fine, G. Boynton)</i> <i>eScience Institute (Dr. A. Rokem)</i>	Aug 2016 – present <i>University of Washington</i> <i>Seattle, WA</i>
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- Developing neurophysiologically inspired models of prosthetic vision, with the goal of improving the perceptual experience of blind individuals implanted with a retinal prosthesis ('bionic eye').
- Experimentally validating these algorithms in Argus II retinal prosthesis patients (in collaboration with Second Sight Medical Products, Inc.).

SSNR Junior Specialist <i>Cognitive Robotics Lab (Profs. J. Krichmar, N. Dutt), UC Irvine</i>	Jun 2016 – Jul 2016 <i>Irvine, CA</i>
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- Devised an efficient neuromorphic system for high-dimensional data compression and factor analysis, inspired by visual motion processing in the mammalian brain (patent pending).

Research Assistant <i>Brain-Inspired Computing Group (Dr. D. Modha), IBM Research – Almaden</i>	Jun 2015 – Aug 2015 <i>San Jose, CA</i>
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- Ported recurrent neural network models to IBM's TrueNorth Neurosynaptic chip (patent pending).

Research Assistant <i>Fraunhofer Institute IPA (Dr. F. Mirus, Prof. A. Verl)</i>	Jun 2013 – Sep 2013 <i>Stuttgart, Germany</i>
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- Developed fast and robust computer vision algorithms for autonomous driving.

Junior Specialist <i>Cognitive Robotics Lab (Profs. J. Krichmar, N. Dutt), UC Irvine</i>	Nov 2011 – Jul 2012 <i>Irvine, CA</i>
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- Co-developed and maintained CARLsim, an open-source software platform for the efficient simulation of large-scale spiking neural networks on x86 and CUDA architectures.
- Interacted with Hughes Research Laboratories (HRL), as part of DARPA SyNAPSE, to design spiking neural network based controllers of autonomous robots amenable for VLSI neuromorphic chips.

Research Assistant <i>Lab for Biosensors and Bioelectronics (Prof. J. Vörös), ETH Zurich</i>	Oct 2010 – Dec 2010 <i>Zurich, Switzerland</i>
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- Produced prototypes and aided in the design of a flexible multi-electrode array for *in vivo* rat's spinal cord stimulation.

FUNDING

- NIH K99/R00 Pathway to Independence Award (\$993,718) 2018 – 2023
- Moore/Sloan/WRF Innovation Postdoctoral Fellowship (\$155,008) 2016 – 2018
- UC Irvine Chair's Fellowship for Outstanding Ph.D. Applicants (\$135,436) 2012 – 2016

SELECTED HONORS AND AWARDS

- Runner-up, Burroughs Wellcome Fund Career Award at the Scientific Interface (CASI) 2018
- Cloud Credits for Research Award, Amazon Web Services (AWS) 2017
- Platform Presenter, Eye & Chip World Congress on Artificial Vision 2017
- Travel Award, COSYNE 2017
- Hardware Award, NVIDIA Corporation 2016
- Best Student Talk Award, Neurorobotics workshop, IEEE ICRA 2014

PROFESSIONAL SERVICE

Editing

- Review Editor, Frontiers in Neurorobotics 2017 – present

Committees

- Postdoctoral Representative, UW Research Advisory Board 2017 – present
- Member, Reproducibility Working Group, UW eScience Institute 2016 – 2018
- Neuronline Community Leader, Society for Neuroscience 2016 – 2017

Workshops

- Co-organizer, Recent Computational Advances in Neuroengineering, COSYNE workshop 2018

Ad-Hoc Reviewing · Journals

publons.com/author/1188259/michael-beyeler

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 Neural Engineering · Journal of Vision · Neural Networks · Neurocomputing · PLoS Computational Biology · PLoS ONE · Sensors · Vision Research

Ad-Hoc Reviewing · Conferences

Computational and 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)

PUBLICATIONS

scholar.google.com/citations?user=1CDDZSIAAAAJ

Manuscripts Under Review or in Preparation

- M3 **Beyeler, M.**, Nanduri, D., Weiland, J., Rokem, A., Boynton, G. M., and Fine, I. (in preparation). A model of ganglion axon pathways accounts for percepts elicited by retinal implants. Code: github.com/VisCog/ArgusShapes.
- M2 **Beyeler, M.** (under review). Biophysical model of axonal stimulation in epiretinal visual prostheses. *bioRxiv* 424622, doi: 10.1101/424622.
- M1 **Beyeler*, M.**, Rounds*, E. L., Carlson, K. D., Dutt, N., and Krichmar, J. L (in revision, *PLOS Computational Biology*). Sparse coding and dimensionality reduction in cortex. *bioRxiv* 149880, doi: 10.1101/149880. (*equal contribution)

Peer-Reviewed Journal Publications

- J5 **Beyeler, M.**, Rokem, A., Boynton, G. M., and Fine, I. (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.**
- J4 **Beyeler, M.**, Dutt, N., and Krichmar, J. L. (2016). 3D visual response properties of MSTd emerge from an efficient, sparse population code. *Journal of Neuroscience* 36(32): 8399–8415.
- J3 **Beyeler, M.**, Oros, N., Dutt, N., and Krichmar, J. L. (2015). A GPU-accelerated cortical neural network model for visually guided robot navigation. *Neural Networks* 72: 75–87.
- J2 **Beyeler, M.**, Richert, M., Dutt, N. D., and Krichmar, J. L. (2014). Efficient spiking neural network model of pattern motion selectivity in visual cortex. *Neuroinformatics*, 1–20.
- J1 **Beyeler, M.**, Dutt, N. D., and Krichmar, J. L. (2013). Categorization and decision-making in a neurobiologically plausible spiking network using a STDP-like learning rule. *Neural Networks* 48C: 109–124.

Peer-Reviewed Conference Publications

- C6 Chou*, T.-S., Kashyap*, H. J., Xing, J., Listopad, S., Rounds, E. L., **Beyeler, M.**, Dutt, N., and Krichmar, J. L. (2018). CARLsim 4: An open source library for large scale, biologically detailed spiking neural network simulations using heterogeneous clusters. *Proceedings of the IEEE International Joint Conference on Neural Networks (IJCNN)*, Rio de Janeiro, Brazil. (*equal contribution) Code: github.com/UCI-CARL/CARLsim4. **Best Student Paper Nominee.**
- C5 **Beyeler, M.**, Boynton, G. M., Fine, I., and Rokem, A. (2017). pulse2percept: A Python-based simulation framework for bionic vision. *Proceedings of the 16th Python in Science Conference*, p.81–88. Code: github.com/uwescience/pulse2percept.
- C4 **Beyeler*, M.**, Carlson*, K. D. , Chou*, T.-S., Dutt, N., Krichmar, J. L. (2015). CARLsim 3: A user-friendly and highly optimized library for the creation of neurobiologically detailed spiking neural networks. *Proceedings of the IEEE International Joint Conference on Neural Networks (IJCNN)*, Killarney, Ireland. Code: github.com/UCI-CARL/CARLsim3. (*equal contribution)
- C3 Carlson, K. D., **Beyeler, M.**, Dutt, N., and Krichmar, J. L. (2014). GPGPU accelerated simulation and parameter tuning for neuromorphic applications. *Proceedings of the 19th Asia and South Pacific Design Automation Conference (ASP-DAC)*, Suntec, Singapore.
- C2 **Beyeler, M.**, Mirus, F., and Verl, A. (2014). Vision-based robust road lane detection in urban environments. *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)*, Hong Kong, China.
- C1 **Beyeler*, M.**, Stefanini*, F., Proske, H., Galizia, C. G., and Chicca, E. (2010). Exploring olfactory sensory networks: simulations and hardware emulation. *Proceedings of the IEEE Biomedical Circuits and Systems conference (BioCAS)*, Paphos, Cyprus. (*equal contribution) **Best Student Paper Nominee.**

Books

- B2 **Beyeler, M.** (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.
- B1 **Beyeler, M.** (2015). OpenCV with Python Blueprints. *Packt Publishing Ltd.*, Birmingham, UK, 230 pages, ISBN 978-178528269-0. Code: github.com/mbeyeler/opencv-python-blueprints.

US Patent Applications

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

CONTRIBUTED PRESENTATIONS AND ABSTRACTS

- A28 **Beyeler, M.**, Nanduri, D., Weiland, J. D., Rokem, A., Boynton, G. M., And Fine, I. (2018). Optimizing stimulation protocols for prosthetic vision based on retinal anatomy. *Annual Meeting of the Organization of Computational Neuroscience (CNS)*, Seattle, WA. (poster)
- A27 **Beyeler, M.**, Rounds, E. L., Carlson, K. D., Dutt, N., and Krichmar, J. L. (2018). Sparse coding and dimensionality reduction in the brain. *Annual Meeting of the Organization of Computational Neuroscience (CNS)*, Seattle, WA. (poster)
- A26 Chou, T.-S., Kashyap, H. K., Xing, J., Listopad, S., Rounds, E. L., **Beyeler, M.**, Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Nanduri, D., Weiland, J. D., Rokem, A., Boynton, G. M., and Fine, I. (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 **Beyeler, M.**, Yucel, E. I., Rokem, A., Boynton, G. M., and Fine, I. (2018). Optimizing stimulation protocols for prosthetic vision based on retinal anatomy. *Computational and Systems Neuroscience (COSYNE) workshops*, Breckenridge, CO. (oral)
- A23 **Beyeler, M.**, Rokem, A., Boynton, G. M., and Fine, I. (2018). Modeling the perceptual experience of retinal prosthesis patients. *UWIN Neural Computation and Engineering Connection (NCEC)*, Seattle, WA. (oral)
- A22 Rounds, E. L., **Beyeler, M.**, Carlson, K. D., Dutt, N., and Krichmar, J. L. (2017). Sparse coding and dimensionality reduction in cortex. *47th Annual Meeting of the Society for Neuroscience (SfN)*, Washington, DC. (poster)
- A21 Kashyap, H. J., Chou, T.-S., Rounds, E. L., Listopad, S., **Beyeler, M.**, Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Rokem, A., Boynton, G. M., and Fine, I. (2017). Reverse-engineering optimized stimulation protocols in epiretinal prosthesis patients. *The Eye & the Chip*, Detroit, MI. (oral, **Platform Presentation**)
- A19 Boynton, G. M., Rokem, A., **Beyeler, M.**, Dorn, J., Sinclair, N. C., Shivdasani, M. N., Petoe, M. A., Hornig, R., and Fine, I. (2017). Efficient and scalable measurements of sensitivity for high resolution electrode arrays. *The Eye & the Chip*, Detroit, MI. (poster, **Best Poster Award**)
- A18 **Beyeler, M.**, Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Boynton, G. M., Fine, I., and Rokem, A. (2017). pulse2percept: A Python-based simulation framework for bionic vision. *Python in Science Conference (SciPy)*, Austin, TX. (oral, youtube.com/watch?v=KxsNAa-P2X4)
- A16 **Beyeler, M.**, Rokem, A., Boynton, G. M., and Fine, I. (2017). Modeling the perceptual experience of retinal prosthesis patients. *Annual Meeting of the Vision Sciences Society (VSS)*, St. Pete's Beach, FL. (oral)
- A15 **Beyeler, M.**, Rokem, A., Boynton, G. M., and Fine, I. (2017). Modeling the perceptual experience of retinal prosthesis patients. *Computational and Systems Neuroscience (COSYNE)*, Salt Lake City, UT. (poster)
- A14 **Beyeler, M.**, Richert, M., Oros, N., Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Richert, M., Oros, N., Dutt, N., and Krichmar, J. L. (2016). GPU-accelerated real-time simulation of information processing in early visual cortex. *The Eye & the Chip*, Dearborn, MI. (poster)
- A11 **Beyeler, M.**, Richert, M., Oros, N., Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Richert, M., Oros, N., Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Carlson, K. D., Chou, T.-S., Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Carlson, K. D., Chou, T.-S., Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Carlson, K. D., Chou, T.-S., Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Richert, M., Oros, N., Dutt, N., and Krichmar, J. L. (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 **Beyeler, M.**, Mirus, F., and Verl, A (2014). Vision-based robust road lane detection in urban environments. *IEEE International Conference on Robotics and Automation (ICRA)*, Hong Kong, China. (oral)
- A4 **Beyeler, M.**, Richert, M., Nageswaran, J. M., Dutt, N. D., and Krichmar, J. L. (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 **Beyeler, M.**, Richert, M., Nageswaran, J. M., Dutt, N. D., and Krichmar, J. L. (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 **Beyeler, M.**, Richert, M., Nageswaran, J. M., Dutt, N. D., and Krichmar, J. L. (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 **Beyeler, M.**, Dutt, N. D., and Krichmar, J. L. (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

- 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 Cognitive Interaction Technology (CITEC)*, Bielefeld University, Bielefeld, 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, 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

Invited Lectures

2018 – present

University of Washington (UW) / University of Puget Sound (UPS)

Seattle / Tacoma, WA

- UW Neurohackademy: Image processing & computer vision with scikit-image (all levels)
- UW Auditory Neuroscience Training Grant (ANTG): Introduction to machine learning (graduate)
- UPS NRSC 490 Advanced Topics in Neuroscience: Visual neuroprostheses (undergraduate)

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 bootcamps 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)

MENTORING EXPERIENCE

- Ezgi I. Yucel, Graduate student, UW 2017 – present
- Ji Min Park, Undergraduate RA, UW (now: Graduate student, Penn State) 2017 – 2018
- Saideep Gupta, Undergraduate RA, UCI (now: Head of Web Development, Wing AI) 2015 – 2016
- Stanislav Listopad, Undergraduate RA, UCI (now: Graduate student, UCI) 2014 – 2016

COMMUNITY INVOLVEMENT AND 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

- American Association for the Advancement of Science (AAAS) 2018 – present
- Organization for Computational Neurosciences (OCNS) 2018 – present
- Vision Sciences Society (VSS) 2017 – present
- Society for Neuroscience (SfN) 2013 – present
- IEEE Robotics and Automation Society (RAS) 2014 – 2016