

Mirko Klukas, PhD

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Education

- Apr 2009 - May 2012 **Ph.D.** Mathematics
[University of Cologne - Cologne, Germany](#)
Scholarship of the German Research Foundation • Focus: Contact & Symplectic Topology
- Jan 2003 - Dec 2008 **M.S.** Mathematics
[University of Cologne - Cologne, Germany](#)
Thesis awarded with a prize of the German Mathematical Society • Minor: Graph Theory & Theoretical Computer Science • Graduated with distinction
- Jul 2010 - Jan 2011 **Guest-doctoral Fellow** Mathematics
[Georgia Institute of Technology - Atlanta GA, USA](#)
Scholarship of the German Academic Exchange Service

Awards & Scholarships

- Apr 2009 - Apr 2012 Research scholarship, German Research Foundation
- Jul 2010 - Jan 2011 Research scholarship, German Academic Exchange Service
- Oct 2009 Award for Master Thesis, German Mathematical Society

Publications

[Computational Neuroscience](#) :

1. **Fragmented spatial maps from surprisal**, with S. Sharma, and I. Fiete (in preparation).
2. **Flexible representation of higher-dimensional cognitive variables with grid cells**, with M. Lewis, and I. Fiete, PLOS Comput. Biol. (2020), 13 pages.
3. **A framework for intelligence and cortical function based on grid cells in the neocortex**, with J. Hawkins, M. Lewis, S. Purdy, and S. Ahmad, Front. Neural Circuits 12 (2019), 14 pages.

[Mathematics](#):

1. **Nested open books and the binding sum**, with S. Durst, Osaka J. Math. 58 (2021), 33 pages.
2. **Open books and exact symplectic cobordisms**, Internat. J. Math. 29 (2018), 19 pages.
3. **Open book decompositions of fibre sums in contact geometry**, Algebr. Geom. Topol. 16 (2016), 25 pages.
4. **Computing the Thurston-Bennequin invariant in open books**, with S. Durst and M. Kegel, Acta Math. Hungar. 150 (2016), 15 pages.
5. **The fundamental group of the space of contact structures on the 3-torus**, with H. Geiges, Math. Res. Lett. 21 (2014), 6 pages.
6. **On prolongations of contact manifolds**, with B. Sahamie, Proc. Amer. Math. Soc. 141 (2013), 7 pages.
7. **Isotopy classification of Engel structures on circle bundles**, with B. Sahamie, arXiv preprint (2012), 13 pages.

[Conference Posters \(Comp. Neurosci.\)](#):

1. Fragmented spatial maps from surprisal and affordances, **Cosyne 2021**
2. Randomly mixed modular grid-place cell network for high capacity associative memory, **Cosyne 2021**
3. Representing non-Euclidean spaces and abstract data structures with grid cells and place cells, **NAISys 2020**
4. Grid Cells in the Neocortex, a Framework for Cortical Computation, **SfN 2018**
5. On path-integrating N-dimensional variables with modules of entorhinal grid cells, **Bernstein Conference 2018**

Research & Working Experience

- Apr 2019 - **Present** **Postdoctoral Researcher** AI / ML / Comp. Neurosci.
[MIT - Department of Brain and Cognitive Sciences - Cambridge MA, USA](#)
Focus: Localization and planning in the hippocampal formation and how this can inform us about general cognitive computations and intelligence • SLAM with recurrent networks • Neural data analysis (TDA, low-dimensional embeddings) • Representation of cognitive spaces
- Nov 2017 - Mar 2019 **Research Scholar** AI / ML / Comp. Neurosci.
[Numenta - Redwood City CA, USA](#)
Role emerged from a month long research visit in Nov 2016 • Focus: Spatial representations in the brain, and their role in more general cognitive computations and intelligence • Emergence of modularity in continuous attractor networks • Relating sparse coding and information-theoretic concepts • Formal framework for Numenta's sequence memory from a compression perspective
- Oct 2015 - Oct 2017 **Postdoctoral Researcher** Mathematics / ML
[Institute of Science and Technology Austria - Klosterneuburg, Austria](#)
Focus: Combination of mathematics and computer science • TDA and Topological cluster methods • Sparse coding • Variable order Markov models
- Sep 2014 - Sep 2015 **Postdoctoral Researcher** Mathematics
[University of Cologne - Cologne, Germany](#)
Focus: Contact and symplectic topology • Low-dimensional topology • Computational topology
- Mar 2013 - Jan 2014 **Technology and Management Consulting**
[Accenture - Düsseldorf, Germany](#)
I was a member of the IT Strategy department, with a focus on digital strategies and technology trends.

Skills

- Coding Python (proficient) • Javascript (proficient) • Julia (getting there) • Gen (getting there)
- ML Pytorch • Recurrent networks (LSTM, Generative Temporal Models, Continuous Time NN, Attractor Networks) • SLAM (visual SLAM, Bayesian Filter, Particle Filter) • Auto-encoder (Variational, Sparse)
- Coursera Certificates Neural Networks for Machine Learning • Deep Learning Specialization: ◦ Sequence Models ◦ Convolutional Neural Networks ◦ Structuring Machine Learning Projects ◦ Improving Deep Neural Networks ◦ Neural Networks and Deep Learning • Visual Perception and the Brain • Computational Neuroscience • The Brain and Space
- Misc **Hacker School** (Feb 2014 - Apr 2014) Three-month, free, self-directed, educational retreat for intellectually curious people who want to get better at programming, New York City, USA
- Civilian Service** (Oct 2001 - Jul 2002) Full-time, individual care of an autistic child at a school for children with special needs, Leverkusen, Germany