Curriculum Vitae

Rainer Engelken
Assistant Professor
Dept of Electrical & Computer Engineering
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Experience

2025 – ongoing	**Assistant Professor (Tenure-Track)**, **Dept of Electrical & Computer Engineering, University of Illinois Urbana-Champaign** Affiliated Faculty, Siebel School of Computing and Data Science Affiliated Faculty, Coordinated Science Laboratory
2017 – 2025	**Postdoc**, Center for Theoretical Neuroscience, Columbia University Advisor: Prof. L. F. Abbott
2012 – 2017	**Ph.D. in Physics (summa cum laude)**, University of Göttingen Advisor: Prof. Fred Wolf, Max Planck Institute for Dynamics and Self-Organization
2009 – 2011	**Diploma in Physics**, University of Tübingen Advisor: Prof. Matthias Bethge, MPI for Biological Cybernetics
2008 – 2009	**Certificate of Advanced Study in Mathematics (Part III)**, University of Cambridge
2007 – 2008	**Visiting Undergraduate Student**, Gatsby Computational Neuroscience Unit, UCL Advisor: Prof. Peter Dayan

Awards & Distinctions

2018	Best Presentation Award (CNS Workshop on Information Theory in Comp. Neuro.)
2012 – 2016	PhD Scholarship, German Protestant Foundation Villigst

2008 – 2011	Scholarship, National Merit Foundation
2005 – 2011	Undergraduate Scholarship, German Protestant Foundation Villigst
2006 – 2007	Fellow of the Interdisciplinary College of Forum Scientiarum (Tübingen)
2005	Travel Scholarship under the Patronage of the German UNESCO Commission

Publications

R. Engelken, M. Monteforte, and F. Wolf. *Sparse chaos in cortical circuits*. arXiv preprint, 2024. doi:10.48550/arXiv.2412.21188.

M. Drangmeister, **R. Engelken**, J. Schleimer, S. Schreiber. *Dynamically rich states in balanced networks induced by single-neuron dynamics*. bioRxiv preprint, 2025. doi:10.1101/2025.02.28.640576.

R. Engelken and L.F. Abbott: *Understanding and Optimizing Temporal Credit Assignment in Biological and Artificial Neural Networks using Dynamical Systems Theory*. Cognitive Computational Neuroscience 2024.

R. Engelken and L.F. Abbott: *Analyzing and Improving Surrogate Gradient Training in Binary Neural Networks Using Dynamical Systems Theory*. ICML Workshop 2024.

R. Engelken: *Gradient Flossing: Improving Gradient Descent through Dynamic Control of Jacobians*. NeurIPS 2023.

R. Engelken: *SparseProp: Efficient Event-Based Simulation and Training of Sparse Recurrent Spiking Neural Networks*. NeurIPS 2023.

R. Engelken, F. Wolf and L.F. Abbott: *Lyapunov spectra of chaotic recurrent neural networks*. Phys. Rev. Res. 5, 043044 (2023).

A. Palmigiano, **R. Engelken**, and F. Wolf: *Boosting of neural circuit chaos at the onset of collective oscillations*. eLife (2023).

R. Engelken and S. Goedeke: *A time-resolved theory of information encoding in recurrent neural networks*. NeurIPS 2022.

R. Engelken, A. Ingrosso, R. Khajeh, S. Goedeke and L.F. Abbott: *Input correlations impede suppression of chaos and learning in balanced rate networks*. PLoS Comput Biol 18(12): e1010590 (2022).

D. R. Kepple, **R. Engelken**, K. Rajan: *Curriculum learning as a tool to uncover learning principles in the brain*. (ICLR) 2022.

R. Engelken, F. Farkhooi, C. van Vreeswijk, D. Hansel and F. Wolf: *A reanalysis of "Two types of asynchronous activity in networks of excitatory and inhibitory spiking neurons"*. F1000Research 5, 2043 (2016).

F. Wolf, **R. Engelken**, M. Touzel, J. Florez and A. Neef: *Dynamical models of cortical circuits*. Current Opinion in Neurobiology, 2014.

Invited Talks & Tutorials

Sparse Chaos in Cortical Circuits, SIAM Conference on Applications of Dynamical Systems (DS25) 2025

Understanding and Optimizing Learning in Spiking Neural Networks using Dynamical Systems Theory, Dynamics Days Europe 2024

Gradient Flossing: Improving Gradient Descent through Dynamic Control of Jacobians, Dynamics Days Europe 2023

A time-resolved theory of information encoding in recurrent neural networks, CNS workshop on Information Theory in Computational Neuroscience; NeuroMatch Conference; Technion; Swartz Meeting; Eugene 2022

Taming chaos in neural circuits, World Wide Theoretical Neuroscience Seminar, 2022

Input correlations impede suppression of chaos and learning in balanced rate networks, Invited virtual talks at RIKEN, Japan; The Mathematical Neuroscience Lab, Penn State; Mt. Sinai, NYC; and MILA, Montreal, 2021

Lyapunov spectra of chaotic recurrent neural networks, Invited virtual talks at ICTP, Trieste, 2021; Cold Spring Harbor Laboratory, 2020; Max Planck Institute for Mathematics in the Sciences, 2020

Event-based simulation of spiking neural networks in Julia, JuliaCon 2017, Berkeley

Chaos and Dynamical Entropy Production in Spiking Networks, Gatsby Computational Neuroscience Unit; EPFL Computational Neuroscience Seminar; Cambridge University; Columbia University; University of Bremen, 2014

Professional Activities

Teaching & Mentoring

Instructor for novel research-focused special topics graduate course ECE598RE: Dynamical Systems and Neural Networks, ECE, UIUC (Fall 2025, tentative Fall 2026)
Co-organizer, *Advanced Course on Theoretical Neuroscience*, Zuckerman Institute, Columbia University (2018 – 2024)
Teaching Assistant, *Methods in Computational Neuroscience*, Marine Biological Laboratory (MBL) (2023)
Teaching Assistant, *Cajal Course in Computational Neuroscience* (2017, 2018)
Co-organizer for four Advanced or Bernstein Computational Neuroscience Summer Schools (2014 – 2017)
Taught seminars at the University of Göttingen on topics including Deep Learning, Neural Plasticity, Information Theory, and Vision (2012 – 2017)
Taught five summer schools for the German Pupils Academy on topics including Neuroscience, Climate Change, and Quantum Computation (2009 – 2013)

Workshop & Conference Organization

Co-organizer, *NeuroNex Neurotheory Workshop Series*, New York (2019)
Co-organizer, *Junior Scientist Workshop on Advanced Neural Data Analysis*, New York (2019)
Co-organizer, *Structure and disorder: From random connections to functional circuits*, Göttingen (2019)
Co-organizer, two workshops on dynamics and learning in neural circuits, Göttingen (2018)
Co-organizer, CNS Workshop *How does learning reshape dimensionality of collective network activity?*, Seattle (2018)
Co-organizer, two Cosyne Workshops on dimensionality and perturbations in neural activity (2016, 2018)

Professional Service & Outreach

Reviewer for ICLR, ICML, NeurIPS, DeepMath, Physical Review E, Physical Review Letters, Nature Communications, and Neural Computation
Co-chair, Zuckerman Trainee Advisory Committee (ZTAC) (2019 – 2020)
Co-organizer, *Growing Up in Science* series, Zuckerman Institute (2018 – 2020)
Facilitator for *Girls Who Code* and *ChickTech* programs, supporting women and girls in STEM (2019)

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