

Zhenrui Liao

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Citizenship: USA

Education & Training

2017–2024	MD (expected), Columbia University College of Physicians and Surgeons
2019–2022	PhD in Neurobiology and Behavior, Columbia University Supervised by ATTILA LOSONCZY
2017	MS in Electrical Engineering, Columbia University (concentration in Systems Biology and Neuroengineering)
2017	BS in Electrical Engineering, Columbia University
2015–2016	MEng Visiting Student, Imperial College London

Publications

* denotes equal contribution

KEY PUBLICATIONS

2022	L. B. Liu, A. Losonczy, and Z. Liao . Tension: A Python package for FORCE learning. <i>PLOS Computational Biology</i> , 2022b
2021	S. Terada, T. Geiller*, Z. Liao *, J. O’Hare*, B. Vancura*, and A. Losonczy. Adaptive stimulus selection for consolidation in the hippocampus. <i>Nature</i> , 2021a
2021	B. Dudok*, M. Szoboszlai*, A. Paul*, P. M. Klein*, Z. Liao *, E. Hwaun, G. G. Szabo, T. Geiller, B. Vancura, B.-S. Wang, S. McKenzie, J. Homidan, L. M. Klaver, D. F. English, Z. J. Huang, G. Buzsáki, A. Losonczy, and I. Soltesz. Recruitment and inhibitory action of hippocampal axo-axonic cells during behavior. <i>Neuron</i> , 2021
2020	F. Sparks*, Z. Liao *, W. Li, A. Grosmark, I. Soltesz, and A. Losonczy. Hippocampal adult-born granule cells drive network activity in a mouse model of chronic temporal lobe epilepsy. <i>Nature communications</i> , 11(1):1–13, 2020

OTHER PUBLICATIONS

2022	A. A. Liu, S. Henin, S. Abbaspoor, A. Bragin, E. A. Buffalo, J. S. Farrell, D. J. Foster, L. M. Frank, T. Gedankien, J. Gotman, J. Guidera, K. L. Hoffman, J. Jacobs, M. J. Kahana, L. Li, Z. Liao , J. J. Lin, A. Losonczy, ..., and G. Buzsáki. A consensus statement on detection of hippocampal sharp wave ripples and differentiation from other fast oscillations. <i>Nature communications</i> , 13(1):1–14, 2022a
2021	D. Hadjiabadi, M. Lovett-Barron, I. G. Raikov, F. T. Sparks, Z. Liao , S. C. Baraban, J. Leskovec,

A. Losonczy, K. Deisseroth, and I. Soltesz. Maximally selective single-cell target for circuit control in epilepsy models. *Neuron*, 2021

2019 G. F. Turi*, W.-K. Li*, S. Chavlis*, I. Pandi, J. O’Hare, J. B. Priestley, A. D. Grosmark, **Z. Liao**, M. Ladow, J. F. Zhang, et al. Vasoactive intestinal polypeptide-expressing interneurons in the hippocampus support goal-oriented spatial learning. *Neuron*, 101(6):1150–1165, 2019

2017 J. D. Zaremba, A. Diamantopoulou, N. B. Danielson, A. D. Grosmark, P. W. Kaifosh, J. C. Bowler, **Z. Liao**, F. T. Sparks, J. A. Gogos, and A. Losonczy. Impaired hippocampal place cell dynamics in a mouse model of the 22q11.2 deletion. *Nature neuroscience*, 20(11):1612–1623, 2017

Talks & Workshops

2022 **Z. Liao**. Hyperdimensional computing: Theory and applications. In *Unsupervised Learning, guest lecture*, New York, NY, 2022f

2022 **Z. Liao**. Hippocampus learns metric spaces. In *Society for Neuroscience (upcoming)*, San Diego, CA, 2022d

2022 **Z. Liao**. A biologically plausible inhibitory plasticity rule for world-model learning in SNNs. In *Spiking Networks as Universal Function Approximators*, virtual, 2022e

2022 **Z. Liao**. Teaching Math: Challenges and perspectives in university-level quantitative pedagogy. In *Center for Teaching and Learning Workshop Series (upcoming)*, New York, NY, 2022b

2022 **Z. Liao**. Towards a Neuroscience of Stories: Metric space learning in the hippocampus. In *Columbia Neurobiology and Behavior Retreat*, Tarrytown, NY, 2022c

2022 L. B. Liu and **Z. Liao**. Use the FORCE: A Python package for training chaotic RNNs. In *North-east Regional Conference on Complex Systems*, Buffalo, NY, 2022

2022 **Z. Liao**. Spiking neural network models in neuroscience (Teaching Assistant). In *COSYNE*, Lisbon, Portugal, 2022a

2021 **Z. Liao**. AI & the Brain: Learning about learning. In *Inspirit AI Spotlight Talks*, virtual, 2021b

2021 **Z. Liao**. Dissecting interictal epileptiform discharge diversity: A Bayesian topic modeling approach. In *American Epilepsy Society*, Chicago, IL, 2021a

2021 **Z. Liao**. Replay of world structure by CA3. In *Organization for Computational Neurosciences*, virtual, 2021c

2021 **Z. Liao**. Spectral and machine learning methods for detection of epileptiform electrophysiological events. virtual / Ripple Methods Consortium hosted by NYU, 2021d

Conference presentations

COMPETITIVE SELECTION

2022 **Z. Liao** and A. Losonczy. Towards a neuroscience of “Stories”: Metric space learning in the hippocampus. In *International Conference on Machine Learning – Universal Reasoning Systems Workshop*, Baltimore, MD, 2022

2022 **Z. Liao***, D. Hadjiabadi*, S. Terada, I. Soltesz, and A. Losonczy. A GABAergic plasticity mechanism for world structure inference by CA3. In *COSYNE*, Lisbon, Portugal, 2022a

2021 **Z. Liao**, A. Losonczy, and C. Papadimitriou. The excitability functionality trade-off: Random graph models of epilepsy. In *COSYNE*, virtual, 2021

GENERAL

- 2022 **Z. Liao** *, D. Hadjiabadi*, S. Terada, I. Soltesz, and A. Losonczy. World structure inference by hippocampal replay. In *Federation of European Neuroscience Societies*, Paris, France (hybrid), 2022b
- 2021 D. Hadjiabadi*, **Z. Liao** *, Q. A. Nguyen, S. Terada, A. Losonczy, and I. Soltesz. Data-driven biophysical model of genetic epilepsy predicts loss of cue cell suppression during sharp-wave ripple associated memory replay. In *American Epilepsy Society*, Chicago, IL, 2021
- 2021 **Z. Liao** *, D. Hadjiabadi*, I. Soltesz, and A. Losonczy. Hebbian plasticity of GABAergic synapses sufficient for consolidation of world structure by ca_3 replay. In *Society for Neuroscience*, virtual, 2021
- 2021 S. Terada, **Z. Liao**, D. Hadjiabadi, I. Soltesz, and A. Losonczy. A novel mechanism of adaptive stimulus selection for sharp wave ripple-related memory consolidation in the hippocampus. In *7th Annual BRAIN Initiative Meeting*, virtual, 2021b
- 2019 F. Sparks*, **Z. Liao** *, I. Soltesz, and A. Losonczy. Circuit level cell-type specific population dynamics within the dentate gyrus during interictal events in the kainic acid mouse model of temporal lobe epilepsy. In *Society for Neuroscience*, Chicago, IL, 2019b
- 2019 F. Sparks*, **Z. Liao** *, I. Soltesz, and A. Losonczy. Interictal events recruit distinct ensembles of adult-born and mature granule cells in the epileptic dentate gyrus. In *Park City Epilepsy Meeting*, Park City, UT, 2019a
- 2019 F. Sparks, S. Wiesenberger, **Z. Liao**, W.-K. Li, R. Nyilas, B. Vancura, H. Blockus, A. Vaziri, and A. Losonczy. Large-scale volumetric calcium imaging of hippocampal microcircuits during head-fixed spatial navigation and learning. In *Inhibition in the CNS - Gordon Research Conference*, Newry, ME, 2019
- 2016 G. Turi, **Z. Liao**, W.-K. Li, J. Zaremba, A. Grosmark, X. Luo, L. Topolnik, and A. Losonczy. Role of hippocampal VIP interneurons in reward-oriented spatial learning. In *Society for Neuroscience*, San Diego, CA, 2016
- 2016 **Z. Liao** and A. Losonczy. A matched filtering algorithm for sharp-wave ripple detection in hippocampal local field potential recordings. In *38th International Conference of the IEEE Engineering in Medicine and Biology Society*, Orlando, FL, 2016. IEEE

Funding

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| 2020-2023 | <p>NIH Ruth L. Kirchenstein Fellowship (F31)</p> <ul style="list-style-type: none"> • Support amount • Project title: Dissecting microcircuit alterations in the epileptic dentate gyrus with functional imaging • Won as a first-year graduate student • Funding organization: NIH National Institute of Neurological Disease and Stroke • Grant ID: 5F31-NS120783 | Principal Investigator
\$171,010 |
| 2017-2020 | <p>NIH Medical Scientist Training Program Training Grant</p> <ul style="list-style-type: none"> • Support amount • Project #1: Mathematical modeling of epileptiform interictal spikes • Project #2: Two-photon imaging of interneurons in hippocampal area CA1 • Funding organization: NIH National Institute of General Medical Sciences • Grant ID: 5T32GM007367-44 | Appointee
\$56,135 |

Other Honors & Awards

2022-2023	Center for Teaching and Learning Lead Teaching Fellowship
2021	American Epilepsy Society Faculty Stipend 2021
2021	Society for Neuroscience 2021 Professional Development Award
2017	Latin Honors (Bachelor's, Master's of Science)
2017	Tau Beta Pi (Engineering Phi Beta Kappa, top 7% of class)
2013	National Merit Scholar

Teaching

INSTRUCTOR

2022-2023	Lead Teaching Fellow	Columbia University (university-wide position)
2022	Mathematics for Theoretical Neuroscience	with Danil Tyukmanov (semester course)
2021	Mathematics for Theoretical Neuroscience	with Danil Tyukmanov (semester course)
2021	Artificial Intelligence	InspiritAI (winter course)
2018, 2019	Pharmacokinetics & Pharmacodynamics	Columbia Medical School (student-led)

TEACHING ASSISTANT

2022	Theoretical Neuroscience	w/ Larry Abbott
2021	Computation and the Brain	Christos Papadimitriou
2020	Computation and the Brain	Christos Papadimitriou
2020	Advanced Machine Learning	Nakul Verma
2020	Machine Learning	Nakul Verma
2019	Unsupervised Learning	Nakul Verma
2018	Information Theory in Theoretical Computer Science	Omri Weinstein
2018	Machine Learning	Nakul Verma
2017	Machine Learning	Its'ik Pe'er
2016	Machine Learning	Daniel Hsu
2015	Professional Engineering	Esther Perea
2014	Analysis and Optimization	Davesh Maulik
2014	Calculus I-III	

Other

SERVICE

2022-	Theoretical Computer Science x Neuroscience Reading Group	Founder, organizer
2020-2021	Columbia COVID-19 Service Corps	Volunteer Vaccinator
2017-2023	CoSMO Medical Student Free Clinic	Junior clinician
2017-2023	Columbia MD-PhD Advisory Committee	Member

HEALTHCARE POLICY

2019	AMA MSS Interim 2019 Resolution 10: Promoting Early Access to Diabetes Care to Reduce the Incidence of End-Stage Renal Disease	
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- Lead author on resolution authored by all 7 AMA regions
 - Result: Recommended for study by AMA MSS Policy Committee
- 2019 AMA MSS Interim 2019 Resolution 84: Increased Recognition and Treatment of Eating Disorders in Minority Populations
- Delivered Region 7's testimony in support
 - Result: Adopted by AMA MSS

PROFESSIONAL SOCIETY MEMBERSHIPS

- 2017- Society for Neuroscience
- 2021- American Epilepsy Society
- 2019- American Medical Association
- 2015-2018 Institute of Electrical and Electronics Engineers (IEEE)
IEEE Engineering in Medicine and Biology Society (EMBS)
IEEE Computational Intelligence Society