# Yubei Chen

Assistant Professor, ECE Department, UC Davis Room 3139, Kemper Hall, One Shields Avenue, Davis, CA 95616 https://yubeichen.com

### **Research Interest**

My work is at the intersection of computational neuroscience and deep unsupervised learning—enhancing our understanding of the computational principles governing unsupervised representation learning in both brains and machines, and reshaping our insights into natural signal statistics.

Keywords: Unsupervised (Self-Supervised) Representation Learning, World Models, Theoretical Neuroscience, Science4AI, AI4Science

#### Education

Ph.D. in Electrical Engineering and Computer Science, UC Berkeley with Designated Emphasis in Communication, Computation, and Stati	Dec. 2019
- Advisor: Professor Bruno Olshausen	
- Thesis: The Sparse Manifold Transform and Unsupervised Learning for Sigr	nal Representation
M.S. in Electrical Engineering and Computer Science, UC Berkeley	Dec. 2018
M.A. in Mathematics, UC Berkeley	May 2015
- Committee: Professor Marc A. Rieffel, Professor John Lott	
B.E. in Electrical Engineering, Tsinghua University, Beijing	Jul. 2012
- Advisors: Professor Yangdong Deng, Professor Wenguang Chen	
Professional and Research Experience	
Electrical and Computer Engineering Department, UC Davis	(Jul. 2023 – )
Neuroscience and Computer Science, UC Davis (by courtesy)	
Affiliated Appointment at UC Berkeley & LBNL	
- Assistant Professor	
Center for Data Science, NYU	(Oct. 2022 – Oct. 2023)
- Postdoctoral Associate, Advisor: Prof. Yann LeCun	
Meta - Fundamental AI Research, New York	(Oct. 2020 – Oct. 2022)
- Postdoctoral Researcher, Advisor: Prof. Yann LeCun	
Aizip, Inc. Cupertino, CA	(Dec. 2019 – )
- Co-founder, Chair of the Technical Advisory Board	
Redwood Center & Berkeley AI Research, UC Berkeley	(Jan. 2020 – Oct. 2020)
- Postdoctoral Associate, Advisor: Prof. Bruno Olshausen	
Redwood Center & Berkeley AI Research, UC Berkeley	(Jan. 2013 – Dec. 2019)
- Graduate Research Assistant, Advisor: Prof. Bruno Olshausen	

Computer Graphics Lab, Stanford University	(Jul. 2011 – Sep. 2011)
- Stanford UGVR Fellow, Advisors: Prof. Ronald Fedkiw and Dr. Wen Z	heng
HPC Embedded Computing Lab, Tsinghua University - Research Assistant, Advisor: Prof. Yangdong Deng	(Mar. 2010 – Jun. 2012)
PACMAN Group, HPC Institute, Tsinghua University - Research Assistant, Advisors: Prof. Wenguang Chen and Dr. Chuntao	(Jun. 2010 – Mar. 2012) Hong
Selected Honors and Awards	
Best of Sensor Award – AI/Machine Learning - Sensor Converge	2023
Outstanding Paper Honorable Mentions Award - The International Conference on Learning Representations (ICLR)	2023
First Place Winner in Object Detection Track - IEEE Low Power Computer Vision Challenge (LPCVC)	2020
NSF GRFP Fellowship - National Science Foundation, USA	2012 – 2015
Chair's Excellence Scholarship - Department of Electrical Engineering and Computer Science, UC Berke	Dec. 2012 Pley
Undergraduate Visiting Research Fellowship (UGVR) - School of Engineering, Stanford University	2011
Comprehensive Scholarship for Academic Excellence - Tsinghua University, Beijing, China	2011 – 2012
Scholarship for Science, Technology, and Innovation - Tsinghua University, Beijing, China	2009 – 2011
Second Prize Winner (the Youngest Winner) - NVIDIA China University GPU Programming Contest	2010
Finalist in Chinese National Physics Olympiad - The Chinese Physical Society	2007

#### Yubei Chen

## Teaching

EEC289A Introduction to Unsupervised Learning, UC Davis Instructor	Spring 2025
EEC161 Applied Probability, UC Davis Instructor	Fall 2024
EEC289A Introduction to Unsupervised Learning, UC Davis Instructor	Spring 2024
Vision Science 265 Neural Computation, UC Berkeley Teaching Assistant	Fall 2016
<b>Computer Science 188 Introduction to Artificial Intelligence, UC Berkeley</b> Teaching Assistant	Fall 2015
<b>CRCNS Course on Mining and Modeling of Neuroscience Data, UC Berkeley</b> Teaching Assistant	Jul.06-17 2015
<ul> <li>[K12] Advising Wevin AI Club at Saratoga High School and Los Altos High School Research Mentor; I supervised 4 high schoolers on Animal Voice Recognition</li> <li>My students built the SOTA cat voice recognition system and presented a potional Conference on Statistical Language and Speech Processing (SLSP), 2020</li> </ul>	ol, CA 2018 - 2020 ster at the Interna-
Professional Service	
Area Chair, International Conference on Computer Vision	2025
Local Chair, Conference on Parsimony and Learning (CPAL)	2025
Rising Star Award Chair, Conference on Parsimony and Learning (CPAL)	2024
Reviewer for:	
- International Conference on Computer Vision (ICCV)	2023
- Transactions on Machine Learning Research (TMLR)	2022 - 2023
- IEEE Transactions on Signal Processing	2022
- Journal of Applied and Computational Topology	2022 – 2023
- Neural Computation	2021 - 2022
- European Conference on Computer Vision (ECCV)	2022
- Committee member, NeurIPS NeurReps Workshop	2022
- IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)	2022
- IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)	2021 – 2024
- NeurIPS SVRHM Workshop	2020, 2022
- AAAI Conference on Artificial Intelligence (AAAI)	2020 - 2021
- International Conference on Learning Representations (ICLR)	2019 – 2021
- International Conference on Machine Learning (ICML)	2019 – 2021
- ICML Human-in-the-Loop Learning (HILL)	2019
- Advances in Neural Information Processing Systems (NeurIPS)	2018 – 2023
TinyML Datasets & Benchmarking Technical Program Committee	2022 –
NSF GRFP Fellowship Ambassador, UC Berkeley	2012 – 2014

#### **Publications**

(P): Preprint; (C): Peer-Reviewed Conference; (J): Journal; (A): Abstract;

- Authorship convention in the field: lead senior authors are listed last; lead junior author is listed first.
- \*: Equal contribution as the first author; †: Equal contribution as the lead senior author
- [42] (P). Seeing from Another Perspective: Evaluating Multi-View Understanding in MLLMs, (Submission to ICCV 2025)
- [41] (C). Chengjie Hao\*, Weyl Lu\*, Yifan Xu, Yubei Chen, Neural Motion Simulator: Pushing the Limit of World Models in Reinforcement Learning, Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2025
- [40] (C). Zeyu Yun, Christopher Kymn, Galen Chuang, Yubei Chen, Bruno Olshausen, Predictive and Invariant Representations via Motion and Form Factorization in Natural Scenes, the Computational and Systems Neuroscience (Cosyne), 2025
- [39] (P). Renzhi He, Haowen Zhou, **Yubei Chen**, Yi Xue, *Recover Biological Structure from a Few Diffraction Images with Neural Volumetric Prior*, (Submission to ICCV 2025)
- [38] (C). Zeyu Yun, Galen Chuang, Derek Dong, **Yubei Chen**, *Denoising for Manifold Extrapolation*, NeurIPS 2024 Workshop on Scientific Methods for Understanding Deep Learning (**NeurIPS SciForDL**)
- [37] (C). Yu-Chieh Chao, **Yubei Chen**, Weiwei Wang, Achintha Wijesinghe, Suchinthaka Wanninayaka, Songyang Zhang, Zhi Ding, *Task-Driven Semantic Quantization and Imitation Learning for Goal-Oriented Communications*, IEEE International Conference on Communications (**ICC**), 2025
- [36] (J). Zhiyu Chen, Ziyuan Wen, Weier Wan, Akhil Redd Pakala, Yiwei Zou, Wei-Chen Wei, Zengyi Li, Yubei Chen, Kaiyuan Yang, PICO-RAM: A PVT-Insensitive Analog Compute-In-Memory SRAM Macro with In-Situ Multi-Bit Charge Computing and 6T Thin-Cell-Compatible Layout, the IEEE Journal of Solid State Circuits (JSSC), 2024
- [35] (C). Chun-Hsiao Yeh, Jiayun Wang, Andrew Graham, Andrea Liu, Bo Tan, Yubei Chen, Yi Ma, Meng Lin, *Insight: A Multi-Modal Diagnostic Pipeline using LLMs for Ocular Surface Disease Diagnosis*, the International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), 2024.
- [34] (C). Jiayun Wang, Stella Yu, **Yubei Chen**, *Trajectory Regularization Enhances Self-Supervised Geometric Representation*, European Conference on Computer Vision (ECCV), 2024. (Oral)
- [33] (P). Chun-Hsiao Yeh, Ta-Ying Cheng, He-Yen Hsieh, David Chuan-En Lin, Yi Ma, Andrew Markham, Niki Trigoni, H. Kung, Yubei Chen, Gen4Gen: Generative Data Pipeline for Generative Multi-Concept Composition. arXiv preprint: 2402.15504 (ICCV 2025 Submission)
- [32] (C). Zeyu Yun, Juexiao Zhang, Bruno Olshausen, Yann LeCun, Yubei Chen, URLOST: Unsupervised representation learning without stationarity or topology. International Conference on Learning Representations (ICLR), 2025
- [31] (P). Jiachen Zhu, Ravid Shwartz-Ziv, Yubei Chen, Yann LeCun, Variance-Covariance Regularization Improves Representation Learning. arXiv preprint: 2306.13292
- [30] (C). Yunhui Gao, Youren Zhang, **Yubei Chen**, Stella Yu, *The emergence of prototypicality: unsupervised feature learning in hyperbolic space*. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (**CVPR**), 2024
- [29] (P). Shengbang Tong\*, Yubei Chen\*, Yi Ma, Yann LeCun, EMP-SSL: Towards Self-Supervised Learning in One Training Epoch. arXiv preprint: 2304.03977

- [28] (P). Bobak Kiani, Randall Balestriero, Yubei Chen, Seth Lloyd, Yann LeCun, *Joint-embedding self-supervised learning in the kernel regime*. arXiv preprint: 2209.14884
- [27] (C). Shengbang Tong\*, Xili Dai\*, Yubei Chen, Mingyang Li, Zengyi Li, Brent Yi, Yann LeCun, Yi Ma, Unsupervised learning of structured representations via closed-loop transcription, Conference on Parsimony and Learning (CPAL), 2024
- [26] (J). Yubei Chen\*, Adrien Bardes\*, Zengyi Li, Yann LeCun, Bag of image patch embedding behind the success of self-supervised learning, Transactions on Machine Learning Research (TMLR), 11/2023
- [25] (P). Zengyi Li, Yubei Chen, Yann LeCun, Friedrich T. Sommer, Neural manifold clustering and embedding. arXiv preprint: 2201.10000 (In revision for Journal of Machine Learning Research, (JMLR))
- [24] (C). Yubei Chen, Zeyu Yun, Yi Ma, Bruno Olshausen, Yann LeCun, Minimalistic unsupervised learning with the sparse manifold transform, International Conference on Learning Representations, (ICLR), 2023 (Spotlight, notable-top-25%)
- [23] (C). Quentin Garrido, Yubei Chen, Adrien Bardes, Laurent Najman, Yann Lecun, On the duality between contrastive and non-contrastive self-supervised learning, International Conference on Learning Representations, (ICLR), 2023 (Oral, notable-top-5%, Outstanding Paper Honorable Mentions Award)
- [22] (C). Pu Hua, Yubei Chen<sup>†</sup>, Huazhe Xu<sup>†</sup>, Simple Emergent Action Representations from Multi-task Policy Training, International Conference on Learning Representations, (ICLR), 2023
- [21] (C). Ho Yin Chau, Frank Qiu, Yubei Chen, Bruno Olshausen, Disentangling images with lie group transformations and sparse coding. Proceeding of Machine Learning Research (PMLR) Volume on Symmetry and Geometry in Neural Representations (NeurReps Workshop), Advances in Neural Information Processing Systems (NeurIPS-W), 2022
- [20] (C). Jiayun Wang\*, Yubei Chen\*, Stella X. Yu, Brian Cheung, Yann LeCun, Compact and optimal deep learning with recurrent parameter generators. IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2023
- [19] (C). Jiayun Wang, Jierui Lin, Qian Yu, Runtao Liu, Yubei Chen, Stella X. Yu, 3D shape reconstruction from free-hand sketches. The 2nd Workshop on Drawings and Abstract Imagery: Representation and Analysis (DIRA), European Conference on Computer Vision (ECCV-W), 2022 (Full-paper Spotlights)
- [18] (J). Hong-Y Hu, Dian Wu, Yi-zhuang You, Bruno Olshausen, Yubei Chen, RG-Flow: A hierarchical and explainable flow model based on renormalization group and sparse prior. Machine Learning: Science and Technology, (MLST), 2022.
- [17] (C). Yunhui Guo, Xudong Wang, Yubei Chen, Stella X. Yu, Clipped hyperbolic classifiers are superhyperbolic classifiers. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2022.
- [16] (C). Chun-Hsiao Yeh, Cheng-Yao Hong, Yen-Chi Hsu, Tyng-Luh Liu, **Yubei Chen**, Yann LeCun, *Decoupled contrastive learning*. European Conference on Computer Vision (ECCV), 2022.
- [15] (C). Zeyu Yun\*, Yubei Chen\*, Bruno Olshausen, Yann LeCun, Transformer visualization via dictionary learning: contextualized embedding as a linear superposition of transformer factors. Deep Learning Inside and Out (DeeLIO) Workshop (NAACL-W), 2021.
- [14] (J). Zengyi Li, Yubei Chen, Friedrich T. Sommer, A neural network MCMC sampler that maximizes proposal entropy. (Entropy), 2021.

- [13] (C). Vincent Lu, Weilin Sun, Aaron Truong, Hermione Bossolina and Yubei Chen, End-to-End Domestic Cat Sound and Emotion Recognition with Deep Neural Networks. International Conference on Statistical Language and Speech Processing (SLSP), 2020.
- [12] (C). Jiayun Wang, Yubei Chen, Rudrasis Chakraborty, Stella X. Yu. Orthogonal convolutional neural networks. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2020.
- [11] (J). Zengyi Li, Yubei Chen, Friedrich T Sommer, Learning energy-based models in high-dimensional spaces with multi-scale denoising score matching. arXiv preprint: 1910.07762, 2019 (Entropy), 2023.
- [10] (P). Juexiao Zhang\*, Yubei Chen\*, Brian Cheung, Bruno Olshausen, Word embedding visualization via dictionary learning. arXiv preprint: 1910.03833, 2019
- [9] (A). Yubei Chen, Dylan M. Paiton, Bruno Olshausen, Friedrich T. Sommer. A geometric theory for complex cells. Annual Meeting of Society for Neuroscience (SFN), 2019.
- [8] (C). Brian Cheung, Alex Terekhov, Yubei Chen, Pulkit Agrawal, Bruno Olshausen, *Superposition of many models into one*. Advances in Neural Information Processing Systems (NeurIPS), 2019.
- [7] (C). Yubei Chen, Dylan Paiton, Bruno Olshausen, *The sparse manifold transform*. Advances in Neural Information Processing Systems (NeurIPS), 2018.
- [6] (J). Cong Wang, Yu Zhao, Yubei Chen, Masayoshi Tomizuka, Nonparametric statistical learning control of robot manipulators for trajectory or contour tracking. Robotics and Computer-Integrated Manufacturing (RCIM), 2015.
- [5] (J). Shuai Mu, Yandong Deng, Yubei Chen, Huaiming Li, Jianming Pan, Wenjun Zhang, Zhihua Wang, Orchestrating cache management and memory scheduling for GPGPU applications. IEEE Transactions on Very Large Scale Integration (VLSI) Systems, 2013.
- [4] (J). Shuai Mu, Dongdong Li, Yubei Chen, Yangdong Deng, Zhihua Wang, Exploiting the task-pipelined parallelism of stream programs on many-core GPUs. IEICE Transactions on Information and Systems, 2013.
- [3] (J). Chuntao Hong, Dehao Chen, Yubei Chen, Wenguang Chen, Weimin Zheng, Haibo Lin, Providing source code level portability between CPU and GPU with mapCG. Journal of Computer Science and Technology (JCST), 2012.
- [2] (C). Yuhao Zhu, Yangdong Deng, Yubei Chen, Hermes: an integrated CPU/GPU microarchitecture for IP routing. ACM/EDAC/IEEE Design Automation Conference (DAC), 2011.
- (Ph.D. Thesis). Yubei Chen, The Sparse Manifold Transform and Unsupervised Learning for Signal Representation. UC Berkeley, 2020.

#### **Invited Talks**

Explainable AI and Data-Centric Efficiency - GenAI Summit, San Francisco	Jun. 2024
Using generative models to improve generative models - GenAI on the Edge Forum, TinyML Foundation	Mar. 2024
Seeking the principles of unsupervised representation learning	
- Asilomar Conference on Signals, Systems, and Computers	Oct. 2024

- Mathematics of Data and Decision in Davis (MADDD) Seminar Series	Apr. 2024
- QuEST Seminar, Air Force Research Laboratory	Mar. 2024
- Online Seminar, TechBeat.net	Jun. 2023
- Research Seminar at Cognitive Science Department, UCSD	Mar. 2023
- Wu Tsai Institute Symposium on Computation and Cognition, Yale University	Mar. 2023
- Research Seminar at ECE Department, UC Davis	Feb. 2023
- Redwood Center for Theoretical Neuroscience Seminar, UC Berkeley	Jan. 2023
- Center for Computational Neuroscience (CCN) Seminar, Flatiron Institute	Jan. 2023
- The System Level Design Group (SLD) Seminar, UT Austin	Dec. 2022
- University of Washington NeuroAI Seminar	Nov. 2022
- UC Berkeley's 34th Annual Bay Area Vision Research Day (BAVRD)	Sep. 2022
RG-Flow: hierarchical and explainable flow model based on renormalization group and s	parse prior
- Facebook AI Research Annual Conference	Dec. 2020
The sparse manifold transform and unsupervised learning for signal representation	
- Research seminar at Prof. Yanzhi Wang's group at Northeastern U., ECE	Jan. 2021
- Research seminar at Facebook AI Research	Mar. 2020
- Research seminar at Prof. Eero Simoncelli's group at NYU, Center for Neural Science	Mar. 2020
The sparse manifold transform	
- Research seminar at Prof. Bin Yu's group at UC Berkeley, Stats Dept.	Mar. 2019
- Vision group research seminar at International Computer Science Institute (ICSI)	Feb. 2019
- AI Yanxishe – Online AI Open Lectures	Dec. 2018
- Cresta AI research seminar	Nov. 2018
- Cerebras systems research seminar	Oct. 2018
Will the three basic ideas in signal modeling give us new directions in control theory?	
- Mechanical Systems Control (MSC) Lab lunch seminar, UC Berkeley	May. 2016