Kai (Karol) Yan

Shanghai, China | +1 3413338605 | karolyan1215@berkeley.edu

EDUCATION

Tongji University **Shanghai, China**
B.S. in Engineering Mechanics (GPA:86.99/100) Sep. 2022-Jul. 2026
University of California, Berkeley (UC Berkeley) **Berkeley, USA**
Visiting Student (GPA:3.7/4.0) Jan. 2025-May 2025
Research Interests: Neural-inspired Algorithm, Neuromorphic Computing for Wearable Devices and BCI.

PUBLICATION

1. **Kai Yan**, Yanbing Jia, Huaguang Gu*, Complex dynamics related seizure in network composed of excitatory and inhibitory neurons modulated by inhibitory autapse. *(Under review of Cognitive Dynamics)*
2. **Kai Yan**, Enhui Ma, Kaicheng Yu* A Self-evolving Agentic Framework based on Supervised Signal Tuning: Take OVD Task as an example. (*Under review of CVPR2026*)

RESEARCH EXPERIENCE

Neuromorphic scientific computing based on single-crystal 2D MoS_2 **Hangzhou, China**
Research Assistant | Prof. Wei Kong at Westlake University Sep. 2025-Present

- **Research Topic:** To addressed the "Hard Computing" bottleneck in existing Compute-in-Memory (CIM) architectures limited by polycrystalline memristors, proposed a high-precision CIM paradigm based on wafer-scale single-crystal MoS_2 to achieve O(1) complexity for scientific computing.
- Designed a Floating-gate Field-effect Transistor (FGFET) using single-crystal MoS_2 with defect engineering via high-temperature vacuum annealing to ensure precision and linearity. Developed an 8-bit bit-slicing architecture combined with a mixed-precision iterative refinement algorithm to map 32-bit scientific problems onto the array.
- Achieved ultra-low device-to-device variability (~5%) and high array yield (>95%) compared to polycrystalline counterparts. Validated the system's capability to solve Poisson equation with high precision and on-chip training accuracy on CIFAR-10 using a calibrated NeuroSim framework.

Self-Evolving Agentic Close-loop Framework **Hangzhou, China**
Research Assistant | Prof. Kaicheng Yu at Westlake University July. 2025-Oct. 2025

- **Research Topic:** To deal with the long-tail tasks in visual tasks, developing a self-evolving agentic system to tune model weights online with synthetic data generated with updated supervised signals.
- Constructed a novel self-evolving agent framework where a LM-based agent guides diffusion models to iteratively generate corrective fine-tuning data based on updated structural ground truth as supervised signal. Validated the framework with OVD tasks using YOLO World and Gligen on COCO benchmark.
- Achieved a 62.5% mAP improvement on failure cases after 3 self-correction loops of model fine-tuning on NVIDIA H800 clusters. Proved the models tuned by data with updated supervised signals can outperform the one with original ground truth by 17% in total mAP and 30% in failure case mAP.

EEG Pattern Recognition and Classification by Class-specific RNN **CA, USA**
Research Assistant | Prof. Lexin Li at UC Berkeley Feb. 2025-July 2025

- **Research Topic:** To avoid high consumption of Transformers and the weakness of Vanilla RNN under edge conditions, developing a novel Class-specific RNN to improve performance on EEG classification.
- Designed a Class-specific RNN assigning predictor RNNs for all signal types and compare their hidden state MSE to classify samples. Generated an EEG simulation dataset with various Gaussian noise level. Mathematically proved that each predictor can learn unique hidden state dynamics by statistic methods.

- Validated that Class-specific RNN achieved accuracy around 100% while Vanilla RNN only achieved 28% on simulation EEG dataset. Computed t-SNE similarity between different predictors in Class-specific RNN to be larger than 1.4.

Biologically plausible Gain&Shift R/SNN with Feedback Control **CA, USA**
Research Assistant | Prof. Kristofer Bouchard at UC Berkeley Jan. 2025-July 2025

- **Research Topic:** To design a biologically plausible algorithm which can be deployed on neuromorphic hardware, developing a Gain&Shift RNN/SNN with LQR and parameter training controller.
- Designed a Gain&Shift modulated Recurrent SNN codebase in 2 weeks. Applied STDP, Dale's law and Hebbian Learning Rules to simulate biological-plausible behavior in networks. Replaced the SGD with a LQR as a feedback controller for training. Utilized Slurm to run large-scale parameter searching.
- Validated that the Gain&Shift RNN/SNN can archieve 10 times lower loss than vanilla RNNs on approximation tasks with chaotic target functions. Analyze more than 10 conditions with ablation study.

The Complex Dynamics of Seizure Modulated by Inhibitory Autapses **Shanghai, China**
Research Assistant | Prof. Huaguang Gu at Tongji University Apr. 2023-Dec. 2024

- **Research Topic:** To understand the complex dynamics in neuron groups modulated by inhibitory autapses during seizures, modeling a coupled network and analyze the results with bifurcation theory.
- Developed a fast-spiking synchronous neural network with inhibitory autapses in C++. Utilized OriginLab and MATLAB to visualize the attractors on parameter planes. Applied the Kuromoto-R1 index and firing rate to quantify the seizure extent of networks.
- Established evidence for dual-regime autaptic modulation according to bifurcation theory, identified the (g_{syn}, β) parameter plane boundaries through the simulation data, and demonstrated how autapses paradoxically reduce the network synchronism from 0.99 to 0.2 and the firing rate from 1 to 0.

PROJECT

Realization of Logic Circuits based on neuromorphic Ion-Fluidic Memristor **Shenzhen, China**
Research Assistant | Prof. Alessandro Siria at ENS Paris & TsingHua X Institute Aug. 2024-Sept. 2024

- Performed circuit simulation using Multisim to design NAND gates. Conducted COMSOL nano-fluidic simulations to reveal hysteresi-curved ion migration dynamics, and demonstrated that surface charge density modulation significantly influences ion migration barriers.
- Designed lithographic mask layouts with L-Edit and integrated fluidic memristors. Conducted patch clamp experiments to validate hysteretic curve in devices. Adjusted the solution concentration to optimize the memristor's On/Off ratio to meet the performance requirements.

SNN-RL E2E Autonomous Driving System Based on Neuromorphic Computing **Shanghai, China**
Team Leader | Prof. Peng Yi at Tongji University Mar. 2024-Apr. 2025

- Developed a STCNN-SNN-Transformer algorithm to address the energy-accuracy-latency trilemma, where low-frequent ST-CNN can extract spatiotemporal features from RGB inputs and event-driven dual-path SNN can achieve 12ms dynamic detection at 0.8mJ/inference
- Constructed comprehensive simulation environments in UE 4 and Microsoft AirSim, covering 50+ edge cases (adverse weather, sensor failures), and optimized SNN layers for compatibility with Synsense Tech's Xylo neuromorphic chip.

SKILL

Programming: C/C++, Python, PyTorch, TensorFlow, Pandas, MPI, Docker, Bash, Git, MySQL
Software: OriginLab, MATLAB, Markdown & LaTeX, Verilog-A, L-edit, Multisim, Comsol, Zotero
Language: English (Proficient), Chinese (Native)