

Mufeng Chen

Email : chenmufeng@zju.edu.cn

Interests: Compute-in-Memory (CiM),
Neuromorphic-Computing, Resistive-RAM (RRAM)
Personal Website: <https://chenmufeng0119.github.io/>

EDUCATION

Zhejiang University

Master of Science in Electronic Engineering

Hangzhou, Zhejiang, China

Sept. 2021 - Present

- **GPA:** 3.93/4.00

Huazhong University of Science and Technology

Bachelor of Engineering in Optical&Electronic Engineering

Wuhan, Hubei, China

Sept. 2017 - Jul. 2021

- **GPA:** 3.92/4.00

Core courses: Circuit Theory: 98/100; Probability Theory and Mathematical Statistics: 100/100;
Electrodynamics: 95/100; Micro/Nano Electronics: 90/100; Micro-nano Optoelectronic Devices: 94/100;
Signal and Linear System: 94/100; Principle and Application of Single Chip Microcomputer: 94/100;
Microcomputer Experiments: 94/100

PUBLICATIONS

- Yu, C., Du, Y., **Chen, M.**, Wang, A., Wang, G., & Li, E. (2022). *MAP-SNN: Mapping spike activities with adaptability, and plasticity into bio-plausible spiking neural networks*. *Frontiers in Neuroscience*, 16, 945037.
- Li, E. P., Ma, H., Ahmed, M., Tao, T., Gu, Z., **Chen, M.**, ... & Chen, W. (2023). *An Electromagnetic Perspective of Artificial Intelligence Neuromorphic Chips*. *Electromagnetic Science*.

PREPRINTS AND OTHER RESEARCH PROJECTS

- **Mufeng Chen**, Erping Li. *Spiking Mixers for Robust and Energy-efficient Vision-and-Language Learning*. 2023. (under review for ICLR 2024)
- **Mufeng Chen**, Haitong Li. *Neuro-Vector-Symbolic Vision Transformer for Few Shot Classification and Generation*. 2023. (to be submitted to DAC-24)
- **Mufeng Chen**, Erping Li, et. al. *SNN-DNN hybrid distillation with mixture of experts*. (to be published)

RESEARCH EXPERIENCES

Reconfigurable Neuromorphic RRAM-CiM for Spiking/Non-spiking Transformer Workload

Advisor: Aili Wang, Liang Zhao, Erping Li

Nov. 2022 - Present

Zhejiang University - University of Illinois Urbana-Champaign Institute

Jiaxing, Zhejiang, China

- Developed a bitline-sharing eDRAM-RRAM hybrid CiM aiming to provide better throughput characteristics against the inherent variation of RRAM cell while taking advantage of the small footprint of RRAM storage and its zero-leakage feature.
- The bitline is reconfigurable to support differential amplifier/transmission gate for diff-frame operations and denoising as well as adaptive ADC for DNN computations.
- Special Input encoding scheme is adapted to support MSB/LSB input format simultaneously in bit-serial DNN mode and spike counting mode for SNN.

Neuro-Vector-Symbolic Vision Transformer for Few Shot Classification and Generation

Advisor: Haitong Li

Apr. 2023 - Present

NanoX Lab, Purdue University

West Lafayette, IN, USA

- Developed Vision Transformer with Hyperdimensional (HD) Computing ladder part, which harnessed HD for enhanced on-chip learning capability. Exploited HRR-based VSA models to retrieve input data generatively and avoid the computation cost of traditional parallel read out schemes for distributed memory systems.
- Developed and modeled in-memory FFT circuit for handling the computation of HRR-based HD computing.

- Trade-off between 2D, 2.5D, and 3D CiM for the above model is investigated, and an accelerator featuring a separate FFN core, attention core, and HD core is developed.

Multimodal Spiking-Mixer with Robustness-Improved ODE-Neuron

Advisor: Erping Li

Jun. 2023 - Oct. 2023

EIEI Center, Zhejiang University

Hangzhou, Zhejiang, China

- Proposed the first vision-language multimodal spiking neural network for image-caption application.
- Viewed SNN as Neural-ODE and analyzed the stability of the ODE to gain adversarial robustness.
- Extended the multimodal vision-language adversarial attack to the SNN domain, proposed the first black-box vision-language attack method, and demonstrated effectiveness compared to naive unimodal implementation.

Charge-Domain CiM for Bayesian Neural Network

Advisor: Kaiyuan Yang

Feb. 2022 - Aug. 2022

SIMS Lab, Rice University

Houston, TX, USA

- Built a variable bit precision neural network quantization method based on variational inference targeting flops reduction.
- Constructed a charge-domain SRAM-CiM for uncertainty-aware CNN quantized by the above algorithm.
- Intended to gain effective energy reduction with charge reuse and unstructured sparsity routing/zero skipping based on workload characteristics.

MAP: A New SNN Training Method

Advisor: Yang Du, Aili Wang, Erping Li

Nov. 2021 - Feb. 2022

EIEI Center, Zhejiang University

Hangzhou, Zhejiang, China

- Proposed an algorithm investigating the discretization problem in time-iteration and demonstrated the robustness of our algorithm under varying iterative step lengths.
- Proposed a spike frequency adaptation (SFA) mode as a multi-spike pattern (MSP) implementation for efficient spike inference and robustness under this mode.
- Enhanced temporal expressiveness using a state-free synaptic response model (SFSRM), and it is compatible with deep learning frameworks.

Polarization—Sensitive Achromatic Metalenses

Aug. 2019 - Jun. 2020

Advisor: Chen Lin

Huazhong University of Science and Technology

Wuhan, Hubei, China

- Designed and developed the FDTD script code of the layout of the monochromatic metalenses.
- Theoretically analyzed the principles of achromatic metalenses and swept the parameters.
- Optimized the metalens, compared it with the monochromatic ones and generated a report.
- Experimentally demonstrated the stable focal length of the designed lens in the visible band.

AWARDS AND HONORS

Outstanding Dissertation for Bachelor's Degree, *Huazhong University of Science and Technology*

Jun. 2021

People's scholarship, *Huazhong University of Science and Technology*

Jun. 2018

SKILLS

- **Coding:** C, C++, Python, MATLAB, Verilog, Chisel.
- **EDA Tools:** Virtuoso, Design Compiler, Synopsys VCS, Lumerical.