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 Hangzhou, Zhejiang, China
Master of Science in Electronic Engineering *Sept. 2021 - Present*

- **GPA**: 3.93/4.00

Huazhong University of Science and Technology Wuhan, Hubei, China
Bachelor of Engineering in Optical&Electronic Engineering *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 Vison 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, China*

- Developed a bitline-sharing eDRAM-RRAM hybrid CiM aiming to provide better throughput characteristic against the inherent variation of RRAM cell while taking advantage of the small footprint of RRAM storage and its zero-leakage characteristic.
- 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 simultaneously support MSB/LSB input format 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*

- Developed Vision Transformer with Hyperdimensional(HD) Computing ladder part which harness HD part for enhanced on-chip learning capability. Exploited HRR based VSA models to retrieve input data in a generative fashion andavoid the computation cost of traditional parellel read out scheme for distributed memory systems.
- Developed and modelled 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, China*

- Proposed the first vision-language multi-modal 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 vison-language adversarial attack to the SNN domain, propose 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*

- 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, China*

- Proposed an algorithm investigating the discretization problem in time-iteration and demonstrated the robustness of our algorithm under varying iterative step lengths.
- Proposed an 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, China*

- Designed and developed the FDTD script code of the layout of the monochromatic metalenses.
- Therotically analyzed the principles of achromatic metalenses and swept the parameters.
- Optimized the metalens and compared it with the monochromatic ones and generated a report regarding it.
- Experimentally demonstrated the stable focal length of 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.