Curriculum Vitae

Cheng Wang

Assistant Professor

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Professional Employment

Assistant Professor	2022 - Present
Iowa State University	Ames, IA
Research Scientist	2019 – 2022
Purdue University	West Lafayette, IN
Research and Development Engineer	2016 – 2019
Seagate Technology	Fremont, CA

Education

Ph.D. Physics	**The University of Texas at Austin**	2010 - 2015 Austin, TX
B.S. Physics	**Peking University**	2005 - 2009 Beijing, China

Current Research (*https://faculty.sites.iastate.edu/chengw/research*)

- **Design machine learning (ML) hardware acceleration through co-design across the stack of device-circuit, architecture, and algorithm**, with a particular emphasis on non-von Neumann ***Computing In Memory*** *(CIM) based on* ***emerging non-volatile memories (NVMs)***.
- **Improve ML processing efficiency** and **develop neuro-inspired computing systems** by exploiting various **emerging electronic, spintronic, and photonic devices** and **materials.**
- **Develop novel artificial intelligence (AI) algorithms** in pursuit of efficient cognitive tasks (such as vision and sequential processing) for **resource-constrained scenarios and edge applications**.

Previous Research Experience

Research Scientist 2019-2022

Center for Brain Inspired Computing (C-BRIC), *Purdue University* West Lafayette, IN

- Center Director: Professor Kaushik Roy

- Explored emerging Spin-Orbit-Torque MRAM crossbars for **reliable ML inference hardware**. Conducted **sparsity-aware device-circuit-system co-design** to address the two main design challenges in analog in-memory computing – crossbar non-idealities and high latency/energy cost from analog-digital converters.
- Proposed a highly **scalable analog magnetic memory** based on **multi-domain quantum spin devices**. Observed **improved energy efficiency and noise resiliency with such neuro-mimetic hardware**.
- Conducted in-depth technology exploration of various leading NVM candidates for **building scalable crossbar-based in-memory computing system**. Integrated technology-aware array-level simulation and analysis of computational error and energy/area cost into system-level performance evaluation.
- Exploited MRAM for **ML training acceleration**. Investigated the design trade-off involving write voltage, latency, and error rate based on the device characteristics. Improved system-level performance by leveraging the inherent algorithm-level noise resiliency combined with a hardware-software co-design.

- Developed exploratory computational models and algorithms for complex AI tasks such as image or text processing. **Achieved significant energy and memory saving at sequential processing** using a novel **spectral domain** oscillatory recurrent neural network.

Senior/Staff R&D Engineer, *Seagate Technology* 2016-2019

Optimized the device design for multi-bit memory, and experimentally demonstrated highly scalable analog magnetic memory states based on commercial data storage platform.

Proposed magnetic granular devices for **analog in-memory computing.** Experimentally demonstrated highly scalable analog magnetic memory states based on commercial data storage platform.

Recognition: Technical Award 2018 *(Fremont Research Center)*

Graduate Research Assistant, *UT Austin* 2010-2015

Observed electrically tunable I-V characteristics with memristive switching in an iridium (Ir)-based quantum material, paving the way of developing memristors based on novel oxides. Discovered sizeable anisotropic magnetoresistance in an antiferromagnetic (AF) oxide which for AF-based memory. Developed electrical detection of spin-transfer-torque driven ferromagnetic resonance (STT-FMR) for developing ultra-fast MRAM.

Research Assistant, *Institute of Physics, Chinese Academy of Sciences* 2009-2010

Developed device modeling of one-dimensional electron transport with current-driven magnetic domain wall motion in magneto-electronic memory devices.

Selected Publications

- D.E. Kim, Aayush Ankit**, Cheng Wang**, and Kaushik Roy*,"* **SAMBA: Sparsity Aware In-Memory Computing Based Machine Learning Accelerator** - *IEEE Transactions on Computers, (2023)*
- Wilfried Haensch, Anand Raghunathan, **Cheng Wang** et al, "**A Co-design view of Compute in-Memory with Non-Volatile Elements for Neural Networks**", *Advanced Materials* (2023).
- **Cheng Wang**, "Enabling efficient machine learning with device-to-algorithm co-design of spintronic hardware: opportunities and challenge" SPIE Spintronics XVI, (2023).
- **Cheng Wang**, Chankyu Lee, and Kaushik Roy, "**Noise resilient leaky integrate-fire neuron based on multi-domain spintronic devices**", *Scientific Reports 12 8361 (2022).*
- Gobinda Saha, **Cheng Wang**, and Kaushik Roy, "**Invited: A Cross-layer Approach to Cognitive Computing**", In press, *IEEE/ACM Design Automation Conference (2022).*
- Kang He, Indranil Chakraborty, **Cheng Wang** and Kaushik Roy, "**Design Space and Memory Technology Co-exploration for In-Memory Computing Based Machine Learning Accelerators**", *IEEE/ACM International Conference on Computer-Aided Design (*ICCAD) (2022).
- Bing Han, **Cheng Wang,** and Kaushik Roy, "**Oscillatory-Fourier Neural Network: A Compact and Efficient Architecture for Sequential Processing**", *Conference on Artificial Intelligence (AAAI 2022),*
- Tanvi Sharma, **Cheng Wang**, Amogh Agrawal, and Kaushik Roy, "**Enabling Robust SOT-MTJ Crossbars for Machine Learning using Sparsity-Aware Device-Circuit Co-design**". 2021 *IEEE/ACM International Symposium on Low Power Electronics and Design (ISLPED)*.
- Hussam Amrouch, **Cheng Wang**, *et al* "**Brain-Inspired Computing: Adventure from Beyond CMOS Technologies to Beyond von Neumann Architectures**", *IEEE/ACM ICCAD 2021.*
- Amogh Agrawal, **Cheng Wang**, Tanvi Sharma, and Kaushik Roy, "**Magneto-resistive Circuits and Systems: Embedded Non-Volatile Memory to Crossbar Arrays**", *IEEE Transactions on Circuits and Systems I. 68, 6 (2021) Selected as Highlight of 2021 June Issue.*