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 2010 - 2015
The University of Texas at Austin Austin, TX

B.S. Physics 2005 - 2009
Peking University Beijing, China

Current Research

Design energy-efficient hardware acceleration for machine learning (ML) through co-design across the stack of device-circuit, architecture, and algorithm, with a particular emphasis on **Computing In Memory** (CIM) based on **emerging non-volatile memories (NVMs)**. Develop novel electronic devices and systems for **emerging non-volatile memory and high-density data storage**.

Improve efficiency of processing **artificial intelligence (AI)** and **brain-inspired computational models** by exploiting various **emerging electronic/photonic devices** and **materials.**

Explore novel algorithms in pursuit of efficient processing of ML tasks (such as computer vision and sequential processing) geared for **resource-constrained scenarios such as 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

- **Cheng Wang**, Chankyu Lee, and Kaushik Roy, "**Noise resilient leaky integrate-fire neuron based on multi-domain spintronic devices**", *Scientific Reports 12 8361 (2022).*
- Wilfried Haensch, Anand Raghunathan, Cheng Wang et al, "**A Co-design view of Compute in-Memory with Non-Volatile Elements for Neural Networks**", in press, Advanced Materials (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.*