

MUHAMMAD RASHED

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EDUCATION

University of Central Florida, Orlando

PhD in Computer Engineering, Department of ECE

Thesis: *Towards Energy-Efficient In-Memory Computing Systems* (Supervisor: Prof. Rickard Ewetz)

January 2020 - present

(Expected in Spring 2024)

University of Texas at San Antonio, San Antonio

Graduate Coursework, Department of ECE

August 2018 - December 2019

Bangladesh University of Engineering and Technology

Bachelor of Science, Department of Electrical and Electronics Engineering

May 2010- September 2015

RESEARCH INTEREST

My research broadly aims to solve the computing-efficiency gap for data driven applications. An emerging solution strategy is to leverage non-volatile memory devices and perform energy-efficient in-memory computing. On this topic I have published 12 top-tier conference papers (average acceptance rate: 20%). My ICCAD'22 paper has received the IEEE/ACM William J. McCalla ICCAD Best Paper Award Nomination. My research interests includes topics, as follows:

- EDA for Emerging Computing Paradigms and Architectures
- Artificial Intelligence
- Hardware Accelerators
- Computer-Aided Design

SELECTED PUBLICATIONS

1. [ICCAD'23] **M Rashed**, S. Thijssen, SK Jha, and R Ewetz, "Automated Synthesis for In-Memory Computing", 42nd International Conference On Computer Aided Design (ICCAD), 2023. (accepted)
2. [ICCAD'23] **M Rashed**, S. Thijssen, SK Jha, H Zheng, and R Ewetz, "Path-based Processing using In-Memory Systolic Arrays for Accelerating Data-Intensive Applications", 42nd International Conference On Computer Aided Design (ICCAD), 2023. (accepted)
3. [ICCAD'23] S. Thijssen, S. Singireddy, **M Rashed**, SK Jha, and R Ewetz, "Verification of Flow-Based Computing Systems using Bounded Model Checking", 42nd International Conference On Computer Aided Design (ICCAD), 2023. (accepted)
4. [ICCD'23] S. Singireddy, **M Rashed**, S. Thijssen, SK Jha, and R Ewetz, "Input-Aware Flow-Based In-Memory Computing", 41st International Conference on Computer Design (ICCD), 2023. (accepted)
5. [TCAD'23] **M Rashed**, S. Thijssen, F Yao, SK Jha, and R Ewetz, "STREAM: Towards READ-based In-Memory Computing for Streaming Based Processing for Data-Intensive Applications", IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, 2023.
6. [DAC'23] S. Thijssen, **M Rashed**, SK Jha, and R Ewetz, "UpTime: Towards Flow-based In-Memory Computing with High Fault-Tolerance", in 60th Design Automation Conference (DAC), 2023.

7. [ASP-DAC'23] M Rashed, SK Jha, and R Ewetz, "Discovering the In-Memory Kernels of 3D Dot-Product Engines", 28th Asia and South Pacific Design Automation Conference, 2023.
8. [ICCAD'22] M Rashed, SK Jha, and R Ewetz, "Logic Synthesis for Digital In-Memory Computing", 41st International Conference On Computer Aided Design (ICCAD), 2022. (**Best paper nomination**)
9. [DAC'22] M Rashed, A Awad, SK Jha, and R Ewetz, "Towards Resilient Analog In-Memory Deep Learning via Data Layout Re-Organization", 59th Design Automation Conference (DAC), 2022.
10. [DATE'22] M Rashed, SK Jha, F Yao and R Ewetz, "Hybrid Digital-Digital In-Memory Computing", 25th Design Automation and Test in Europe Conference (DATE), 2022.
11. [ASP-DAC'22] M Rashed, S. Thijssen, F Yao, SK Jha, and R Ewetz, "STREAM: Towards READ-based In-Memory Computing for Streaming based Data Processing", 27th Asia and South Pacific Design Automation Conference (ASP-DAC), 2022.
12. [ICCAD'21] M Rashed, SK Jha, and R Ewetz, "Hybrid Analog-Digital In-Memory Computing", 40th International Conference On Computer Aided Design (ICCAD), 2021.
13. [MICRO'21] M Chowdhury, M Rashed, A Awad, R Ewetz, and F Yao, "LADDER: Architecting Content and Location-aware Writes for Crossbar Resistive Memories", 54th International Symposium on Microarchitecture (MICRO), 2021.

Prior to PhD:

14. [ICAEE'17] M Rashed, M Zaman, M Islam and M Raihan, "An analysis on the required reinforcement for embedding a nuclear power plant in a generic power system", 4th International Conference on Advances in Electrical Engineering (ICAEE), 2017.
15. [EICT'17] S Saha, S Ukil and M Rashed, "Numerical investigation on the performance of new ultra-thin CZTS solar cell using SCAPS", 3rd International Conference on Electrical Information and Communication Technology (EICT), 2017.
16. [ICAEE'17] A Dewanjee, N Dey, M Rashed, A Muhury and J Dhar, "High performance cost effective formalin detector using conductivity property", 4th International Conference on Advances in Electrical Engineering (ICAEE), 2017.
17. [ICECE'16] M Nadim, M Rashed, A Muhury and S Mominuzzaman, "Estimation of optimum tilt angle for PV cell: A study in perspective of Bangladesh", 9th International Conference on Electrical and Computer Engineering (ICECE), 2016.

ABSTRACTS/POSTER PRESENTATIONS

1. [DATE'22] PhD Forum, 26th Design Automation and Test in Europe Conference (DATE), 2023.
2. [DAC'22] PhD Forum, in 58th Design Automation Conference (DAC), 2022.
3. [DAC'21] Young Fellow Program, in 58th Design Automation Conference (DAC), 2021.

WORK EXPERIENCE

University of Central Florida
Graduate Research Assistant

January 2020 - present

- Developed a logic synthesis framework for digital in-memory computing. The framework improves the area-latency of multiplication operation by 77% and 20% over the state-of-the-art. [ICCAD'22, ICCAD'23]

- Designed a in-memory systolic array system using path-based in memory computing. The system is 23X faster than traditional systolic arrays. [ICCAD'23]
- Developed an efficient 3D dot product engine (DPE) architecture that achieves 2.02X, 2.37X, and 2.45X improvements in area, energy, and latency respectively over 2D DPE. [ASP-DAC'23]
- Developed a data layout re-organization framework for analog in-memory deep learning. The framework improves precision in hardware by up to 3.2X. [DAC'22]
- Developed design automation infrastructure for hybrid analog-digital in-memory computing. The hybrid paradigm achieved 2.5X overhead improvement over state-of-the-art paradigms. [ICCAD'21, DATE'22]
- Proposed a streaming based in-memory computing architecture for evaluating Boolean logic. The architecture improves performance over state-of-the-art with up to 20X by eliminating expensive and error prone WRITE operations. [ASP-DAC'22, TCAD'23]
- Delivered an effective and low-cost location and data aware processor-side architecture for memristor based memory systems. The framework called LADDER achieves 13.2% performance improvement over state-of-the-art designs. [MICRO'21]

University of Texas at San Antonio
Graduate Research Assistant

August 2018 - December 2019

- Developed secure automated vehicular communication protocol between OBU and RSU units.

Abul Khair Steel Melting Limited
Technical Management

October 2015 - June 2018

- Supervised electrical power distribution in the Main Receiving Sub-Station (MRSS).
- Supervised the routine electrical maintenance to circumvent breakdowns. Reduced equipment shut-down by two occurrences per year.

SKILLS

- *Programming language:* C++, Python, MATLAB and Verilog.
- *VLSI Tools:*
 - Synthesis Tool: Design Compiler, ABC, YOSYS, SIS
 - FPGA Software: Xilinx Vivado Design Suite
 - Profiler: CACTI 7, ARM Forge
- *Operating Systems and Software:* Linux, Windows, Office Software, Latex, AutoCad.

TEACHING EXPERIENCE

- **C++ and Data Structures (UTSA)**
 Object-oriented programming including data abstraction, inheritance, operator overloading and polymorphism. Application of OOP to study various data structures including stacks, queues, linked lists, trees, binary trees and graphs.
- **Engineering Analysis and Computation (UCF)**
 Engineering analysis and computation with structured constructs. Subscripted variables, functions, input/output. Applications in embedded systems and examples in numerical methods.

- ***Guest Lecture: Computer-Aided Design of VLSI*** (UCF)

An introduction to computer-aided design (CAD) for very large scale integration (VLSI). The focus is on algorithms and data structures that are used within logic synthesis.

PROFESSIONAL SERVICE

- Session Chair, Design Automation Conference (DAC) 2022
- Technical Reviewer, IEEE Transactions on Emerging Topics in Computing 2022
- Technical Reviewer, International Conference on Computer Design (ICCD) 2021, 2022
- Technical Reviewer, The Great Lakes Symposium on VLSI (GLSVLSI) 2021, 2022
- Technical Reviewer, International Conference on AI Circuits and Systems (AICAS) 2022, 2023

AWARDS AND HONORS

- IEEE/ACM William J. McCalla **ICCAD Best Paper Award Nomination** (2022)
- David T. and Jane M. Donaldson Scholarship in the amount of \$4,000.00 (2022)
- DATE Travel Grant (2023)
- UCF SGA Travel Grant (2023)
- NSF Travel Grant (2021,2022,2023)
- ACM Travel Grant (2022)
- **Best Research Video Award** at the Design Automation Conference (DAC) Young Fellow (2021)
- The Presentation Fellowship by UCF Graduate Studies (2021, 2022)
- 3MT Research Finalist at the University of Texas at San Antonio (2019)