Seyed Milad Ebrahimipour

M.Sc. in Computer Engineering

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Summary

Education

2016–2019 **M.Sc. in Computer Engineering**, *Shahid Bahonar University of Kerman*, Kerman, Iran, 19.60/20.

2012–2016 **B.Sc. in Computer Engineering**, *Shahid Bahonar University of Kerman*, Kerman, Iran, 17.80/20.

Selected Publications

[1] Seyed Milad Ebrahimipour, Behnam Ghavami, Hamdi Mousavi, Mohsen Raji, Zhenman Fang, and Lesley Shannon. Aadam: A fast, accurate, and versatile aging-aware cell library delay model using feed-forward neural network. In *Proceedings of the 2020 ACM/SIGDA International Conference On Computer Aided Design (ICCAD)*, pages 1–9, 2020.

[2] Seyed Milad Ebrahimipour, Behnam Ghavami, and Mohsen Raji. A statistical gate sizing method for timing yield and lifetime reliability optimization of integrated circuits. *IEEE Transactions on Emerging Topics in Computing*, 2020.

Research Projects

- **Yield and Lifetime Reliability in ASICs:** I have developed a particular interest in reliability modelling [1] and improvement of ASICs [2]
- **Reliability in FPGAs:** I have developed a framework for lifetime reliability analysis of FPGAs [3] as well as aging-aware FPGA architecture exploration[4]
- **Robustness Analysis of Hardware Accelerators:** I have worked on analysis of aging-induced delay degradation effects on FPGA-based Deep Learning Accelerators [5]
- **Dependability at Architecture Level:** I have developed a method for aging-aware Instruction Set Encoding in processors for lifetime reliability enhancement of Instruction Cache [5]

Selected Honors and Awards

2019 Selected as the **Best Student** in Computer Engineering Department, Shahid Bahonar University of Kerman

2019 **Ranked first GPA** among my Masters graduation class (30 students)

2016 **Ranked first GPA** among my Bachelors graduation class (70 students)

International Research Collaborations

Reconfigurable Computing LAB, **Simon Fraser University**, British Columbia, Canada
Collaboration on reliability in FPGAs and hardware accelerators research projects.
http://www2.ensc.sfu.ca/ lshannon/rcl/

Details

Education

Master

2016–2019 **M.Sc. in Computer Engineering, Computer Architecture**, *Department of Computer Engineering, Shahid Bahonar University of Kerman*, Kerman, Iran, 19.60/20.

Thesis Title *Aging-aware Reliability Improvement of Digital Systems*

Thesis GPA 19.50/20

Supervisor Professor Behnam Ghavami

Selected Courses and GPAs:

- Advanced Computer Architecture: 19/20
- Embedded System Design: 20/20
- Design of Low Power Systems: 18.75/20
- Advanced Computer Architecture: 19/20
- Performance Evaluation of Computer Systems: 19.5/20
- Fault Tolerant System Design: 20/20
- Computer Arithmetic: 20/20
- Quantum Computing: 20/20
- Fault Tolerant System Design: 20/20

Bachelor

2012–2016 **M.Sc. in Computer Engineering, Computer Hardware**, *Department of Computer Engineering, Shahid Bahonar University of Kerman*, Kerman, Iran, 17.80/20.

Thesis Title *Design and Implementation of ARM7-TDMIS on Xilinx Spartan 6 FPGA*

Thesis GPA 20/20

Supervisor Professor Behnam Ghavami

Selected Courses and GPAs:

- Computer Architecture: 20/20
- Logic Circuits: 17.50/20
- Signals and Systems: 20/20
- Design of Algorithms: 20/20
- Probability and Statistics: 19/20
- Electronic Digital: 18/20
- Automated Design of Digital Circuits: 20/20
- Embedded and Real-time Systems: 20/20
- VLSI System Design: 20/20
- Engineering Mathematics: 19.50/20
- Electronic Circuits: 18/20
- Electrical Circuits: 18/20
- Machine Language and Assembly: 20/20

Awards and Honors

2019 Selected as the **Best Student** in Computer Engineering Department, Shahid Bahonar University of Kerman

2019 **Ranked first GPA** among my Masters graduation class (30 students)

2018 Erasmus+ Winter School, **Gradana EU Project Scholarship**, Universit of Bonn, Germany

2016 Received **full Scholarship** for Masters degree (Tuition waiver), Shahid Bahonar University of Kerman

2016 **Ranked first GPA** among my Bachelors graduation class (70 students)

2016 **Exempted** from Iranian University Entrance Exam as an exceptional talent

2012 Received **full Scholarship** for Bachelors degree (Tuition waiver), Shahid Bahonar University of Kerman

Research Projects

- **Yield and Lifetime Reliability in ASICs:** With the CMOS technology scaling, transistor aging has become one major issue affecting circuit reliability and lifetime. In this research project, I have contributed in several papers, in which I first developed a machine learning based model, [1], to accurately estimate the delay of a circuit at the projected lifetime. Furthermore, I have proposed a fast and scalable logic re-synthesis technique to improve the lifetime reliability constraint of large scale combinational circuits [5, 6]. Besides that, due to technology scaling, the difficulty of precise fabrication process increases which leads to significant yield loss. Therefore, I proposed an incremental gate sizing method to improve both timing yield and lifetime reliability of the circuit [2].
- **Reliability in FPGAs:** Transistor aging raises a vital lifetime reliability challenge for FPGA devices in advanced technology nodes, which could lead to the performance loss or timing failure of FPGA designs over the time. In this project, I developed a framework capable of exploring different architectural ideas to find an architecture that suits the designers constraints from the aging-aware lifetime reliability perspective [7]. Furthermore, the framework is capable of estimating the projected lifetime delay of a circuit mapped on a FPGA.
- **Robustness Analysis of Hardware Accelerators:** Deep neural networks have achieved phenomenal successes in vision recognition tasks, which motivate the deployment of deep learning in portable and smart wearable devices. To overcome the fundamental challenges of power and resource limitation, application-specific integrated circuit accelerators have emerged to compact the model and use lower precision arithmetic to increase the throughput of computation with reduced power consumption. Although very high energy efficiency has been achieved by removing redundant weights, compressing data and even sacrificing timing margin, such trend in hardware acceleration that pushes the deep learning systems to the error threshold can be disastrous for the tasks they performed due to failure or degraded performance of circuit components.Therefor, in this research project, I have worked on analysis of aging-induced delay degradation effects on FPGA-based Deep Learning Accelerators [8]
- **Dependability at Architecture Level:** Although transistor aging leads to increase the delay of combinational circuits, its effect on the access latency of SRAM arrays is negligible; yet, it could significantly lessen the Static Noise Margin (SNM) of an SRAM cell. As a result, in this project, I proposed an Instruction Set Encoding techniqueto improve the lifetime reliability of instruction cache [4, 11, 12].

Publications

Published Papers

[1] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Hamid Mousavi, Mohsen Raji, Zhenman Fang, Lesley Shannon, "Aadam: A Fast, Accurate, and Versatile Aging-Aware Cell Library Delay Model using Feed-Forward Neural Network", *IEEE/ACM International Conference on Computer-Aided Design* ***(ICCAD '20)***, *2020*.

[2] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "A Statistical Gate Sizing Method for Timing Yield and Lifetime Reliability Optimization of Integrated Circuits", *IEEE Transactions on Emerging Topics in Computing* ***(IEEE TETC)***, *2020*.

[3] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "Adjacency criticality: a simple yet effective metric for statistical timing yield optimisation of digital integrated circuits", ***IET Circuits, Devices*** & ***Systems***, *2019*.

[4] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "Aging-aware Instruction Set Encoding using a Graph-based Scheme for Lifetime Reliability Enhancement of Instruction Cache", The 24^{th} Annual National Conference of the Iranian Computer Association **(CSICC)**, *2019*, Tehran, Iran (In Persian).

[5] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "A Partitioning-based lifetime Reliability Improvement of Digital Circuits using Logic Re-synthesis", 4^{th} Conference on Contemporary Issues in Computer information and Sciences **(CICIS)**, *2019*, Tehran, Iran (In Persian).

[6] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "A Fast Method for Aging Effects Mitigation in Digital Circuits using Logic Re-synthesis", The 23^{rd} Annual National Conference of the Iranian Computer Association **(CSICC)**, *2018*, Tehran, Iran (In Persian).

Under Review Papers

[7] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Zhenman Fang, Lesley Shannon, "LEAP: A Deep Learning based Aging-Aware Architecture Exploration Framework for FPGAs", *29th ACM/SIGDA International Symposium on Field-Programmable Gate Arrays* ***(FPGA 2021)***, *2021*

[8] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, Zhenman Fang, Lesley Shannon, "Calculated Risks of Delay Degradation on FPGA-based Deep-learning Accelerators", *ACM/IEEE Design Automation Conference* ***(DAC'21)***, *2021*

[9] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "Aging and Process Variation-aware Statistical Gate Sizing using Incremental-based Criticality Computation", *IEEE Transactions on Very Large Scale Integration*, **(IEEE TVLSI)**

In Preparation

[10] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "An Aging-aware FPGA-based Ring Oscillator Physical Unclonable Function"

[11] Amin Shafiei, **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "Aging-aware Instruction Set Encoding in GPUs"

[12] **Seyed Milad Ebrahimipour**, Behnam Ghavami, Mohsen Raji, "Lifetime Reliability Improvement of Tag Array in Cache Memories"

Skills

- **Programming Languages:** C++ [1-13], Python [1,7,8], MATLAB [2,3], JAVA (Localization of Camunda Business Process Management Suite (BPMS) as a part of millitary service project)
- **Machine Learning:** Tensorflow and Keras [7, 8], PyTorch[1]
- **HDL:** VHDL (B.Sc. thesis), Verilog [2,5,6,7,8]
- **Reconfigurable Computing:** Verilog-To-Routing (VTR) [7,8], RapidSmith, OpenFPGA
- **Front-End, Verification and Simulation:** Xilinx Vivado tool-set (Computer-Aided Design Laboratory Course), Xilinx ISE Toolset (B.Sc. Thesis), Intel Quartus [8], Modelsim (B.Sc. Thesis), OpenTimer[1], GEM5[4]
- **High-Level Synthesis:** Leflow and LegUp [8], DNNWeaver
- **Back-End:** Synopsys HSPICE [1,2,4,7,8,9], Synopsys PSPICE
- **Micro-controller:** STM32 ARM (Microprocessor LAB), AVR, Arduino
- **Version Control Management:** Git

Experience

Research Experience

2016–present **Research Assistant**, *Reliable Embedded System Design group*, Shahid Bahonar University of Kerman, Kerman, Iran.

- **Supervisor:** Professor Behnam Ghavami
- **Master Thesis:** Aging-aware Reliability Improvement of Digital Systems
- **Contributed** in **12** papers [1-12]
- **Bachelor Thesis:** Design and Implementation of ARM7-TDMIS on Xilinx Spartan 6 FPGA

Summer 2018 **Research Intern**, *Reliable Embedded System Design group*, Shahid Bahonar University of Kerman, Kerman, Iran.

- **Supervisor:** Professor Mohsen Raji
- Reliability Degradations in SRAM-based components [4]

Summer 2017 **Research Intern**, *Reliable Embedded System Design group*, Shahid Bahonar University of Kerman, Kerman, Iran.

- **Supervisor:** Professor Mohsen Raji
- Increasing the reliability of digital circuits in the scope of transistor aging [6]

Teaching Experience

2016–2019 **Laboratory Instructor**, *Department of Computer Engineering*, Shahid Bahonar University of Kerman.

Courses:

- Computer Architecture Laboratory
  - Fall 2016, Winter 2016, Fall 2017
- Microprocessor Laboratory
  - Winter 2017, Fall 2018, Winter 2018, Fall 2019, Winter 2019
- Computer-Aided Design Laboratory
  - Fall 2019, Winter 2019

2019–2019 **Teaching Assistant**, *Department of Computer Engineering*, Shahid Bahonar University of Kerman.

Courses:

- Computer-Aided Design
  - Winter 2016, Fall 2017, Winter 2017, Fall 2018, Winter 2018, Fall 2019
- Logic Design
  - Winter 2017
- Computer Architecture
  - Fall 2018, Winter 2018

References

Professor Behnam Ghavami

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Professor Mohsen Raji

Assistant Professor
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Shiraz University
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