Anthony Cabrera

Heterogeneous Computing Research Scientist

cabreraam AT ieee DOT org | cabreraam.github.io

Summary

Experienced heterogeneous computing researcher and lifelong learner with a penchant for exploring questions around the hardware-software interface. Adept at quickly learning skills, languages, or tools necessary to answer research questions. Strives to communicate complex ideas effectively and accessibly. Previously held DoD-Secret clearance.

Research and Work Experience

Architectures and Performance Group @ Oak Ridge National Laboratory

Oak Ridge, TN (Remote)

Research Scientist — *Jan 2022 - Present*

Software Engineer — *Aug 2020 - December 2021*

- Developing an LLVM front-end for Fortran
- Leading a multi-institution performance and portability evaluation comparing Intel and Xilinx FPGA OpenCL kernels
- Developing Hexagon DSP kernels for the Qualcomm Snapdragon chip, as part of DARPA's DSSoC project
- Exploring GPU-FPGA collaboration on HPC mini applications as part of the DoE Exascale Compute Project

Computer Science and Engineering Department @ Washington University in St. Louis

St. Louis, MO

Visiting Research Scientist — *May 2022 - Present*

Stream Based Supercomputing Laboratory @ Washington University in St. Louis

St. Louis, MO

Graduate Research Assistant — *July 2016 - July 2020*

- Thesis: Domain Specific Computing in Tightly Coupled Heterogeneous Systems
- Evaluated the Intel HARPv2 CPU+FPGA platform as a domain specific compute solution
- Created a benchmark suite of data integration applications (DIBS) to identify opportunities for hardware acceleration
- Ported Needleman-Wunsch OpenCL Kernels to the Intel HARPv2 CPU+FPGA platform to analyze kernel design, performance, and portability
- Architected and optimized hardware for DIBS applications using OpenCL targeting the Intel HARPv2

The MITRE Corporation

Shiloh, IL

Graduate Prototyping and Software Engineer — *May 2019 - August 2019*

- Created a neural network to detect cars from wireless iPhone camera stream targeting the NVIDIA Jetson Nano
- Deployed containers on GPU-enabled HPC resources to train convolutional neural networks
- Mentored undergraduate intern project on hyperparameter performance analysis
- Maintained GitLab repository to document work and enable continued development of project
- Selected as one of four interns across all of MITRE's sites to deliver company-wide presentation on project

Arm Holdings

Austin, TX

Graduate Research Intern — *May. 2018 - Aug. 2018*

- Quantified spatial and temporal locality by creating a novel technique based on reuse distance
- Developed dynamic binary instrumentation clients to profile memory subsystem characteristics
- Identified strategies around data layout transformations and paging to improve memory subsystem performance

Advanced Sensors Research Laboratory @ Washington University in St. Louis

St. Louis, MO

Undergraduate and Graduate Research Assistant — *May 2014 - July 2016*

- Developed the software/UI for filter alignment of NIR fluorescence imagers
- Assisted medical researchers with NIR fluorescence and polarization imaging studies
- Aided in the design and fabrication of a custom PCB around an ultra low-noise imaging sensor

Education

Washington University in St. Louis — *St. Louis, MO*

PhD Computer Engineering — *August 2020*

MS Computer Science — *August 2018*

BS Computer Engineering, Second Major Computer Science — *May 2015*

BSAS Electrical Engineering

Hendrix College — *Conway, AR*

BA Chemical Physics, Minor Music — *May 2013*

Peer Reviewed Publications

1. NR Miniskar, AR Young, FY Liu, **AM Cabrera**, JS Vetter, "Efficient FPGA Design Environment for Extremely Low Latency Scientific Machine Learning Applications", *In Review*.

2. AR Young*, **AM Cabrera***, JS Vetter, "Design and Analysis of CXL Performance Models for Tightly-Coupled Heterogeneous Computing", *ACM International Workshop on Extreme Heterogeneity Solutions (ExHET '22 @ PPoPP '22)*.

3. CJ Faber, T Plano, S Kodali, Z Xiao, A Dwaraki, JD Buhler, RD Chamberlain, **AM Cabrera**, "Platform Agnostic Streaming Data Application Performance Models", *ACM/IEEE Redefining Scalability for Diversely Heterogeneous Architectures (RSDHA '21 @ SC '21)*.

4. Zhili Xiao, RD Chamberlain, **AM Cabrera**. "HLS Portability from Intel to Xilinx: A Case Study", *IEEE High Performance Extreme Computing Conference (HPEC '21)*. [Paper] [Slides]

5. **AM Cabrera**, S Hitefield, J Kim, S Lee, NR Miniskar, JS Vetter, "Toward Performance Portable Programming for Heterogeneous System-on-Chips: Case Study with Qualcomm Snapdragon SoC", *IEEE High Performance Extreme Computing Conference (HPEC '21)*. [Paper] [Slides]

6. **AM Cabrera**, AR Young, J Lambert, Z Xiao, A An, S Lee, Z Jin, J Kim, J Buhler, RD Chamberlain, JS Vetter, "Toward Evaluating High-Level Synthesis Portability and Performance between Intel and Xilinx FPGAs", *ACM International Workshop on OpenCL (IWOCL '21)*. [Paper] [Slides] [Video]

7. **AM Cabrera**, RD Chamberlain, "Design and Performance Evaluation of Optimizations for OpenCL FPGA Kernels", *IEEE High Performance Extreme Computing Conference (HPEC '20)*. [Paper] [Slides]

8. **AM Cabrera**, RD Chamberlain, "Designing Domain Specific Computing Systems", *IEEE International Symposium on Field-Programmable Custom Computing Machines (FCCM '20)*. [Paper] [Slides] [Video]

9. **AM Cabrera**, RD Chamberlain, JC Beard, "Multi-spectral Reuse Distance: Divining Spatial Information from Temporal Data", *IEEE High Performance Extreme Computing Conference (HPEC '19)*. [Paper] [Slides]

10. **AM Cabrera**, RD Chamberlain, "Exploring Portability and Performance of OpenCL FPGA Kernels on Intel HARPv2", *ACM International Workshop on OpenCL (IWOCL '19)* **Best Presentation Award**. [Paper] [Slides]

11. CJ Faber, **AM Cabrera**, O Booker, G Maayan, RD Chamberlain, "Data Integration Tasks on Heterogeneous Systems Using OpenCL", *ACM International Workshop on OpenCL (IWOCL '19)*. [Paper]

12. **AM Cabrera**, CJ Faber, K Cepeda, R Derber, C Epstein, J Zheng, RK Cytron, RD Chamberlain, "DIBS: A Data Integration Benchmark Suite", *ACM/SPEC International Conference on Performance Engineering (ICPE '18)*. [Paper] [Slides]

*Denotes equal contribution.

PhD Dissertation

Domain Specific Computing in Tightly-Coupled Heterogeneous Systems [Text] [Slides]

Honors and Awards

2020	**SC20 Early Career Program**, Supercomputing 2020	*Atlanta, GA*
2020	**Honors Designation for PhD Progress Review (Top 15-20% of students)**, CSE Department @ WUSTL	*St. Louis, MO*
2020	**Engineering PhD Student Commencement Marshal**, WUSTL	*St. Louis, MO*
2019	**Best Presentation Award**, International Workshop on OpenCL	*Boston, MA*
2019	**Graduate Student Ambassador**, Intel Corporation	*St. Louis, MO*
2019	**Travel Grant**, Supercomputing 2019	*Denver, CO*
2018	**Travel Grant**, Supercomputing 2018	*Dallas, TX*
2017	**Travel Grant**, Supercomputing 2017	*Denver, CO*
2015	**Graduate Danforth Scholar**, WUSTL	*St. Louis, MO*
2013	**Harold P. Brown Engineering Fellowship**, McKelvey School of Engineering @ WUSTL	*St. Louis, MO*
2013	**Hendrix College Chamber Orchestra Award**, Hendrix College	*Conway, AR*
2012	**Transamerica Employer Solution & Pension Scholarship Award**, Transamerica Corporation	*Little Rock, AR*
2011	**Hendrix College Chamber Orchestra Award**, Hendrix College	*Conway, AR*

Teaching Experience

FL17, FL18	**WUSTL CSE 560M Computer Systems Architecture I**, Graduate Teaching Assistant	*St. Louis, MO*
SU18	**WUSTL CSE 566S High Performance Computing**, Graduate Teaching Assistant	
SP16	**WUSTL CSE {4,5}63M Digital Integrated Circuit Design and Architecture**, Graduate Teaching Assistant	
FL14, SP15	**WUSTL CSE 200 Scientific Computing**, Undergraduate Teaching Assistant	

Press

2021	**SCTV Interview**, SC21 Inclusion and Diversity with AJ Lauer and Anthony Cabrera	*St. Louis*
2021	**SCTV Interview**, Promoting the SCALE students program at SC	*Virtual*

Professional Service

2022	**SC22 Inclusivity Committee**, Supercomputing 2022	*Dallas, TX*
2022	**Program Committee**, International Workshop on OpenCL and SYCLcon	*Remote*
2021	**SC21 Inclusivity Committee**, Supercomputing 2021	*St. Louis, MO*
2021	**Program Committee**, International Workshop on OpenCL and SYCLcon	*Remote*
2019	**Lead Student Volunteer: Communications Committee Press Liaison**, Supercomputing 2019	*Denver, CO*
2019	**Student Volunteer**, Supercomputing 2018	*Dallas, TX*
2017	**Student Volunteer**, Supercomputing 2017	*Denver, CO*

Skills

Languages	Bash, C, C++, CMake, Python
Frameworks	CMake, DynamoRIO, Git, Intel HLS, OpenCL, Xilinx HLS