

# Anthony Cabrera

HETEROGENEOUS COMPUTING RESEARCH SCIENTIST

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## 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 2021 - 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

### 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 HARV2 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 HARV2 CPU+FPGA platform to analyze kernel design, performance, and portability
- Architected and optimized hardware for DIBS applications using OpenCL targeting the Intel HARV2

### 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

## Peer Reviewed Publications

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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 (IWOC '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 (IWOC '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 (IWOC '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

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

## Honors and Awards

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

## Teaching Experience

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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

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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

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2022 **SC22 Inclusivity Committee**, Supercomputing 2021 *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

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