

My goal is to make high performance computing easy to use and portable, it's time to make the hardware work for the software and not the other way around.

## SUMMARY

Jonathan is an experienced researcher, leader, and technical manager. He has a broad educational background and a history of successfully leading diverse teams to accomplish extremely difficult, complex technical tasks.

## EDUCATION

### **Washington University in St. Louis**

*St. Louis, Missouri*

#### **Ph.D. Computer Science**

August 2015

### **The Johns Hopkins University**

*Baltimore, Maryland*

#### **M.S. Bioinformatics**

May 2010

### **Louisiana State University**

*Baton Rouge, Louisiana*

#### **B.S. Biology**

minor: **history**

#### **B.A. International Studies, Central Asian Focus**

minor: **Russian**

December 2005

## THESIS

**Beard, J. C. (2015, August)**. Online Modeling and Tuning of Parallel Stream Processing Systems (*PhD Thesis*). Department of Computer Science and Engineering, Washington University in St. Louis.

## JOURNAL PUBLICATIONS

Li, P., **Beard, J. C.** and Buhler J. (2017, September), Deadlock-free Buffer Configuration for Stream Computing. In: *International Journal of High Performance Computing Applications*. (**IJHPCA**)

**Beard, J. C.**, Li, P. and Chamberlain, R. D. (2016, October) RaftLib: A C++ Template Library for High Performance Stream Parallel Processing. In: *International Journal of High Performance Computing Applications*. (**IJHPCA**)

## CONFERENCE PUBLICATIONS

\* indicates acceptance rate  $\leq$  25%

**Beard, J. C. (2017, October)**. The Sparse Data Reduction Engine: Chopping sparse data one byte at a time. In *Proceedings of the International Symposium on Memory Systems* (pp. 34-48). ACM.

\***Beard, J. C.** and Chamberlain, R. D. (2015, August) Run Time Approximation of Non-blocking Service Rates for Streaming Systems In: *Proceedings of Euro-Par 2015 Parallel Processing*. (**Euro-Par**)

**Beard, J. C.,** Epstein C., and Chamberlain, R. D. (2015, August) Run Time Approximation of Non-blocking Service Rates for Streaming Systems In: *Proceedings of 2015 IEEE 17th International Conference on High Performance Computing and Communications*. (IEEE HPCC)

\***Beard, J. C.,** Epstein C., and Chamberlain, R. D. (2015, January) Automated Reliability Classification of Queueing Models for Streaming Computation using Support Vector Machines. In *Proceedings of the 5th ACM/SPEC international conference on Performance engineering*. ACM (ACM ICPE/SPEC)

\***Beard, J. C** and Chamberlain, R. D. (2013, August) Analysis of a Simple Approach to Modeling Performance for Streaming Data Applications. In *Proceedings of the International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems*. (IEEE MASCOTS)

\* **Beard, J. C.** and Chamberlain, R. D. (2013, April). Use of Simple Analytic Performance Models for Streaming Data Applications Deployed on Diverse Architectures. , In *Proceedings of IEEE International Symposium on Performance Analysis of Systems and Software*. (IEEE ISPASS)

\* Lancaster, J. M., Wingbermuehle, J. G., **Beard, J. C.,** and Chamberlain, R. D. (2011, October). Crossing Boundaries in TimeTrial: Monitoring Communications Across Architecturally Diverse Computing Platforms. In *Proceedings of the IFIP 9th International Conference on Embedded and Ubiquitous Computing*. (IEEE EUC)

## WORKSHOP PUBLICATIONS

Dunham, Curtis, and **Beard, J. C.** . (2018, January). This Architecture Tastes Like Microarchitecture. In The 2nd Workshop on Pioneering Processor Paradigms . (HPCA18 - WP3)

**Beard, J. C.,** and Randall, J. (2017, June). Eliminating Dark Bandwidth: a data-centric view of scalable, efficient performance, post-Moore. In International Conference on High Performance Computing (pp. 106-114). (ISC - HCPM)

Li, P., **Beard, J. C.** and Buhler J. (2015, February). Deadlock-free Buffer Configuration for Stream Computing. In *Proceedings of Programming Models and Applications for Multicores and Manycores*. (ACM PMAM)

**Beard, J. C.,** Li, P. and Chamberlain, R. D. (2015, February). RaftLib: A C++ Template Library for High Performance Stream Parallel Processing. In *Proceedings of Programming Models and Applications for Multicores and Manycores*. (ACM PMAM)

**Beard, J. C.,** & Chamberlain, R. D. (2014, September). Use of a Levy Distribution for Modeling Best Case Execution Time Variation. In A. Horváth and K. Wolter (Editors), *Computer Performance Engineering*, Volume 8721 of *Lecture Notes in Computer Science*, pp. 74–88. Springer International Publishing, presented at the *European Workshop on Performance Engineering*. (EPEW)

## PATENTS

U.S. 10,067,708 Beard, J. C., “Memory Synchronization Filter.” Filing Date 22 December 2015, Granted 4 September 2018

U.S. 15/166,444 Beard, J. C., “Method and Apparatus for Scheduling in a Non-Uniform Compute Device” Filing Date 27 May 2016

U.S. 15/166,458 Beard, J. C., “Method and Apparatus for Maintaining Data Coherence in a Non-Uniform Compute Device” Filing Date 27 May 2016

U.S. 15/166,467 Beard, J. C., “Method and Apparatus for Reordering in a Non-Uniform Compute Device” Filing Date 27 May 2016

U.S. 15/218,838 Beard, J. C., “Self Replicating Molecular Logging Device” Filing Date 28 July 2016

U.S. 15/361,770 Beard, J. C., “Virtual Context Format for Fast Heterogeneous State Migration” Filing Date 28 November 2016

U.S. 15/361,819 Beard, J. C., “Efficient Lazy Migration of Virtual Compute Contexts” Filing Date 28 November 2016

U.S. 15/361,843 Beard, J. C., “Smart Sparse Data Movement Engine for Increasing Utilization of Bandwidth and Cache Lines” Filing Date 28 November 2016

U.S. 15/361,871 Beard, J. C., “Virtual Context Table for Fast Heterogeneous Context Migration” Filing Date 28 November 2016

U.S. 15/483,036 Beard, J. C., “Cache-Based Communication Between Execution Threads of a Data Processing System” Filing Date 10 April 2017

U.S. 15/650,056 Beard, J. C., “Memory Address Translation” Filing Date 14 July 2017

U.S. 15/649,976 Beard, J. C., “Method and Apparatus for Fast Context Cloning in a Data Processing System” Filing Date 14 July 2017

U.S. 15/650,008 Beard, J. C., “Memory Node Controller” Filing Date 14 July 2017

U.S. 15/649,930 Beard, J. C., “Method and Apparatus for Two-Layer Copy-on-Write” Filing Date 14 July 2017

U.S. 15/724,433 Beard, J. C., “A predictor to help decide whether it more optimal to perform a give atomic operation 'near' the core (eg in the L1 cache/ LS queue) or far (eg L3 cache or L3-memory interconnect)” Filing Date 4 October 2017

U.S. 15/819,328 Beard, J. C., “The Memory Storm Fabric for Hardware Accelerated, Scalable Virtual Shared Memory” Filing Date 21 November 2017

U.S. 15/819,378 Beard, J. C., “An efficient method for scalable Range Based Coherence Modification ” Filing Date 21 November 2017

U.S. 15/819,574 Beard, J. C., “Method for Fast Virtual Address Translation for Virtual Machines and Multiply Nested Virtual Machines using the Memory Storm Fabric” Filing Date 21 November 2017

U.S. 15/939,637 Beard, J. C., “Dynamic SVE Vectorization of Scalar Operations using Dataflow Vectorization” Filing Date 29 March 2018

## **TALKS/PANELS** (OTHER THAN PAPERS FOR CONFERENCES)

Reducing Dark Bandwidth Through Data Reduction Near Memory (UCAR-SEA 2018, March)

A Vision For Destruction Of Post-Moore Disruption: How I Learned To Stop Worrying And Love Non-Von Neumann (UCAR-SEA 2018, March)

New and Cool Memory Technologies: My ramblings about memory systems (MEMSYS 2017, October)

Eliminating Dark Bandwidth: A memory-centric view of scalable efficient performance post-Moore (ISC 2017, June)

Good FIFOs Make Good Thread Neighbors (CPPNow 2017, May)

Parallel Programming with RaftLib: streaming/data-flow concurrency via concise C++ Iostream-like operators (CPPNow 2017, May)

Future of Memory Technology for Exascale and Beyond IV (SC 2016, November)

Come Stream with Me, presented (CPPNow 2016, May)

RaftLib, presented to world-wide programming systems group (Arm Inc., 2015, July)

Model Selection for Queue Occupancy Given Noisy Execution Environments (Washington University in St. Louis, 2013, November)

Use of Simple Analytic Performance Models for Streaming Data Applications Deployed on Diverse Architectures (Washington University in St. Louis, 2012, September)

## IN THE NEWS

- [Shedding Light on Dark Bandwidth](#), published 14 September 2017, The Next Platform
- [Momentum is Building for Arm in HPC](#), published 30 June 2017, The Next Platform

## HONORS/AWARDS

- Google-Student Veterans of America (SVA) Scholarship 2013
- ACM Upsilon Pi Epsilon Academic Honor Society
- Numerous military awards (Meritorious Service Medal, 2x Army Commendation Medal, multiple others)

## AFFILIATIONS/PROFESSIONAL ACTIVITIES

- Stream Based Supercomputing Lab Alumni (<http://sbs.wustl.edu>)
- ACM (Upsilon Pi Epsilon, SIGMETRICS, SIGHPC)
- IEEE Computer Society
- US Army Veteran
- ISC 2019 “Architectures, Networks & Infrastructure
- Supercomputing 2016 Technical Program Committee (Architecture and Networks)
- Supercomputing 2017 Technical Program Committee (Architecture and Networks)
- Supercomputing 2018 Technical Program Committee (Architecture and Networks)
- Supercomputing 2019 Architecture and Networks Committee Co-Chair
- The International Conference on Memory Systems (MEMSYS) 2018 (Organizing Committee)
- 47th International Conference on Parallel Processing (ICPP) 2018 (Architecture Committee)
- 2018 US Department of Energy Extreme Heterogeneity Workshop (Report Co-author)
- GoingArm Event Developer 2017/2018/2019

## MAJOR CURRENT PROJECTS

- Data Movement Optimized/Memory Centric System Architecture
- Compute Near Data (Processing In-/Near-Memory, PINM)
- †[RaftLib](#) (streaming parallel asynchronous programming environment)

†denotes personal FOSS projects

## PREVIOUS PROJECTS

- Fast Forward 2 (DOE Exascale project)
- Data Movement Dominates (led by Sandia National Labs)

## PROFESSIONAL EXPERIENCE

### **Staff Research Engineer, Arm Inc.**

*Austin, Texas — April 2017 - present*

### **Senior Research Engineer, Arm Inc.**

*Austin, Texas — April 2015 - March 2017*

I am the technical lead for the development of next generation systems architectures focused on scalability and reduced data movement. This work includes virtual memory systems, accelerator integration, low overhead communications, and improving programmability of heterogeneous systems. In previous roles I've investigated hardware and workloads for compute near data as part of the DOE FastForward-2 Project, as well as programming models for massively parallel distributed computation. Arm representative to Sandia National Labs led Data Movement Dominates DOE Project, develop-

ing methodologies to reduce the cost of data movement, improve the utilization of memory relative to computation through a variety of innovative technologies. Developing simulation techniques to deal with massive scale-out issues that arise from the need to simulate high throughput traffic on hardware that doesn't yet exist.

**Advisor, [FastData.io](http://FastData.io)**

*November 2016 - present*

**Chief Executive Officer, Arkhesoft LLC**

*June 2010 - present*

Sole proprietor and consultant.

**Research Assistant, Washington University in St. Louis**

*St. Louis, MO — June 2010 - April 2015*

Ph.D. Student at Washington University in St. Louis. I worked as a research assistant under the direction of Dr. Roger Chamberlain in the Stream Based Supercomputing Lab. My research involved using machine learning, queuing theory, signal processing, and control theory to improve the understanding and application of mathematical models for the optimization of stream compute systems.

**Instructor, Washington University in St. Louis**

*St. Louis, MO — January 2012 - May 2012*

Co-Instructed CSE 462M (Computer Systems Design), introduction to modern design practices and the use of FPGA hardware prototyping. Students used a commercial CAE/CAD system for VHDL-based design and simulation while designing a computation system. Students focused on the hardware / software co-design of a novel bio-sequence assembly algorithm deployed on a field programmable gate array and multiple multi-core processors (course webpage: <http://goo.gl/dPEdC9>)

**Deputy Director of Medical Informatics, U.S. Army**

*Heidelberg, DE — January 2009 - June 2010*

Started the medical informatics department for the European Regional Medical Command as the interim director. I was responsible for all initial hiring, planning (long term and short term), office procurement and provisioning. Long term responsibilities included development of medical information management systems, software development, IT and healthcare provider contract management, mathematical modeling of patient flow and outcomes, development of data mining systems. Managed over 200 employees as well as an \$8 million budget in four countries. Fostered relationships with partners in both industry and within the military community.

**Aide-de-Camp, U.S. Army**

*Heidelberg, DE — July 2007 - January 2009*

Aide-de-Camp for two consecutive Commanding Generals of the Europe Regional Medical Command which has health care facilities in 11 countries (both Eastern & Western Europe and Balkan) with over 92,000 beneficiaries. I coordinated all types of actions with international state officials, handled international logistics and was personally responsible for the security of the general. This role afforded me the opportunity to meet U.S. Senators, Congressmen, their staffers as well as heads of state. I became an expert multi-tasker. I finished a graduate degree, while juggling traveling out-of-country six out of seven weekdays while making the general's job look easy.

**Safety Manager (1st HBCT, 2ID), U.S. Army**

*Dongducheon, South Korea — March 2007 - July 2007*

Program manager in charge of directing and monitoring company (~6000 personnel) compliance with OSHA, international safety and environmental standards. Responsible for strategic planning, technical support, and overall management for environment, health, safety, training, and industrial hygiene programs.

**Medical Administrator (Medical Platoon Leader, 1-72 "First Tank"), U.S. Army**

*Dongducheon, South Korea — April 2006 - March 2007*

Responsible for directing a multi-national team of healthcare providers and support staff in daily operations. Managed and maintained equipment assets worth over 12 million USD. Instituted teamwork driven processes incorporating monitoring, analysis, and planning of the patient cycle to improve patient care.