

Jiajia, Li

Computational Science & Engineering – Georgia Institute of Technology

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EDUCATION

Georgia Institute of Technology

Ph.D Candidate, Advisor: Prof. Richard Vuduc

High Performance Computing

2013 – Present

University of Chinese Academy of Sciences (UCAS)

Doctor of Engineering, Advisors: Prof. Mingyu, Chen and Guangming, Tan

Computer Architecture

2008 – 2013

Dalian University of Technology

Bachelor of Sciences, As an Accelerated Student

Information and Computing Science

2005 – 2008

PUBLICATIONS

- **Jiajia Li**, Jee Choi, Xing Liu, Richard Vuduc. Non-Negative CP Decomposition on Distributed Clusters. 2016. (To be submitted)
- **Jiajia Li**, Jee Choi, Ioakeim Perros, Jimeng Sun, Richard Vuduc. Model-Driven Sparse CP Decomposition for High-Order Tensors. 2016. (Under review)
- **Jiajia Li**, Yuchen Ma, Chenggang Yan, Richard Vuduc. Optimizing Sparse Tensor Times Matrix on multi-core and many-core architectures. The sixth Workshop on Irregular Applications: Architectures and Algorithms (IA³), co-located with SC. 2016. (Accepted)
- **Jiajia Li**, Ioakeim Perros, Jimeng Sun, Richard Vuduc. Model-driven Sparse CP Decomposition for High-Order Tensors. The fifth international Women in HPC workshop, co-located with SC. [poster]. 2016. (Accepted)
- Casey Battaglini, **Jiajia Li**, Ioakeim Perros, Jimeng Sun, Richard Vuduc. Tensors in Data Analysis: Methods, Applications, and Software. 2015. (To be submitted)
- **Jiajia Li**, Casey Battaglini, Ioakeim Perros, Jimeng Sun, Richard Vuduc. An Input-Adaptive and In-Place Approach to Dense Tensor-Times-Matrix Multiply. The International Conference for High Performance Computing, Networking, Storage and Analysis (SC) 2015
- **Jiajia Li**, Zhonghai Zhang, Guangming Tan, David Bader. SMAT: A Cross-Platform Input Adaptive Auto-Tuner for Sparse Matrix-Vector Multiplication. Technical Report. 2014
- **Jiajia Li**. Research on Sparse Matrix Vector Multiplication Auto-tuning Method. PhD Thesis. The University of Chinese Academy of Sciences, Beijing, China. 2013
- **Jiajia Li**, Guangming Tan, Mingyu Chen, Ninghui Sun. SMAT: An Input Adaptive Auto-Tuner for Sparse Matrix-Vector Multiplication. Programming Language Design and Implementation (PLDI) 2013
- **Jiajia Li**, Xingjian Li, Guangming Tan, Mingyu Chen, Ninghui Sun. An Optimized Large-Scale Hybrid DGEMM Design for CPUs and ATI GPUs. International Conference on Supercomputing (ICS) 2012
- **Jiajia Li**, Xiuxia Zhang, Guangming Tan, Mingyu Chen. The Study of Choosing the Best Storage Format of Sparse Matrix Vector Multiplication, Journal of Computer Research and Development. (IN CHINESE)
- **Jiajia Li**, Xiuxia Zhang, Guangming Tan, Mingyu Chen. Algebraic Multi-grid Optimization Study on GPU. HPC China (IN CHINESE) 2011
- Xiuxia Zhang, Mingyu Chen, **Jiajia Li**, Guangming Tan. Memory Accessing Analysis of Sparse Matrix Vector Multiplication and Optimization. HPC China (IN CHINESE) 2011

- **Jiajia Li**, Guangming Tan, Mingyu Chen. Automatically Tuned Dynamic Programming with an Algorithm-by-Blocks. 16th International Conference on Parallel and Distributed Systems (ICPADS) 2010

WORK EXPERIENCE

Intel Parallel Computing Research Lab

Research Intern, Mentor: Dr. Mikhail Smelyanskiy

May-Jul 2015

IBM Thomas J. Watson Research Center

Research Intern, Mentor: Dr. Jee Choi and Dong Chen

May-Aug 2016

HONORS AND AWARDS

2016: Selected students to attend IEEE-WIE Women's Leadership Summit 2016

2013: ZhuLiYueHua Award for the Excellent PhD Students of Chinese Academy of Sciences (Top 0.2%)

2013: Merit Student of Institute of Computing Technology

2011: Xia Peisu Scholarship of Institute of Computing Technology (Top 1%)

2011: Outstanding Research Assistant of the Computer Architecture Laboratory at UCAS

2010: Outstanding Student of the Computer Architecture Laboratory at UCAS

RESEARCH EXPERIENCE

Work on Tensor Algorithms

01/2015 – now

HPC Garage

Graduate Research Assistant

- Implemented distributed sparse CP-APR algorithm for non-negative **sparse** tensors using MPI, achieved $90\times$ speedup on 320 IBM Power8 cores. (Jointed work with IBM Data Centric Systems Research Group).
- Optimizing matricized tensor times Khatri-Rao product (MTTKRP) and CP decomposition for high-order **sparse** tensors on multicore CPU architecture by proposing a novel memoization algorithm. (Paper submitted)
- Collecting sparse tensors from real-world applications to build a **sparse** tensor dataset.
- Building a **sparse** tensor operation library (SpTOL) for tensor decomposition on multicore CPU and GPU with MATLAB interface, to support applications in healthcare analytics and deep learning areas. (Part of this work is published in SC'16 IA³).
- Completed a survey on "Tensors in Data Analysis". (Paper to be submitted)
- Built an input-adaptive and in-place approach to **dense** tensor-times-matrix multiply (InTensLi) by eliminating data transformation, and achieved $4\text{-}13\times$ speedups over state-of-the-art libraries. (Published in SC'15)

Optimization on Graph Algorithms

12/2013 – 11/2014

HPC LAB

Graduate Research Assistant

- Optimization on dynamic single-source shortest path problem using a hybrid Bellman-Ford and Dijkstra's algorithm.
- Breadth-First Search Optimization on Intel Xeon Phi. 1) Combine Bulk Synchronous Parallel (BSP) model and dynamic thread allocation strategy; 2) Use SIMD intrinsics with gather/scatter and prefetching operations.

SMAT: An Application- & Architecture-Aware Auto-tuner of SpMV

10/2011 – 12/2013

High Performance Computer Research Center, HPC LAB

Graduate Research Assistant

Compared with the functions in MKL library, SMAT ran faster by more than **3 times**.

- Extracted a set of parameters to represent SpMV's performance characteristics according to the observations of 2373 matrices in UF sparse matrix collection.
- Applied machine learning method to formulate the prediction model in decision tree pattern to search the best SpMV kernel.
- Provided an unified interface based on CSR format, when choosing the "best" format and implementation of SpMV.
- Achieved the performance up to 75 and 33 GFLOP/s in single- and double-precision respectively on Intel platform with 12 threads. Based on SMAT, AMG algorithm showed above 20% performance improvement.
- Extended the SMAT framework to GPU and Intel Xeon Phi platforms.

Algebraic Multigrid (AMG) Optimization on GPU

12/2010 – 05/2011

CARCH and Institute of Applied Physics and Computational Mathematics,

Graduate Research Assistant

AMG-GPU achieved $2\times$ **speedup** using Jacobi iterative method, compared with CPU version.

- Applied CSR-SpMV optimization on GPU to optimize SpMV kernels in AMG.
- Concluded that due to the diverse features of AMG on different grid levels, different optimization methods should be dynamically applied on each level.

Hybrid DGEMM Design for a Heterogeneous CPU-GPU Architecture

04/2010 – 12/2010

CARCH

Graduate Research Assistant

Achieved **844 GFLOPS** with **80%** floating-point efficiency on a system comprising Intel CPU and ATI GPU.

- Developed a new software pipelining for the DGEMM kernel running on CPU-GPU heterogeneous architecture.
- Compared with AMD's ACML-GPU library, the optimized DGEMM improved performance by more than 2 times.
- Concluded that the major scaling bottleneck is resource contention, especially PCIe contention and host memory contention.

Dynamic Programming Auto-tuning

09/2009 – 04/2010

CARCH

Graduate Research Assistant

Achieved speedup as $10\times$ for scalar program and further $4\times$ (**double**) or $2\times$ (**single**) for SIMDization program.

- Proposed an algorithm-by-blocks for dynamic programming.
- Built an automatically tuned system for optimizing dynamic programming on current general-purpose processors.

SKILLS

Platforms: Linux, Windows, Mac OS

Programming Language: C++, C, Assembly(familiar), Scala, Perl, Python, Shell, Matlab, HTML

Parallel Programming: MPI, OpenMP, CUDA, Apache Spark

ACTIVITIES

Aug 2014-now: As an organizer of Hot CSE seminar, a PhD academic seminar in GT CSE.

Nov 2013-now: As a Volunteer Librarian of Repetitive Stress Injury (RSI) Lending Library of GT College of Computing.

Apr 2016: As a volunteer judge for Undergraduate Research Opportunities Program 11th Annual Undergraduate Research Spring Symposium.

Oct 2015: As a Reviewer of "The Transactions on Parallel and Distributed Systems"

Sep 2015: As a Reviewer of "The 21st IEEE International Conference on Parallel and Distributed Systems (ICPADS'15)"

Fall 2014: As a Teach Assistant of "High-Performance Computing: Tools and Applications (CSE 6230)"

May 2014: As a Reviewer of "the Frontiers of Computer Science"

Nov 2013, 2015: As a Volunteer Reviewer of "National Center for Women & IT (NCWIT) Award"

Oct 2013, 2014: As a Volunteer Reviewer of "President's Undergraduate Research Awards (PUMA)"

Aug 2013-2016: As a PC member of Parallel Algorithm Track of "National Annual Conference on High Performance Computing (HPC China)"

May 2012: As a Teach Assistant of "Parallel Computer Architecture" class of Dragonstar Project

2012: As a Teacher for One-Day Training of "Parallel Computing on GPU using CUDA" in Sun Yat-sen University

HOBBIES

Traveling, Singing, Swimming, Running, Playing Pingpong, Billiards