

# Jiajia Li

Computational Science & Engineering – Georgia Institute of Technology

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## EDUCATION

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**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

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- **Jiajia Li**, Jee Choi, Xing Liu, Richard Vuduc. Non-Negative CP Decomposition on Distributed Clusters. 2016. (To be submitted)
- Yue Zhao, **Jiajia Li**, Chunhua Liao, Xipeng Shen. Deep Learning for Sparse Matrix Format Selection: Challenges and Opportunities. 2016. (Submitted)
- Xiuxia Zhang, Guangming Tan, Shuangbai Xue, **Jiajia Li**, Keren Zhou, Mingyu Chen. Understanding the GPU Microarchitecture to Achieve Bare-Metal Performance Tuning. PPOPP'17. (Accepted)
- **Jiajia Li**, Jee Choi, Ioakeim Perros, Jimeng Sun, Richard Vuduc. Model-Driven Sparse CP Decomposition for High-Order Tensors. 31st IEEE International Parallel & Distributed Processing Symposium. IPDPS. 2017. (Accepted)
- **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 (IA<sup>3</sup>), co-located with SC. 2016.
- **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.
- 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
- **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

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### IBM Thomas J. Watson Research Center

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

May-Aug 2016

### Intel Parallel Computing Research Lab

Research Intern, Mentor: Dr. Mikhail Smelyanskiy

May-Jul 2015

## HONORS AND AWARDS

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**2016:** Travel grant from the Institute for Pure and Applied Mathematics (IPAM) for Big Data Meets Computation Workshop 2017

**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

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### Optimizing 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 CPUs by proposing a novel memoization algorithm. (Accepted by IPDPS'17)
- Collecting sparse tensors from real-world applications to build a **sparse** tensor dataset.
- Building a **sparse** tensor operation library (ParTI) 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 has been published in IA<sup>3</sup> @ SC'16 and Tensor-Learn Workshop @ NIPS'16.).
- 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)

### 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 a machine learning method to formulate a decision tree prediction model to search the optimal SpMV kernel.
- Provided an unified interface based on CSR format, when choosing from different formats and SpMV implementations.
- 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× 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 ACML-GPU library, the optimized DGEMM improved performance by more than 2×.
- Concluded that the major scaling bottleneck is resource contention, especially PCIe and host memory contention.

## **Dynamic Programming Auto-tuning**

**09/2009 – 04/2010**

*CARCH*

*Graduate Research Assistant*

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

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

## **SKILLS**

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**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**

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**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**

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