

M. HARPER LANGSTON

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EDUCATION

New York University, Graduate School of Arts and Sciences,
Courant Institute of Mathematical Sciences, New York, NY
Ph.D. in Computer Science, January 2012
Dissertation Title: *An Adaptive Fast Volume Solver in Three Dimensions for Free-Space, Periodic and Dirichlet Boundary Conditions*
Honors: McCracken Fellowship
Research Advisors: Denis Zorin and Leslie Greengard

New York University, Graduate School of Arts and Sciences,
Courant Institute of Mathematical Sciences, New York, NY
M.S. in Scientific Computing, May 2003
Research Advisors: Denis Zorin and George Biros, Academic Advisor: Michael Shelley

Bowdoin College, Brunswick, ME
B.A. double major in Mathematics and Russian Language, Magna Cum Laude, June 1997
Honors: 1995 Smyth Mathematics Prize, 1994-1997 James Bowdoin Scholar

Middlebury College, Middlebury, VT
Intensive Russian Language Summer Program, 1994

EXPERIENCE

Reservoir Labs, New York
Managing Engineer, February 2015 - Present
Manage team of engineers and researchers, leading and developing novel algorithms and software for signal processing, machine learning, fast solvers, fast Fourier transforms, fast polynomial solvers, and radar technology using Agile software development approach. PI for Phase 2 DOE SBIR and manage team of subcontractors at StonyBrook and Brookhaven National Lab. Manage several Phase I SBIR and other government-based projects. Write and manage applications for funding. Instituted official code reviews and project tracking using Atlassian tools Jira, Confluence, and Crucible. Develop production-level and research software for commercial clients, primarily in C/C++, JAVA, and Python.

Senior Research Engineer, November 2012 - January 2015
Researching and developing cutting-edge technologies for public and private industry partners. In particular, current work focused on research and development for exascale software stack; development of tools and algorithms for power-efficient embedded architectures; optimization of sparse multilinear algebraic decompositions; development of sparse diagonally dominant linear systems and graph sparsifications; implementation of fast multidimensional numerical solvers and tools; optimizations for proprietary software tools, specifically the R-Stream package; and, building relationships and developing grants between industry and academic partners.

New York University, Graduate School of Arts and Sciences,
Courant Institute of Mathematical Sciences, New York, NY
Adjunct Assistant Professor, 2013 - Present
Design, organize, and lecture for graduate-level courses through Courant Institute's Mathemat-

ics and Computer Science Departments.

Perceptive Pixel, New York, NY and Washington, DC

Software Engineer, December 2011 - November 2012

Built tools and software for touch-enabled hardware. In particular, developed software tools to record, play back and visualize touch sensor input. Software extensions include capturing and playing back video stream and touch data in sync from a web camera of user and sensor input stream. Also developed software support for enabling document manipulation across multi-user touch screen sessions as well as managed support for CNN-specific applications during 2012 election season. Work performed in C++.

Center for Plasma Edge Simulation, New York, NY and Washington, DC

Research Scientist, July 2010 - September 2010

Developed Fast Multipole Method based cross-verification tools for existing codes for plasma edge simulation in three-dimensional toroidal geometries. This work was supported through the Department of Energy and the Princeton Plasma Physics Laboratory.

Georgia Institute of Technology, Atlanta, GA

Computational Science and Engineering Research Scientist, September 2008 - April 2010

Computational Science and Engineering Research Affiliate, May 2010 - May 2011

Worked on modeling brain tumors for potential predictive biomedical applications in the field of medical imaging. Model includes multi-threaded diffusion and multigrid elasticity solvers; optimization solver incorporates parallel octree registration approaches to predict tumor locations and growth rates in patients. Regularly gave presentations, wrote grant proposals and conducted research. All software was produced in-house, using C, C++, MPI, and OpenMP; research supported through National Institutes of Health and Department of Defense grants and coordinated by the University of Pennsylvania Radiology Department.

New York University, Graduate School of Arts and Sciences,

Courant Institute of Mathematical Sciences, New York, NY

Research Assistant

September 2003 - August 2008

Focused on developing fast, parallel, highly scalable three-dimensional PDE solvers in complex geometries with non-homogeneously distributed forces. Previous work focused on mesh-free adaptive particle and vortex methods for high Reynolds number fluid flow and investigating and visualizing fluid simulations solved using embedded boundary methods. This work was supported through the Department of Energy and Princeton Plasma Physics Laboratory. Work performed using C, C++, Matlab, Fortran, and Python.

Adjunct Instructor

Graduate Discrete Mathematics, Summers 2004-2008

Teaching Assistant

Graduate Computer Graphics, September 2004 - December 2004 (Ken Perlin)

Graduate Experiments in Motion Capture, January 2004 - May 2004 (Chris Bregler)

Undergraduate Numerical Computing, September 2002 - December 2002 (Olof Widlund)

Recitation Leader

Undergraduate Algorithms, September 2003 - December 2003 (Allan Gottlieb)

Media Research Lab Junior Research Scientist

November 2000 - August 2002

Assisted in developing a teleimmersive responsive workbench, an interactive stereoscopic environment for use in real-time visualization of complex geometries and fluid simulations.

Computer Science Department Webmaster

December 2000 - May 2002

Maintained and updated web infrastructure for academic department, including SQL server database and PHP interface for intranet tracking of graduate and undergraduate students.

Jaron Lanier / Advanced Network & Services, Inc., New York, NY

Software Engineering Contractor, September 2001 - November 2001

Assisted in porting and redeveloping virtual worlds, immersive environments which respond to musical stimulation.

Mighty Seven Networks, New York, NY

Operations/Database Developer, January 2001 - September 2001

Developed solutions for online marketing firm by creating back-end databases and interfaces.

McKinsey & Company, New York, NY

Innovation and Technology Management Research Specialist, October 1997 - November 2000

Researched, interpreted and disseminated information regarding technology-based companies in areas of innovation, commercialization, building new businesses and research and development for proposals and internal and external reports. Developed statistical tools used in technology market analysis. Maintained internal databases and websites.

Bowdoin College, Brunswick, ME

Mathematics Department Research Assistant, January 1997 - May 1997 (Wells Johnson)

Assisted in investigation of properties of non-unique factorization in quadratic fields.

PUBLICATIONS A Sparse Multidimensional FFT for Real Positive Vectors

In Submission, <http://arxiv.org/abs/1604.06682>, 2016

Authors: Pierre-David Letourneau, M. Harper Langston, Benoit Meister, Richard Lethin

Adaptive Inhomogeneous PDE Solvers for Complex Geometries

In Preparation, 2016

Authors: M. Harper Langston, Denis Zorin and Leslie Greengard

A Sparse Multi-Dimensional Fast Fourier Transform with Stability to Noise in the Context of Image Processing and Change Detection

IEEE Conference on High Performance Extreme Computing (HPEC '16), 2016

Authors: Pierre-David Letourneau, M. Harper Langston, Richard Lethin

Accelerated Low-rank Updates to Tensor Decompositions

IEEE Conference on High Performance Extreme Computing (HPEC '16), 2016

Authors: Muthu Baskaran, M. Harper Langston, Tahina Ramananandro, David Bruns-Smith, Tom Henretty, James Ezick, Richard Lethin

Optimization of the Domain Dslash Operator for Intel Xeon CPUs

34th International Symposium on Lattice Field Theory, 2016

Authors: Meifeng Lin, Eric Papenhausen, M. Harper Langston, Benoit Meister, Muthu Baskaran, Chulwoo Jung, Taku Izubuchi

An Interactive Visual Tool for Code Optimization and Parallelization Based on the Polyhedral Model

Sixth International Workshop on Parallel Software Tools and Tool Infrastructures (PSTI 2016), Held in conjunction with ICPP-2016, the 45rd International Conference on Parallel Processing, August 16-19, 2016, Philadelphia, PA

Authors: Eric Papenhausen, Klaus Mueller, M. Harper Langston, Benoit Meister, Richard Lethin

Polyhedral User Mapping and Assistant Visualizer Tool for the R-Stream Auto-Parallelizing Compiler

IEEE 3rd annual Working Conference on Software Visualization (IEEE VISSOFT), 2015

Authors: Eric Papenhausen, Bing Wang, M. Harper Langston, Muthu Baskaran, Tom Henretty, Taku Izubuchi, Ann Johnson, Chulwoo Jung, Meifeng Lin, Benoit Meister, Klaus Mueller, Richard Lethin

Optimizing the Domain Wall Fermion Dirac Operator Using the R-Stream Source-to-Source Compiler

33rd International Symposium on Lattice Field Theory, 2015

Authors: Meifeng Lin, Eric Papenhausen, M. Harper Langston, Benoit Meister, Muthu Baskaran, Taku Izubuchi, Chulwoo Jung

A Tale of Three Runtimes

Technical Report, In Submission, 2014

Authors: Nicolas Vasilache, Muthu Baskaran, Tom Henretty, Benoit Meister, M. Harper Langston, Sanket Tavarageri, Richard Lethin

Re-Introduction of Communication-Avoiding FMM-Accelerated FFTs with GPU Acceleration

IEEE Conference on High Performance Extreme Computing (HPEC '13), 2013

Authors: M. Harper Langston, Muthu Baskaran, Benot Meister, Nicolas Vasilache and Richard Lethin

A Massively Parallel Adaptive Fast-Multipole Method on Heterogeneous Architectures, *Communications of the ACM*, Volume 55 Issue 5, 2012

Authors: Ilya Lashuk, Aparna Chandramowlishwaran, M. Harper Langston, Tuan-Anh Nguyen, Rahul Sampath, Aashay Shringarpure, Rich Vuduc, Lexing Ying, Denis Zorin and George Biros

A Free-Space Adaptive FMM-Based PDE Solver in Three Dimensions,

Communications in Applied Mathematics and Computational Science, Volme 6, Issue 1, 2011

Authors: M. Harper Langston, Denis Zorin and Leslie Greengard

A Massively Parallel Adaptive Fast-Multipole Method on Heterogeneous Architectures, *In The 22nd ACM/IEEE Conference on Supercomputing*, 2009, Best Paper Finalist.

Authors: Ilya Lashuk, Aparna Chandramowlishwaran, M. Harper Langston, Tuan-Anh Nguyen, Rahul Sampath, Aashay Shringarpure, Rich Vuduc, Lexing Ying, Denis Zorin and George Biros

A New Parallel Kernel-Independent Fast Multipole Method, *In The 16th ACM/IEEE Conference on Supercomputing*, 2003. Awarded the Best Student Paper award, nominated for Gordon Bell and Best Technical Paper awards.

Authors: Lexing Ying, George Biros, Denis Zorin and M. Harper Langston

Cash: Distributed Cooperative Buffer Caching, *Technical Report*, 2003.

Authors: Chris Decoro, M. Harper Langston and Jeremy Weinberger

CONTRIBUTOR U.S. DOE Top Ten Exascale Research Challenges

United States of America Department of Energy, Office of Science, Office of Advanced Scientific Computing Research, Subcommittee Report, February 2014

**SELECTED
INVITED
TALKS AND
POSTERS**

New York Scientific Data Summit (NYSDDS), New York, NY
NYSDDS Conference, 2016
A Tool for Exploring Parallel Software Transformations

DOE, Office of Nuclear Physics, Gaithersburg, MD
2016 SBIR/STTR Exchange Meeting
Polyhedral Mapping Assistant and Visualizer (PUMA-V)

IEEE VISSOFT, Bremen, Germany
IEEE 3rd annual Working Conference on Software Visualization, 2015
Polyhedral User Mapping and Assistant Visualizer Tool for the R-Stream Auto-Parallelizing Compiler

DARPA PERFECT PI Meeting, Arlington, VA
Annual PI Meeting for Defense Advanced Research Projects Agency PERFECT Program, 2014
Multi-Threaded Low-Communication FFTs on Heterogeneous Architectures (CPU + GPU)

IEEE HPEC, Waltham, MA
IEEE Conference on High Performance Extreme Computing, 2013
Re-Introduction of Communication-Avoiding FMM-Accelerated FFTs with GPU Acceleration

National Science Foundation RTG Symposium, New York, NY
Courant Institute of Mathematical Sciences, September 2012
An Adaptive Fast-Multipole Method-Based PDE Solver in Three Dimensions for Various Boundary Conditions and Geometries

NASA Langley Research Center, Hampton, Virginia
Safety Critical Avionics Systems Branch, March 2012
An Adaptive Fast Multipole Method-Based Free-Space PDE Solver in Three Dimensions

Georgia Institute of Technology, Atlanta, GA
Center for Plasma Edge Simulation (CPES) Annual Conference, December 2008
Further Developments in FMM Solvers

New Jersey Institute of Technology, Newark, NJ
Frontiers in Applied and Computational Mathematics Conference, May 2008
Fast Elliptic PDE Solver for Non-Homogeneous Force Distributions in Complex Geometries

Princeton Plasma Physics Laboratory, Princeton, NJ
Computational Plasma Physics Group Seminar Series, March 2008
A Kernel-Independent FMM-Based Elliptic PDE Solver in Complex Geometries with Non-homogeneous Force Distributions

Oak Ridge National Lab, Oak Ridge, TN
Center for Plasma Edge Simulation (CPES) Annual Conference, December 2007
FMM-Based Solvers

**REVIEWED
TEXTS**

Discrete Mathematics: An Introduction to Proofs and Combinatorics, 1st Edition, Houghton Mifflin Company, 2009 by Kevin Ferland

Mathematical Proofs: A Transition to Advanced Mathematics, 2nd Edition, Addison Wesley, 2007 by Gary Chartrand, Albert D. Polimeni, and Ping Zhang

Regular referee for SIAM Journal on Scientific Computing (SISC); reviewed and refereed submitted articles for SC08 and SC09, the International (Supercomputing) Conference for High Performance Computing, Networking, Storage and Analysis; reviewed articles for Siggraph 2004-2007, IEEE TPDS 2015, IEEE HPEC 2014-2015.

REFERENCES Available upon request.