Cristopher Cecka

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EDUCATION

Stanford University *Fall 2006 – Spring 2011*

M.S., Ph.D. Computational and Mathematical Engineering *Stanford, CA*

- Advisor: Eric Darve
- Specialization: Boundary element methods via fast multipole methods, finite element methods, high performance computing, spectral analysis.

Harvey Mudd College *Fall 2002 – Spring 2006*

B.Sc. Computer Science / Mathematics *Claremont, CA*

- Specialization: Scientific Computing, Algorithms, Graphics.

B.Sc. Physics

- Specialization: Computational Physics and Modeling, E&M, Quantum Mechanics.

Minor: Music

RESEARCH INTERESTS

- High performance computing with (1) GPU and (2) distributed memory systems.
- Hierarchical algorithms with applications in (1) computational physics (FMM/Treecode), (2) linear algebra (H-matrices), and (3) machine learning (convolutions, RBFs, generalized N-body).
- Fast low-rank factorizations, approximation theory, direct solvers for hierarchical matrices with applications in computational statistics, inverse problems, filtering, scattering, etc.
- Software and algorithm design for (1) scientific computing and (2) high performance computing.

PROFESSIONAL EXPERIENCE

NVIDIA Research *Jan 2015 – Present*

Programming Systems and Applications Group *Santa Clara, CA*

Senior Research Scientist

Stanford University *Jan 2016 – Present*

Institute for Computational and Mathematical Engineering *Stanford, CA*

Adjunct Professor

Massachusetts Institute of Technology *Spring 2014 – Dec 2014*

Department of Mathematics *Cambridge, MA*

Postdoctoral Associate

Harvard University *Summer 2011 – Dec 2014*

Institute for Applied Computational Science *Cambridge, MA*

Research Scientist and Lecturer

Stanford University *Fall 2006 – Spring 2011*

Institute for Computational and Mathematical Engineering *Stanford, CA*

Graduate Research Assistant, Teaching Assistant

Syracuse University *Summer 2004 – 2006*

Department of Physics *Syracuse, NY*

Research Assistant, Outside Consultant

Harvey Mudd College *Spring 2004 – Fall 2005*
Research Assistant, Teaching Assistant *Claremont, CA*

BOOK CHAPTERS

1. **Cris Cecka**, Adrian Lew, and Eric Darve. Application of assembly of finite element methods on graphics processors for real-time elastodynamics. In Wen-Mei W. Hwu, editor, *GPU Computing Gems*, chapter 16, pages 187–205. Morgan Kaufmann Publishers, Jade edition, 2011

JOURNAL ARTICLES

1. Pierre Létourneau, **Cris Cecka**, and Eric Darve. Cauchy fast multipole method for general analytic kernels. *SIAM Journal on Scientific Computing*, 36(2):A396–A426, 2014
2. **Cris Cecka** and Eric Darve. Fourier-based fast multipole method for the Helmholtz equation. *SIAM Journal on Scientific Computing*, 35(1):A79–A103, 2013
3. Toru Takahashi, **Cris Cecka**, William Fong, and Eric Darve. Optimizing the multipole-to-local operator in the fast multipole method for graphical processing units. *International Journal for Numerical Methods in Engineering*, 89(1):105–133, 2012
4. **Cris Cecka**, Adrian Lew, and Eric Darve. Assembly of finite element methods on graphics processors. *International Journal for Numerical Methods in Engineering*, 85(5):640–669, 2011
5. Eric Darve, **Cris Cecka**, and Toru Takahashi. The fast multipole method on parallel clusters, multicore processors, and graphics processing units. *Comptes Rendus Mecanique*, 339(2-3):185–193, 2011

CONFERENCE PUBLICATIONS (REFEREED)

1. **Cecka, Cris**. Low communication FMM-accelerated FFT on GPUs. In *Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis*, SC '17, pages 54:1–54:11, New York, NY, USA, 2017. ACM
2. Yang Shi, U.N. Niranjan, Animashree Anandkumar, and **Cris Cecka**. Tensor contractions with extended blas kernels on cpu and gpu. In *2016 IEEE 23rd International Conference on High Performance Computing (HiPC)*, pages 193–202, Dec 2016
3. **Cris Cecka** and Simon Layton. FMMTL: FMM template library; a generalized framework for kernel matrices. In *European Numerical Mathematics and Advanced Applications (ENUMATH)*, 2013
4. Tommy MacWilliam and **Cris Cecka**. CrowdCL: Web-based volunteer computing with WebCL. In *IEEE High Performance Extreme Computing Conference (HPEC), 2013*, pages 1–14, 2013
5. Toru Takahashi, **Cris Cecka**, and Eric Darve. Optimization of the parallel black-box fast multipole method on CUDA. In *Innovative Parallel Computing (InPar), 2012*, pages 1–14, 2012
6. **Cris Cecka**, Pierre-David Létourneau, and Eric Darve. Fast multipole method using the Cauchy integral formula. In Bjorn Engquist, Olof Runborg, and Yen-Hsi R. Tsai, editors, *Numerical Analysis of Multiscale Computations*, volume 82 of *Lecture Notes in Computational Science and Engineering*, pages 127–144. Springer Berlin Heidelberg, 2012. 10.1007/978-3-642-21943-6_6
7. Toru Takahashi, **Cris Cecka**, and Eric Darve. An acceleration of multipole-to-local operation for low-frequency fast multipole BIEM with GPU. *IABEM 2011 Symposium*, 2011
8. **Cris Cecka**, Adrian Lew, and Eric Darve. Introduction to Assembly of Finite Element Methods on Graphics Processors. *IOP Conference Series: Materials Science and Engineering*, 10:012009, 2010
9. Pierre-David Létourneau, **Cris Cecka**, and Eric Darve. Generalized fast multipole method. *IOP Conference Series: Materials Science and Engineering*, 10(1):012230, 2010
10. Toru Takahashi, **Cris Cecka**, and Eric Darve. An implementation of low-frequency fast multipole BIEM for Helmholtz equation on GPU. *The Computational Mechanics Conference*, 2010(23):319–321, Sep 2010

GRANTS

$130,487. Tree- and Multipole-based algorithms for Exascale Computing *January 2012*

Principal Investigators:

- **Cris Cecka**, Harvard University
- Lorena Barba, Boston University
- Hans Johnson, University Massachusetts Amherst

Massachusetts Green High-Performance Computing Center Consortium Seed Grant Program

SELECT INVITED TALKS

1. International Supercomputing Conference 2017, Denver, Colorado. *Low-communication FMM-accelerated FFTs on GPUs*.
2. **Keynote:** PPAM 17, Lublin, Poland. *High performance tensor computations and applications to FFTs*.
3. GTC 2017, San Jose, California. *Low-Communication FFT with Fast Multipole Method.*
4. SIAM CSE 2017, Atlanta, Georgia. *Tensor Contractions with Extended BLAS.*
5. Rice University 2014, Houston, Texas. *Structured Dense Matrices in Computational Science.*
6. ENUMATH 2013. Lausanne, Switzerland. *FMMTL: FMM Template Library.*
7. SIAM Annual Meeting 2013. San Diego, California. *FMM applications with a kernel-matrix library.*
8. SHAXC Workshop 2012. KAUST, Saudi Arabia. *Stages of the Fast Multipole Method on the GPU.*
9. GPU@BU Workshop 2011. Boston, Massachusetts. *Application of FEM Assembly on GPU, Thoughts on CUSP and Sparse Matrices.*
10. IMA Conference - High Performance Computing and Emerging Architectures 2011. Minneapolis, Minnesota. *Introduction to GPGPU Tutorial* and *Application of Assembly of Finite Element Methods*
11. Army Science Conference 2010. Orlando, Florida. *Real-Time Elastodynamics with GPU.*
12. International Supercomputing Conference 2010. New Orleans, Louisiana. *High Performance FEM with GPU.*
13. World Congress on Computational Mechanics 2010. Sydney, Australia. *Assembly of Finite Element Methods on Graphics Processors.*
14. European Conference on Computational Mechanics 2010. Paris, France. *Fourier Based MLFMM for the Helmholtz Equation.*
15. Thermal and Fluid Sciences Affiliates and Sponsors Conference 2010. Stanford, CA. *Assembly of Finite Element Methods on Graphics Processors.*
16. US National Congress on Computational Mechanics 2009. Columbus, Ohio. *Assembly of Finite Element Methods on Graphics Processors.*
17. Supercomputing Conference 2008. Austin, Texas. *Fourier Based MLFMM for the Helmholtz Equation.*

TEACHING

Instructor: CME212 – Advanced Programming for Scientists and Engineers *Winter 2017*

- Core course for ICME MS/PhD. *Stanford*

Instructor: CME212 – Advanced Programming for Scientists and Engineers *Winter 2016*

- **New core course** for the Computational and Mathematical Eng. MS/PhD program. *Stanford*
- Responsible for 68 graduate students and 5 teaching assistants.

Instructor: CS207 – Systems Development for Computational Science *Spring 2014*

- Core course for IACS MS. *Harvard*
- Responsible for 38 students (25G, 13U) and 3 teaching fellows.

Instructor: CS205 – Computing Foundations for Computational Science *Fall 2013*

- Core course for IACS MS. *Harvard*
- Developed and managed 256-core computing cluster for student use.

- Responsible for 84 students (48G,26U,13E) and 6 teaching fellows.

Instructor: CS207 – Systems Development for Computational Science *Spring 2013*
- Core course for IACS MS. *Harvard*
- Responsible for 26 students (15G,11U) and 2 teaching fellows.

Instructor: CS205 – Computing Foundations for Computational Science *Fall 2012*
- Core course for IACS MS. *Harvard*
- Responsible for 80 students (42G,35U,13E) and 6 teaching fellows.

Instructor: CS207 – Systems Development for Computational Science *Spring 2012*
- **New core course** for the Institute for Applied Computational Science Masters program. *Harvard*
- Responsible for 22 students (17G,5U) and 1 teaching fellow.

Instructor: CS205 – Computing Foundations for Computational Science *Fall 2011*
- **New core course** for the Institute for Applied Computational Science Masters program. *Harvard*
- Developed and managed a new 16-node, 32-GPU computing cluster for student use.
- Responsible for 65 students (42G,23U,16E) and 4 teaching fellows.

Lecturer, Graduate TA: CME343 – Parallel Numerical Algs with CUDA and MPI *Spring 2011*
- **New course** – developed syllabus and programming assignments. *Stanford*
- Developed and managed a new GPU cluster for student use.

Lecturer: AHPCRC Summer Institute on Computational Science *Summer 2010*
- Undergraduate summer course. *Stanford*

Graduate TA: CME106 – Intro Probability and Statistics for Engineers *Winter 2007*
- Weekly help sessions for more than 100 students. *Stanford*

Lecturer, Mentor: Science Education Seminar *Spring 2006*
- High school science outreach through Harvey Mudd College.

Coach, Teacher: MATHCOUNTS Program *Fall 2000 – Spring 2001*
- Middle school math outreach. Volunteered to keep MATHCOUNTS at Discovery Middle School.

MENTORING

Chenhan Yu *Summer 2016*
- Summer Research: Semiring linear algebra primitives.
- Produced GKMX and HMLP libraries for kernel matrix and machine learning computations.

Wesley Chen *Summer 2013*
- Summer Research: Communication optimal N-body algorithm for symmetric direct interactions.
- Continuing through fall and winter to write and publish results.

Ryan Meltzer and Chi Zeng *Spring 2013*
- Extension of CS205 final project on profiling and benchmarking GPUs.
- Poster presentation at GTC 2013.
- Invited talk at Northeastern University's Accelerating Research Workshop.

Tommy MacWilliam *Spring 2013*
- Development of CrowdCL: High performance web-based computing.
- Published and presented at IEEE HPEC 2013.

Jimmy Zhu *Summer 2012*
- Summer Research: Scalable treecodes using parallel primitives

Samir Patel *Fall 2011 – Spring 2012*

- Senior Thesis: GPU optimized immersed solid Navier-Stokes

Juan Pablo Samper Mejia and Vivian Nguyen *Summer 2010*

- Undergraduate summer research: Realtime finite element analysis of dynamic problems using GPUs
- AHPCRC Best Research Award

AWARDS AND ACHIEVEMENTS

- Teaching Excellence Award, Fall 2014.
- Teaching Excellence Award. Fall 2013.
- Teaching Excellence Award. Spring 2013.
- Teaching Excellence Award. Spring 2012.
- NSF Fellowship Honorable Mention. Spring 2008.
- Stanford School of Engineering Graduate Fellowship, Spring 2007.
- Harvey Mudd College with double major and high honors. Spring 2006.
- Outstanding Award in ICM Competition 2006 - 1 of top 4 out of 225 entries.
  Published in the *Journal of Undergraduate Mathematics and its Applications* 27.2 (2006).

PROFESSIONAL ACTIVITIES

PROFESSIONAL GROUPS

Member – Harvard IACS Advisory Board
Member – Society for Industrial and Applied Mathematics (SIAM)
Member – Institute of Electrical and Electronics Engineers (IEEE)
President – Stanford Computational Math Consulting Group (C^2). Fall 2010 – Spring 2011.

CONFERENCES AND JOURNALS

Co-organizer

BatchedBLAS Birds of a Feather, Supercomputing Conference 2017.
Harvard IACS ComputeFest Workshop 2014.
Minisymposium in SIAM Computational Science and Engineering, February 2013.
"Applications and New Developments in fast multipole and tree-based methods"
Harvard IACS ComputeFest Workshop 2013.
IACS High Performance Computing Journal Club.

External Reviewer (Selected)

Computers and Fluids 2014
Engineering Analysis with Boundary Elements 2014
Numerical Methods in Engineering 2013
Computing in Science and Engineering 2013
Innovative Parallel Computing 2012
Computing in Science and Engineering 2012
International Journal for Numerical Methods in Fluids 2012
IEEE Transactions on Very Large Scale Integration Systems 2011
Journal of Parallel and Distributed Computing 2011
Transactions on Mathematical Software 2011

VOLUNTEERING AND OTHER ACTIVITIES

President – Stanford Racquetball Club
Instructor – Stanford Windsurfing Club
Racquetball – Juniors national level
Crew – Juniors state level
Recreational Windsurfing, Skateboarding, Sailing, Skiing.

REFERENCES

- Director Hanspeter Pfister. Applied Computational Science, Harvard University.
  Contact: 617-496-8269 pfister@seas.harvard.edu
- Professor Lorena Barba. Mechanical and Areospace Engineering, George Washington University.
  Contact: 617-909-5900 labarba@gwu.edu
- Professor Laurent Demanet. Mathematics, Massachusetts Institute of Technology.
  Contact: 617-324-2614 laurent@math.mit.edu
- Professor Eric Darve. Mechanical Engineering, Stanford University.
  Contact: 650-918-6407 darve@stanford.edu
- Director Margot Gerritsen. Computational and Mathematical Eng, Stanford University.
  Contact: 650-725-3542 margot.gerritsen@stanford.edu