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# Cris Cecka <ccecka@seas.harvard.edu>

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<http://people.seas.harvard.edu/~ccecka/>

## EDUCATION

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- Harvard University** *2011-Present*
- Lecturer/Researcher
- Stanford University** *2006-2011*
- PhD Computational and Mathematical Engineering
    - Boundary Element Methods via Fast Multipole Methods, High Performance Computing via GPUs, Finite Element Methods, Spectral Analysis.
- Harvey Mudd College** *2002-2006*
- B.S. Physics
    - Theoretical and Computational, Physical Modeling, E&M, Optics, Quantum Mechanics.
  - B.S. Computer Science / Mathematics
    - Computational Modeling, Scientific Computing, Algorithms, Graphics, Games.

## RESEARCH EXPERIENCE

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- Stanford University, Nagoya University** *Feb 10 - Present*
- Research Assistant – Black Box Fast Multipole Method on GPU**
- Implementations of critical stages of the BBFMM on GPU.
  - Strategies for memory coalescing, avoiding shared memory bank conflicts, and avoiding thread divergence.
- Stanford University** *Jun 09 - Apr 10*
- Research Mentor – Sparse Matrix Solvers in Heterogeneous Parallel Computing.**
- Directed two undergraduate students in developing a sparse matrix solver on a cluster of GPUs.
- Stanford University** *Aug 09 - Present*
- Research Assistant – Cauchy Fast Multipole Method**
- Formulating a novel generalized fast multipole method and investigating error control.
  - This method promises to require the user to only provides a routine to evaluate an analytic kernel.
- Stanford University** *Jul 08 - Present*
- Research Assistant – Assembly of Finite Element Methods on GPUs**
- Computations on unstructured meshes accelerated with massively parallel NVIDIA GPUs.
  - Application of these methods to a nonlinear elastodynamics finite element model.
- Stanford University** *Mar 07 - Present*
- Research Assistant – Fourier Based Helmholtz Fast Multipole Method**
- Novel formulation of the Helmholtz FMM which eases error control and implementation.
  - Provided error analysis, optimization, and application to EM and acoustical scattering.
- Harvey Mudd College with Los Alamos National Laboratories** *Aug 05 - May 06*
- Research Team Member – Dynamic Multiscale Tumor Modeling**
- 5 HMC students in conjunction with LANL vascularized a dynamic multiscale model of a developing tumor spheroid and incorporated various schedules of chemotherapy. The model was composed of
    - Extracellular Model - Diffusion of chemicals between cells.
    - Cellular Model - Monte Carlo governed cell movement and growth.
    - Subcellular Model - Cell cycle, protein network, and protein expression.
  - Researched and developed a diffusion equation integrator with time and space dependent source/sink terms which could be applied to a system with arbitrary Dirichlet boundary conditions and geometries.
- Harvey Mudd College** *Jun 05 - Aug 05*
- Research Assistant – Quantum Programming and Quantum Computing**

- Researched requirements and restrictions of any quantum computing language - quantum operator and quantum bit manipulation, reversibility, state coherence, no cloning, etc.
- Researched current quantum computing algorithms (Deutsch-Jozsa, Grover, Shor, teleportation, encryption, operator decomposition, etc) and studied optimization, implementation, and correctness. Investigated existing quantum computing languages and simulators including QCL and Q-Language.

#### Syracuse University

Jun 04 - Present

#### Research Assistant/Outside Consultant – Thomson Problem

- Research and development in Computational Condensed Matter Physics.  
<http://thomson.phy.syr.edu/>
- Hosts the most extensive and interactive database on the generalized Thomson Problem in the world.
- Mesh generation, graphics engine, relaxation algorithms, and all support code is original.

#### PUBLICATIONS

- Cecka C, Lew A, Darve E. *Assembly of Finite Element Methods on Graphics Processors*. IJNME, 85(5):640-669, 2011.
- Cecka C, Lew A, Darve E. *Application of Assembly of Finite Element Methods on Graphics Processors for Real-Time Elastodynamics*. GPU Gems 3, July 2011.
- Takahashi T, Cecka C, Darve E. *The Fast Multipole Method in Parallel Clusters, Multicore Processors and Graphic Processing Units*. Comptes Rendus Mècanique. *Accepted*.
- Cecka C, Darve E. *Fourier Based FMM for the Helmholtz Equation*. SINUM. *Submitted*.
- Takahashi T, Cecka C, Fong W, Darve E. *Optimizing the Multipole-to-Local Operator in the Fast Multipole Method for Graphical Processing Units..* IJNME. *Accepted*.
- Letourneau P, Cecka C, Darve E. *Cauchy Fast Multipole Method for General Analytic Kernel*. In *Progress*

#### PROCEEDINGS

- Cecka C, Lew A, Darve E. *Introduction to Assembly of Finite Element Methods on Graphics Processors*. WCCM2010 Proceedings.
- Cecka C, Letourneau P, Darve E. *Fast Multipole Method using the Cauchy Integral Formula*. BIRS 2010 Proceedings.
- Letourneau P, Cecka C, Darve E. *Generalized Fast Multipole Method*. WCCM2010 Proceedings.

#### INVITED TALKS

- Supercomputing Conference 2008. Austin, Texas. *Fourier Based MLFMM for the Helmholtz Equation*.
- US National Congress on Computational Mechanics 2009. Columbus, Ohio. *Assembly of Finite Element Methods on Graphics Processors*.
- Thermal and Fluid Sciences Affiliates and Sponsors Conference 2010. Stanford, CA. *Assembly of Finite Element Methods on Graphics Processors*.
- European Conference on Computational Mechanics 2010. Paris, France. *Fourier Based MLFMM for the Helmholtz Equation*.
- World Congress on Computational Mechanics 2010. Sydney, Australia. *Assembly of Finite Element Methods on Graphics Processors*.
- Supercomputing Conference 2010. New Orleans, Louisiana. *High Performance FEM with GPU*.
- Army Science Conference 2010. Orlando, Florida. *Real-Time Elastodynamics with GPU*.
- IMA Conference - High Performance Computing and Emerging Architectures 2011. Minneapolis, Minnesota. *Introduction to GPGPU Tutorial and Application of Assembly of Finite Element Methods*

#### TEACHING EXPERIENCE

##### Stanford University

Apr 11 - Jun 11

#### Lecturer/Teaching Assistant – CME343 Parallel Numerical Algorithms with CUDA and MPI

- New course at Stanford - Proposed curriculum and schedule, wrote lectures and homeworks.
- Developed and managed a new GPU cluster for the course.

**Stanford University***Jun 10 - Sep 10***Mentor – AHCRC Summer Institute Research**

- Advised a team of two undergrads in summer research on OpenGL/CUDA interoperability and user interface design.
- Team won Best Project award after final research presentations.

**Stanford University***Jun 09 - Apr 10***Lecturer/Mentor/Supervisor – AHCRC Summer Institute + Research**

- Developed curriculum, wrote homework, and taught a series of courses on GPU computing.
- Advised a team of two undergrads in summer research on heterogeneous parallel computing applied to sparse matrix-vector products.
- Hired and continued to mentor the team throughout the next school year.

**Stanford University***Jan 07 - Mar 07***Course Assistant – CME106 Intro to Prob/Stat for Engineers**

- Responsible for grading rubrics, office hours, review sessions, and occasional lectures.

**Harvey Mudd College***Jan 06 - May 06***Student – IE197HM Science/Math Education**

- Developed one hour science projects, discussions, and demonstrations for a local middle school's weekly class period.
- Lead the class in building projects and scientific/mathematical discussions.

**Discovery Middle School***Oct 00 - Mar 01***Teacher/Coach – MATHCOUNTS**

- Volunteered to design, promote, and teach Discovery's waning MATHCOUNTS program.
- Organized and led multiple teams in competition. My students received 2nd at state level.

**AWARDS AND ACHIEVEMENTS**

- NSF Fellowship Honorable Mention.
- Stanford School of Engineering Graduate Fellowship
- Graduated Harvey Mudd College with double major and high honors.
- Outstanding Award in ICM Competition 2006 - 1 of top 4 out of 225 entries
  - Published in the *Journal of Undergraduate Mathematics and its Applications*.

**ACTIVITIES AND VOLUNTEERING**

President Stanford Racquetball Club  
TA Stanford Windsurfing Club  
ICME Computational Consulting Group  
Racquetball, Crew, Windsurfing, Sailing, Skiing

**RESEARCH REFERENCES**

- Professor Eric Darve. Stanford University - Mechanical Engineering.  
Contact: 650-918-6407 darve@stanford.edu
- Professor Adrian Lew. Stanford University - Mechanical Engineering.  
Contact: 650-725-3585 lewa@stanford.edu
- Professor Mark Bowick. Syracuse University - Condensed Matter Physics.  
Contact: 315-443-5979 bowick@physics.syr.edu