

# Matthew Buoni

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**Education**      **Ph.D. Mechanical Engineering, University of California, Santa Barbara**  
(June 2008), **GPA:** 4.0/4.0. Emphasis in Computational Science &  
Engineering.

**M.S. Mechanical Engineering, University of California, Santa Barbara**  
(September 2004), **GPA:** 4.0/4.0. Emphasis in Computational Science &  
Engineering.

**B.S. Engineering Physics, Ohio State University** (June 2001), **GPA:**  
3.97/4.0. Minor emphasis in Mechanical Engineering.

**Appointments**    **Los Alamos National Laboratory**, Los Alamos Mathematical Modeling and  
Analysis (LAMMA) student program, *Summer 2006*.

**University of California, Santa Barbara**, Postdoctoral researcher, *June 2008*  
– *May 2009*.

**Los Alamos National Laboratory**, Postdoctoral researcher, Theoretical  
Division: Mathematical Modeling and Analysis (T-5), *August 2009 – present*.

## **Research Experience and Interests**

- Presently performing numerical simulations of compressible magnetohydrodynamic (MHD) turbulence and developing data analysis algorithms to interpret the results and help understand the physics.
- Presently developing code for constructing two-dimensional Voronoi diagrams on complex, non-convex domains.
- Presently developing high order schemes for tracer transport on Voronoi meshes with application to global climate modeling.
- Developed mathematical models and computer simulations of copper electrodeposition for interconnects on computer processors. (*Petzold Group, UCSB Mechanical Engineering, Fall 2005 – present*)
- Developed mathematical models and computer simulations for planet formation and evolution. (*Mathematical Modeling and Analysis Group, Los Alamos National Laboratory, Summer 2006*)
- Developed mathematical models and computer simulations for

multiphase complex fluids. (*Banerjee Group, UCSB Chemical Engineering, Fall 2002 – Summer 2005*)

- Developed simplified models for complex networks, such as ecosystems, the Internet and economies, using graph theory and genetic algorithms. (*Carlson Group, UCSB Physics, Fall 2001 - Summer 2002*)
- Developed and performed computational gas dynamics simulations using the Direct Simulation Monte-Carlo (DSMC) method. (*Nonequilibrium Thermodynamics Lab, Ohio State U., Mechanical Engineering, Summer 2000 – Spring 2001*)
- Performed electron density measurements in weakly ionized non-equilibrium plasmas using microwave attenuation techniques. (*Nonequilibrium Thermodynamics Lab, Ohio State U., Mechanical Engineering, Summer 1999 – Spring 2000*)
- Designed and fabricated electronic circuit for a low temperature double resonance probe. (*Nuclear Magnetic Resonance Lab, Ohio State U., Physics, Summer 1998 - Spring 1999*)

## **Teaching Experience**

**CLAS (Campus Learning Assistance Services) Tutor, UCSB** (Winter 2004 - Summer 2004, Fall 2005 - Winter 2008)

- Tutored extensively for all levels of math, physics and engineering.
- Led group tutoring sections as well as one-on-one tutoring with student athletes, disabled students and other students seeking private tutoring.
- Held final reviews at the end of each quarter.

**Teaching Assistant - College Algebra and Pre-Calculus, Ohio State U., Math** (Fall 1998 - Spring 2001)

- Led Recitation for four classes of 20-30 students per quarter
- Created and proctored quizzes and graded quizzes and homework, which were 20% of a student's grade.
- Held office hours, midterm reviews, and final reviews outside of regular teaching hours.

**Lab Teaching Assistant - Honors Introduction to Physics, Ohio State U., Physics** (Winter 1998 - Spring 1998)

**Tutor - Calculus and Differential Equations, Ohio State U., Math** (Fall 1997 - Spring 1998)

## **Publications**

“An algorithm for simulation of electrochemical systems with surface-bulk coupling strategies,” M. Buoni, L. Petzold, accepted to *J. Comp. Phys.* (2009).

“Effect of Additives on Shape Evolution during Electrodeposition: IV. Superfilling in Small Trenches,” M. Willis, M. Buoni, L. Petzold, R. Braatz, R.C. Alkire, submitted to *J. Electrochem. Soc* (2009).

“A fast potential and self-gravity solver for disks,” S. Li, M. Buoni and H. Li, *Astrophysics Journal*, vol. 181, pp. 244-254 (2009).

“An efficient, scalable numerical algorithm for the simulation of electrochemical systems on irregular domains,” M. Buoni, L. Petzold, *J. Comp. Phys.*, vol. 225, pp. 2320–2332 (2007).

“Numerical Simulation of Two Phase Fluid Flow with Long Range Surface Forces,” M.S. Thesis, University of California, Santa Barbara (2004).

“Simulation of Compressible Gas Flow in a Micronozzle - Effect of Walls on Shock Structure,” M. Buoni, D. Dietz, K. Aslam, and V. V. Subramaniam, 35th AIAA Thermophysics Conference, June 11-14, 2001, Anaheim, CA.

“Electron density and recombination rate measurements in CO-seeded optically pumped plasmas,” Elke Plonjes, Peter Palm, Matt Buoni, Vish V. Subramaniam, Igor Adamovich, *J. App. Phys.*, vol. 89, No. 11, pp. 5903-5910 (2001).

“Small tip angle NMR as a probe of electron-mediated nuclear spin-spin couplings in  $\text{YBa}_2\text{Cu}_3\text{O}_7$ ,” C.H. Pennington, S. Yu, K.R. Gorny, M.J. Buoni, W.L. Hulst, J.L. Smith, *Phys. Rev. B* 63, 054513 (2001).

**Courses  
Taken**

- Matrix Analysis (both analytical and numerical)
- Numerical Simulation of ODEs
- Numerical Simulation of PDEs - Finite Difference and Finite Element Analysis
- ODE theory (Perturbation Theory, Chaos & Bifurcation Theory)
- Parallel Programming in MPI, Parallel Computing and Program Parallelization
- 1-year course in Computational Fluid Dynamics
- 1-year course in Linear System Control Theory (finite and distributed systems)
- 2 quarters graduate Quantum Mechanics
- graduate Statistical Mechanics
- graduate Classical Mechanics
- Colloids and Interfaces
- Ecological Dynamics
- graduate Monte-Carlo and Molecular Dynamics Simulation
- Real & Complex Analysis
- graduate Linear Algebra (in finite and infinite dimensions)

- graduate Solid-state Physics
- graduate Compressible Gas Dynamics
- graduate Plasma Physics

**Other Skills  
& Expertise**

- Highly experienced and skilled C, Fortran and Matlab programmer
- Experience in C++, MPI, Maple, Mathematica, HTML, LaTeX
- Enjoy working with others in a team environment
- Highly focused, self-driven and independent thinker and problem solver

**Awards**

- NSF IGERT (Integrative Graduate Education and Research Traineeship) Fellowship, 2004-2007
- National Science Foundation Fellowship, 2001-2004
- Distinguished Alumni Award, Physics, Ohio State U. (highest award granted to any graduating senior), 2001
- Goldwater National Scholarship, Barry M. Goldwater Foundation, 2000