Kevin T. Chu

CONTACT INFORMATION

Serendipity Research
Mountain View, CA

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EDUCATION

Massachusetts Institute of Technology, Cambridge, MA
Ph.D. Applied Mathematics, September 2005
Thesis: *Asymptotic Analysis of Extreme Electrochemical Transport*
Advisor: Martin Z. Bazant

Stanford University, Stanford, CA
M.S. Scientific Computing and Computational Mathematics, June 1999

Stanford University, Stanford, CA
B.S. Chemistry (minors: Mathematics, Physics, Computer Science), June 1998

Illinois Mathematics & Science Academy, Aurora, IL
H.S. 1994

AWARDS AND HONORS

Visiting Scientist Appointment (1 month), Institute of High Performance Computing (2009)
Frederic A. Howes Scholar in Computational Science, Department of Energy (2006)
Elected to Sigma Xi Scientific Research Society as a full member (2005)
Department of Energy Computational Science Graduate Fellow (2002 – 2005)
MIT Mathematics Department Fellowship (2001)
Elected to Phi Beta Kappa Honor Society (1998)
Hughes Fellowship for undergraduate research in Physics at Emory University (1997)
Bing Chemistry Summer Undergraduate Fellowship at Stanford University (1996)
National Merit Scholarship (1994)

RESEARCH INTERESTS

application of mathematical/computational methods to scientific/engineering problems, computational science and engineering, material science, energy systems and energy efficiency, numerical methods (e.g. spectral methods, level set methods, structured adaptive mesh refinement), high-performance computing and scientific software development

RESEARCH EXPERIENCE

Independent Research Scientist (Sep 2007 – present)
Serendipity Research, Mountain View, CA
high-performance computing, GPU computing, crystal growth modeling and simulation, optimal time step selection for finite-difference schemes, phase field modeling
Collaborators:
Institute for High Performance Computing, Singapore, Singapore

Department of Mechanical and Aerospace Engineering
Princeton University, Princeton, NJ
Postdoctoral Research Associate (Jul 2005 – Sep 2007)
Advisor: David J. Srolovitz
Mathematical and computational modeling of the structure and dynamics of dislocation networks and grain boundaries.

Department of Mathematics
Massachusetts Institute of Technology, Cambridge, MA
Graduate Student (Sep 2001 – Jul 2005)
Advisor: Martin Z. Bazant

Mathematical and numerical modeling of electrochemical systems, ion transport processes, and induced-charge electroosmosis.

Center for Applied Scientific Computing
Lawrence Livermore National Laboratory, Livermore, CA
Summer Student Researcher (Jun 2004 – Aug 2004)
Advisor: David Trebotich
Enhanced existing C++/Fortran77 microfluidics simulation to include electrokinetic effects. This practicum appointment was part of the program requirements for the Computational Science Graduate Fellowship (CSGF) sponsored by the Department of Energy.

Center for Applied Scientific Computing
Lawrence Livermore National Laboratory, Livermore, CA
Computer Scientist/Math Programmer (Sep 1999 – Oct 2000)
Software developer on the Structured Adaptive Mesh Refinement Applications Infrastructure (SAMRAI) Project. Collaborated with researchers at the Institute for Geophysics and Planetary Physics at UCLA to develop an adaptive magnetohydrodynamics algorithm for global magnetosphere modeling.

Physics Department
Emory University, Atlanta, GA
Summer Student Researcher (Jun 1997– Aug 1997)
Advisor: Katherine Benson
Project Title: *A Quantum Field Theory Approach to Post-Inflationary Universe Reheating*

Chemistry Department
Stanford University, Stanford, CA
Undergraduate Researcher (Jan 1995– Oct 1996)
Advisor: Michael D. Fayer
Project Title: *Kinetics of Photoinduced Electron Transfer over a Micelle Surface*

Teaching Qualifications

calculus, linear algebra, differential equations, numerical methods, asymptotic and perturbation methods, modeling and simulation, computational science, electrochemical transport

Teaching Experience

Mechanical and Aerospace Engineering
Princeton University, Princeton, NJ
Volunteer Assistant Instructor: *Mathematical Methods of Engineering Analysis II* (2006,2007)
Topics covered: complex variables, partial differential equations, Fourier and Laplace tranforms, basic numerical methods, basic asymptotic methods

Department of Mathematics
Massachusetts Institute of Technology, Cambridge, MA
Volunteer Teaching Assistant: *Introduction to Modeling and Simulation* (2004)
Topics covered: random walks and diffusion processes, Monte carlo methods, continuum models (*e.g.* elastic structural mechanics and heat transport), finite difference methods, finite element methods, basic quantum mechanics and chemical physics.
Supervised a student project on diffusion-limited aggregation.
Training: Participated in department *Micro-teaching Workshop* (2004)

Short-Course for High School Students
Illinois Mathematics & Science Academy, Aurora, IL
Designed a short-course titled *Dimensional Analysis and Scaling Arguments: Getting the Right Answer (Without The Sweat)* to be given during Intersession 2003. The primary goal

of the course was to allow talented high-school students to theoretically explore interesting physical phenomena using only relatively simple mathematical tools taught in the advanced high-school curriculum (*i.e.* basic calculus). *Offered but not given due to low student enrollment.*

Department of Chemistry
Stanford University, Stanford, CA
Teaching Assistant: *Chemical Separations* (1997)
Teaching Assistant: *Qualitative Organic Analysis* (1997)

Tutoring Services
Stanford University, Stanford, CA
Resident Tutor for physics and mathematics (1997 – 1998)
Freshman Dorm Tutor for mathematics (1995 – 1996)
General Tutor for Center for Teaching and Learning (1995 – 1998)

Publications

1. K. T. Chu. *Using Optimal Time Step Selection to Boost the Accuracy of Finite Difference Schemes for Time Dependent PDEs.* Submitted for review.
2. Z. Chen, K. T. Chu, D. J. Srolovitz, J. M. Rickman, and M. P. Haataja. *Dislocation Climb-Strengthening in Systems with Immobile Obstacles: a 3D level-let simulation study.* Phys. Rev. B, **81**, 054104 (2010).
3. K. T. Chu. *Using Optimal Time Step Selection to Boost the Accuracy of FD Schemes for Variable-Coefficient PDEs.* Proceedings of the World Congress on Engineering, London, 2009.
4. K. T. Chu. *A direct matrix method for computing analytical Jacobians of discretized nonlinear integro-differential equations.* J. Comput. Phys., **228**, 5526–5538 (2009).
5. K. T. Chu and M. Z. Bazant. *Surface Conservation Laws at Microscopically Diffuse Interfaces.* J. Colloid Interface Sci., J. Colloid Interface Sci., **315**, 319–329 (2007).
6. Y. Jung, K. T. Chu and S. Torquato. *A Variational Level Set Approach for Surface Area Minimization of Triply Periodic Surfaces*, J. Comput. Phys. **223**, 711–730 (2007).
7. K. T. Chu and M. Z. Bazant. *Nonlinear electrochemical relaxation around conductors.* Phys. Rev. E. **74**, 011501 (2006).
8. K. T. Chu and M. Z. Bazant. *Electrochemical thin films at and above the classical limiting current.* SIAM J. Appl. Math. **65**, 1485–1505 (2005).
9. M. Z. Bazant, K. T. Chu and B. J. Bayly. *Current-voltage relations for electrochemical thin films.* SIAM J. Appl. Math. **65**, 1463–1484 (2005).
10. K. Weidemaier, H. L. Tavernier, K. T. Chu, and M. D. Fayer. *Photoinduced Electron Transfer between Donors and Acceptors on Micelle Surfaces.* Chem. Phys. Lett. **276**, 309–315 (1997).

Software Libraries

1. K. T. Chu and M. Prodanović. *Level Set Method Library (LSMLIB).*
   URL http://ktchu.serendipityresearch.org/software/lsmlib/index.html
2. K. T. Chu and C. H. Rycroft. *Pseudospectral Method Library (PSLIB).*
   URL http://ktchu.serendipityresearch.org/software/pslib/index.html
3. K. T. Chu. *SAMRAI Rapid Development Kit.*
   Description: Software development kit for rapid prototyping within the SAMRAI software framework.
   URL http://ktchu.serendipityresearch.org/software/samrai_rdk/index.html

Invited Seminars & Colloquia

1. *Getting Started with GPU Computing: Programming Paradigm and Optimization Principles*
   Institute of High Performance Computing, A*STAR, Singapore
   August 24, 2009
2. *Extensions of Optimal Time Step Selection: Boosting the Accuracy of Finite Difference Methods for Variable Coefficient PDEs and Systems of PDEs*
   Institute of High Performance Computing, A*STAR, Singapore
   September 11, 2008
3. *Workshop on Techniques in High-Performance Conputational Science*
   Institute of High Performance Computing, A*STAR, Singapore
   October 17, 2007
4. *High-Order Numerical Methods from Low-Order Stencils for Time-Dependent PDEs*
   Institute of High Performance Computing, A*STAR, Singapore
   October 10, 2007
5. *Recent Applications of Level Set Methods in Material Science: Equilibrium/Optimal Microstructures & Dislocation Models of Grain Boundaries*
   Lawrence Berkeley Laboratory, Berkeley CA
   March 26, 2007
6. *Recent Applications of Level Set Methods in Material Science: Equilibrium/Optimal Microstructures & Dislocation Models of Grain Boundaries*
   Department of Mathematics, San Jose State University
   March 22, 2007
7. *Overview of Structured Adaptive Mesh Refinement (SAMR) and The SAMRAI Software Library*
   Institute of High Performance Computing, A*STAR, Singapore
   January 29, 2007
8. *Towards an Understanding of Nonlinear Electrochemical Transport*
   Mathematical Sciences Colloquium
   Worcester Polytechnic Institute, October 27, 2006
9. *Towards an Understanding of Nonlinear Electrochemical Transport*
   Frederick Howes Scholar Seminar
   Computational Science Graduate Fellowship (CSGF) Annual Conference
   Washington, D.C., June 20, 2006
10. *Toward an Understanding of Nonlinear Electrochemical Transport*
    PDE & Numerical Methods Seminar
    Penn State University, November 14, 2005
11. *Less is More: Efficient Numerics for Model Physics Problems in Simple Geometries*
    Computational Science Graduate Fellowship (CSGF) Annual Conference
    Washington, D.C., June 23, 2005

Contributed Presentations & Minisymposia

1. K. T. Chu and J. V. Lambers
   Using Optimal Time Step Selection to Boost the Accuracy of Finite-Difference Schemes for Variable-Coefficient and Systems of Time-Dependent PDEs
   SIAM Annual Meeting
   Denver, CO, July 10, 2009
2. K. T. Chu and J. V. Lambers
   Using Optimal Time Step Selection to Boost the Accuracy of FD Schemes for Variable-Coefficient
   International Conference of Applied and Engineering Mathematics

World Congress on Engineering
London, U.K., July 3, 2009

3. K. T. Chu
High-Order Accurate Finite Difference Schemes Via Optimal Time Step Selection.
SIAM Annual Meeting
San Diego, CA, July 10, 2008

4. K. T. Chu and M. Prodanović
LSMLIB: A Level Set Method Software Library for Application Developers (mini-symposium)
SIAM Conference on Computational Science & Engineering
Costa Mesa, CA, February 21, 2007

5. K. T. Chu, A. T. Lim, Y. Xiang and D. J. Srolovitz
A Level Set Approach to Dislocation Models of Low-Angle Grain Boundary Structure and Motion Boundaries
SIAM Conference on Computational Science & Engineering
Costa Mesa, CA, February 20, 2007

6. K. T. Chu, Y. Xiang, and D. J. Srolovitz
Level Set Method Approaches to Dislocation Models of Grain Boundaries
SIAM Conference on Analysis of Partial Differential Equations
Boston, MA, July 10, 2006

7. K. T. Chu and D. J. Srolovitz
Parallel Dislocation Dynamics Simulations Using LSMLIB (poster)
SIAM Parallel Processing Conference
San Francisco, CA, February 23, 2006

8. K. T. Chu and M. Z. Bazant
Nonlinear Surface Transport in the Thin Double-Layer Limit
American Physical Society March Meeting
Baltimore, MD, March 16, 2006

9. K. T. Chu, Y. Ben and M. Z. Bazant
Impact of Diffuse Layer Charging Dynamics on Induced Charge Electro-osmotic Flows
American Physical Society March Meeting
Los Angeles, CA, March 23, 2005

10. K. T. Chu
Applied Math and Computer Simulations: A Waltz
Simple Person's Applied Math Seminar
Massachusetts Institute Technology, September 16, 2004

11. K. T. Chu
The Art of Approximating Functions (A.K.A. Getting a "Good Enough" Answer as Quickly as Possible)
Simple Person's Applied Math Seminar
Massachusetts Institute Technology, May 6, 2004

12. K. T. Chu and M. Z. Bazant
Continuum Modeling of Ion Transport in Nano-electrochemical Systems
American Physical Society March Meeting
Montreal, Canada, March 25, 2004

Academic Service

Co-organizer for *Simple Person's Applied Mathematics Seminar* (2003 – 2005)
Department of Mathematics
Massachusetts Institute of Technology, Cambridge, MA
Organized graduate student seminar series focused on applied mathematics.

Scientific Computing Software System Administrator (2002 – 2005)
Department of Mathematics
Massachusetts Institute of Technology, Cambridge, MA
Ordered, assembled, configured, and administered the Applied Mathematics Computational Laboratory, a 16 node (32 processor) Linux-based Beowulf cluster. Primarily responsible for maintaining the scientific computing software for the cluster and teaching users how to use the cluster for their specific applications. Put together a collection of tutorials, manuals, and FAQs into a simple web site for the cluster.

Founder/Co-organizer for *Math Study Group* (2000)
Center for Applied Scientific Computing
Lawrence Livermore National Laboratory, Livermore, CA
Organized weekly math/numerical methods seminar series targeted towards junior staff members to enable them to better understand and contribute to the laboratory simulation efforts.

Freshman Academic Advisor (1999)
Stanford University, Stanford, CA

Professional Affiliations

Society for Industrial and Applied Mathematics, Sigma Xi

Other Professional Experience

Galapagos Computing, Inc., Mountain View, CA
CEO (Jan 2010 – present)
Design, engineering, manufacturing, and sales of premium high-performance computing solutions specially designed for individual computational scientists and engineers.

Serendipity Research, Mountain View, CA
Research Scientist/Consultant (May 2009 – present)
Consulting services for scientific computing, high-performance computing, and mathematical/numerical modeling.

Vitamin D, Inc., Menlo Park, CA
Software Engineer/Research Scientist (Nov 2007 – Apr 2009)
Research and development in artificial intelligence and computer vision systems.

Longevity Investments, Santa Clara, CA
Manager and Co-founder (Dec 2006 – present)
Manager for a small investment fund.

Thinking Investments, Inc., Waltham, MA
Software Engineer (Oct 2000 – Jun 2001)
Design and implementation of core financial engine software library based on proprietary algorithms. Administration of the Linux systems used by financial engine R&D group.

Expertise

Programming paradigms: parallel and high-performance computing, GPU computing

Programming languages:
Proficient in: C, C++, MATLAB, Python
Experience with: Java, Perl, Fortran 77, MPI, OpenMP, mixed-language programming

Scientific Computing/Numerical Libraries:
Proficient in: SAMRAI, CUDA
Experience with: BLAS, LAPACK