Kevin T. Chu

CONTACT INFORMATION

Serendipity Research
Mountain View, CA

E-mail: ktchu@serendipityresearch.org
Webpage: http://ktchu.serendipityresearch.org

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

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 & AREAS OF EXPERTISE

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

Programming Languages: Python, C/C++, Java, JavaScript, SQL, Perl, bash, PHP, HTML, CSS, Fortran 77, mixed-language programming

High-Performance/Scientific Computing: MPI, OpenMP, CUDA, MATLAB, NumPy, BLAS, LAPACK, ATLAS, ZeroMQ

Software Engineering: git, Mercurial, Subversion, autotools

Databases: Oracle, SQLite, MySQL, PostgreSQL, Redis, SQLalchemy

Cloud/Grid Computing: Amazon Web Services (AWS), GridGain, Portable Batch System (PBS)

Testing Frameworks: Java jUnit, Python unittest, Check, googletest, Jenkins

Web: Django, WordPress, Apache Tomcat, Apache

Mathematical/Statistical Techniques: probability, regression analysis, linear algebra, ordinary and partial differential equations, image processing, numerical methods, simulation and modeling, asymptotic analysis

Publishing: LaTEX, Microsoft Office

Operating Systems: Linux, Unix, Mac OS X, Windows (XP/Vista/7)

Professional Experience

Velexi Corporation, Mountain View, CA
CEO and Founder (Jan 2010 – present)
Design, engineering, manufacturing, and sales of premium high-performance computing solutions specially designed for individual computational scientists and engineers. Designed, prototyped, produced and brought to market the *QuickCharge* adapter, a unique consumer cellphone accessory.

Serendipity Research, Mountain View, CA
Research Scientist/Consultant and Founder (Sep 2007 – present)
Consulting and research in the areas of applied mathematics, computational science, high-performance computing, numerical modeling/simulation, scientific software development.

Longevity Investments, Santa Clara, CA
Portfolio Manager and 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.

Research Experience

Serendipity Research, Mountain View, CA
Research Scientist/Consultant (Sep 2007 – present)
Client sample: MIT Lincoln Laboratory, Institute of High Performance Computing (Singapore), Qualcomm
Project topics: scientific computing, high-performance computing, GPU computing, mathematical/numerical modeling and simulation, crystal growth modeling and simulation, optimal time step selection for finite-difference schemes, phase field modeling, biologically-insired machine learning algorithms, radar simulation, compressive sensing

Institute of High Performance Computing, A*STAR, Singapore, Singapore
Visiting Scientist (Jan 2009 - Dec 2009)
Collaborators: David T. Wu, S.S. Jerry Quek
Development of novel approaches for the simulation of polycyrstalline growth processes.

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

Princeton University, Princeton, NJ
Department of Mechanical and Aerospace Engineering
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.

Massachusetts Institute of Technology, Cambridge, MA
Department of Mathematics
Graduate Student (Sep 2001 – Jul 2005)

Advisor: Martin Z. Bazant
Mathematical and numerical modeling of electrochemical systems, ion transport processes, and induced-charge electroosmosis.

Lawrence Livermore National Laboratory, Livermore, CA
Center for Applied Scientific Computing
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.

Lawrence Livermore National Laboratory, Livermore, CA
Center for Applied Scientific Computing
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.

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

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

Publications

1. K. T. Chu. *Boosting the accuracy of finite difference schemes via optimal time step selection and non-iterative defect correction.* Appl. Math. and Comput., **218**, 3596–3614 (2011).
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. T. Ralston and K. T. Chu *Enhancing the Space Fence Performance Evaluation System (PES): GPGPU Computing in a Complex, Multithreaded Software System*
HPEC 2010
Lexington, MA, September 15, 2010

2. 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

3. 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

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

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

6. 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

7. 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

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

9. 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

10. 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

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

12. 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

13. 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

Professional Affiliations

Society for Industrial and Applied Mathematics, Sigma Xi

Teaching Qualifications

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

Teaching Experience

Princeton University, Princeton, NJ
Mechanical and Aerospace Engineering
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

Massachusetts Institute of Technology, Cambridge, MA
Department of Mathematics
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)

Illinois Mathematics & Science Academy, Aurora, IL
Short-Course for High School Students
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.*

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

Stanford University, Stanford, CA
Tutoring Services
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)

Academic Service

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

Massachusetts Institute of Technology, Cambridge, MA
Department of Mathematics
Scientific Computing Software System Administrator (2002 – 2005)
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.

Lawrence Livermore National Laboratory, Livermore, CA
Center for Applied Scientific Computing
Founder/Co-organizer for *Math Study Group* (2000)
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.

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