REBECCA J. HARTMAN-BAKER

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EDUCATION

June 2005 Ph.D., Computer Science (with certificate in Computational Science and Engineering), University of Illinois at Urbana-Champaign, Urbana, Illinois.
Dissertation title: *The Diffusion Equation Method for Global Optimization and Its Application to Magnetotelluric Geoprospecting*.
Advisor: Professor Michael T. Heath.

May 1998 B.S., Physics with Honors, University of Kentucky, Lexington, Kentucky.
Summa cum Laude, Phi Beta Kappa.

AWARDS AND HONORS

- Outstanding Graduate Student Service Award, Department of Computer Science, University of Illinois, Urbana-Champaign, 4 years, 2000-2004.
- GK-12 Fellowship, 2003-2004.
- SURGE Fellowship, 1998-2003.
- Member, Phi Beta Kappa, 1997-present.
- Member, Sigma Pi Sigma (Physics Honor Society), 1996-present.
- National Merit Scholarship, University of Kentucky, 1993-1997.

GRANTS AND FELLOWSHIPS

- *Supercomputer Allocations, 2003-2005.* Co-authored proposals for allocations on National Computational Science Alliance (NCSA) supercomputers. Awarded 50,000 SU on NCSA IA-32 Linux Cluster (2003) and 10,000 SU on NCSA IBM p690 and 90,000 SU on NCSA Xeon Linux Cluster (2004-2005). (Principal Investigator: Dr. Michael T. Heath)
- *GK-12 Fellowship, 2003-2004.* Support for collaboration with high school Physics teacher, during which devised and implemented supercomputing project in which students performed structural analysis of truss, using remotely finite element software on Linux cluster located at TRECC facility in suburban Chicago.

- *SURGE (Support for Under-Represented Groups in Engineering) Fellowship, 1998-2003.* UIUC College of Engineering provided one year of full support for first year of graduate school, and supplemental assistance thereafter.

RESEARCH EXPERIENCE

Oak Ridge National Laboratory 2005-present

- *Computational Scientist, Center for Computational Science (2007-present)*
  Supervisor: Dr. Ricky Kendall
  - Assist user projects in transition from prototype to production runs on leadership supercomputers. Continue involvement in development of MADNESS. Work to solve biofuel supply chain infrastructure problem at petascale. Pursue research in other areas of interest.
- *Postdoctoral Research Associate, Computer Science and Mathematics Division (2005-2007)*
  Supervisor: Dr. George Fann
  - Participated in development of MADNESS in C++.
  - Primary contribution in load balancing for massively parallel leadership computing systems. Given an octree, determine how to subdivide and distribute data among processors for optimal load balance. Factors to consider include computational work associated with each tree node and cost of communication. Devised new partitioning heuristic and implemented it in C++.

University of Illinois at Urbana-Champaign 1999-2005

- *Thesis Research (2001-2005)*
  Advisor: Professor Michael T. Heath
  Developed new method to solve magnetotelluric geoprospecting problem using a selection method and diffusion equation method for global optimization. Developed multilevel parallelization strategies for efficient objective function evaluation and problem solution. Through this work, successfully applied for allocations on NCSA IA-32 Linux cluster (2003), and IBM p690 and Xeon Linux Cluster (2004). This work included three main areas of investigation:
  - *Selection Methods:* Developed selection method for solution of magnetotelluric inverse problem, which is traditionally solved using Tikhonov regularization.
  - *Diffusion Equation Method for Global Optimization (DEM):* Devised and evaluated discrete version of DEM. Extended understanding of theoretical underpinnings of DEM. Invented heuristics to determine sufficiency of diffusion and size of continuation steps.
  - *Parallelization:* Designed three-tier parallelization using MPI. Formulated schemes for dynamic work allocation.
- *Research Assistant, Computational Chemistry and Biology, NCSA (2002-2003)*
  Supervisor: Dr. Sudhakar Pamidighantam
  Assisted in upkeep and installation of computational chemistry and biology software on NCSA HPC resources.
  - Developed computational chemistry grid portal GridChem.

- *Research Assistant, Computational Science and Engineering (1999-2001)*
  Supervisor: Professor Michael T. Heath
  - Investigated topology optimization problem.

Sandia National Laboratories, Albuquerque, New Mexico Summer 2001

- *Graduate Student Intern, Computational Math and Algorithms*
  Supervisor: Dr. David Day
  - Investigated magnetotelluric imaging inverse problem.

Center for Materials Research and Analysis, University of Nebraska-Lincoln, Lincoln, Nebraska Summer 1996

- *NSF Undergraduate Research Assistant*
  - Utilized computer image analysis to determine optimal shape for simple shear specimen.

SRI International, Menlo Park, California Summer 1995

- *NSF Undergraduate Research Assistant*
  Supervisor: Dr. Xiao A. Shen
  - Tested Huffman codes for possible use in encrypted optical data storage in photon echo memory.

TEACHING EXPERIENCE

Oak Ridge National Laboratory 2005-present

- *Instructor, "Advanced Crash Course in Supercomputing," June 16, 2008.* Taught one-day course aimed at high school, undergraduate, and graduate student interns with some programming experience interested in using supercomputer. Developed slides and lectures covering MPI, OpenMP, parallelization, makefiles, and job submission scripts, and presented lectures. Oversaw planning of course aimed at novice users.
- *Instructor, "Crash Course in Supercomputing," June 12, 2006 and June 19, 2007.* Taught one-day course aimed at high school, undergraduate, and graduate student interns interested in using supercomputer. Developed slides and lectures covering basics of Unix, vi editor, MPI, parallelization, makefiles, and job submission scripts, and presented lectures.

University of Illinois, Urbana-Champaign 2001-2005

- *NSF Graduate Teaching Fellow in K-12 Education, NCSA (2003-2004).* Collaborated with high school Physics teacher to integrate computer-based modeling and scientific visualization into the classroom. Devised and implemented supercomputing project in which students performed structural analysis of truss, using remotely finite element software on Linux cluster located at TRECC facility in suburban Chicago. Wrote handouts and scripts, compiled finite element software, and taught the supercomputing unit in the classroom. Collaborator: Mr. Joseph Liaw, Hinsdale Central High School,

Hinsdale, Illinois.

- *Teaching assistant, CS 257, Numerical Methods, Department of Computer Science (2001-2002).* Held office hours and lab hours, monitored course newsgroup, graded exams and projects, created handouts, quizzes, and exams, collected assignments, assisted professor with communications, and substitute lectured for professor. Supervisor: Professor Robert Skeel.

- *Instructor, NCSA/MSI/JEF Research Experience for High School and Undergraduate Students Cluster Computing Workshop, Arlington, VA, June 14-18, 2004.* Taught minority high school and undergraduate students in JEF program to use Linux cluster. Developed slides and lectures covering basics of Unix, vi editor, MPI, makefiles, and job submission scripts, and presented lectures at workshop.

Champaign Park District, Champaign, Illinois 2004-2005

- *Instructor, Shito Ryu Karate.* Teach children ages 8-12 basics of karate history; punches, kicks, and blocks; kata (forms); self-discipline, self-esteem, and physical fitness strategies. Supervisor: Chris Johnston, 6th Degree.

University of Kentucky, Lexington, Kentucky 1995-1997

- *Tutor, Learning Services Center.* Tutored minority students in Physics and Calculus.

SERVICE AND SYNERGISTIC ACTIVITIES

- Chair, Signage, Infrastructure Committee, SC09, 2009.
- Co-chair, Signage, Infrastructure Committee, SC08, 2008.
- Member, Planning Committee for Evaluation of NSF GK-12 Program, March 2007.
- Referee, *SIAM Journal on Optimization,* April 2006.
- Reviewer, DOE ECPI Grant Review Panel, March 2006.
- Mentor, Association for Women in Mathematics, 2006-present.
- Invited panelist, Student Days, SC04, Pittsburgh, Pennsylvania, November, 2004.
- Engineering and Physical Sciences Area Block Grant Committee, Campuswide Fellowship Board, UIUC, 2004.
- Fellowships, Assistantships, and Admissions Committee, Department of Computer Science, UIUC, 2002-2003.
- Student Volunteer, SC02, Baltimore, Maryland, November, 2002.
- Teaching Evaluation and Improvement Committee, Department of Computer Science, 2000-2002.
- Chair, Organizing Committee for Midwest Numerical Analysis Day, May 12, 2001.
- Treasurer, Computer Fear Film Festival, UIUC, 2000-2003.
- Undergraduate Studies Committee, Department of Computer Science, UIUC, 1999-2000.
- Graduate Student Advisor for Undergraduates, Department of Computer Science, UIUC, 1999-2003.

PUBLICATIONS

Hartman-Baker, R., R.J. Harrison, and G.I. Fann, *Load Distribution in MADNESS*, in preparation.

Hartman-Baker, R., I. Busch, M. Hilliard, R. Middleton, and M. Schultze. "Solution of Mixed-Integer Programming Problems on the XT5," *Proceedings of CUG 2009*, Atlanta, 2009.

Barrett RF, Ahern S, Fahey MR, Hartman-Baker R, Horner JK, Poole SW, and Sankaran R. *MPI in scientific computation: An application survey.* Technical report, Oak Ridge National Laboratory, 2008.

Fann, G.I., R.J. Harrison, G. Beylkin, J. Jia, R. Hartman-Baker, W.A. Shelton, and S. Sugiki. 2007. MADNESS applied to density functional theory in chemistry and nuclear physics. *Journal of Physics: Conference Series, SciDAC 2007* 78: 012018.

Hartman-Baker, R. J. *The Diffusion Equation Method for Global Optimization and Its Application to Magnetotelluric Geoprospecting,* Ph.D. dissertation, Department of Computer Science, University of Illinois at Urbana-Champaign, Technical Report UIUCDCS-R-2005-2578, August 2005.

Shen, X.A., R. Hartman, and R. Kachru. 1996. Impulse-equivalent time-domain optical memory. *Optics Letters* 21: 833-835.

CONFERENCES

Hartman-Baker, R., I. Busch, M. Hilliard, R. Middleton, and M. Schultze. *Solution of Mixed-Integer Programming Problems on the XT5*, Contributed presentation, CUG 2009, Atlanta, 2009.

Hartman-Baker, R., and A. Tharrington. *Developing, Recruiting, and Retaining Underrepresented Groups in the National Laboratory System*, Birds of a Feather Session, Richard Tapia Celebration of Diversity in Computing Conference, 2009.

Hartman-Baker, R., R.J. Harrison, and G.I. Fann. *Load Distribution in MADNESS*, Contributed presentation, SIAM Conference on Parallel Processing for Computational Sciences, 2008.

Dynamic Load Balancing in MADNESS. Poster presentation, ORNL Celebration of Women in Science, March 2007.

Dynamic Load Balancing in MAD++. Poster presentation, ORNL Celebration of Women in Science, May 2006.

Parallelization of the Diffusion Equation Method for Global Optimization. Contributed presentation, SIAM Conference on Parallel Processing for Scientific Computing, San Francisco, California, February 2006.

The Diffusion Equation Method for Global Optimization. Poster presentation, SIAM Conference on Optimization, Stockholm, Sweden, May 2005.

A Finite-Difference Approach to the Diffusion Equation Method. Poster presentation, SIAM Annual Meeting, Portland, Oregon, July 2004.

PROFESSIONAL AFFILIATIONS

- Member, SIAM.

LANGUAGES

- English: native tongue.
- French: proficient.
- Russian: working knowledge.

REFERENCES

Dr. George Fann
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