

ANSHUL GUPTA

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RESEARCH INTERESTS

Scientific Computing

Sparse matrix computations, graph algorithms, numerical linear algebra.

Parallel Computing

Parallel algorithms, performance and scalability analysis of parallel systems.

EDUCATION

University of Minnesota, Minneapolis, MN

September 1989 – August 1995

Degree: Ph. D. in Computer Science

Thesis Title: Analysis and Design of Parallel Algorithms for Scientific Computing

Indian Institute of Technology, New Delhi, India

August 1984 – June 1988

Degree: B. Tech. in Computer Science and Engineering

Thesis Title: Parallel Execution of Logic Programs

RESEARCH EXPERIENCE

IBM T. J. Watson Research Center
Yorktown Heights, NY

Research Staff Member
September 1995 – present

Current research involves developing scalable distributed-memory and shared-memory parallel algorithms for sparse matrix and graph computations aimed at solving large sparse systems of linear equations through direct and iterative methods, developing industrial strength software to implement these algorithms, and applying them in solving real problems in science, engineering, and optimization.

Developed and published new serial and parallel algorithms for direct and iterative solution of sparse systems of linear equations and implemented these algorithms in a widely used and recognized software package called WSMP. WSMP includes some of the fastest and most scalable solvers for large sparse systems of linear equations.

Parallelized large FEM and other scientific computing codes and worked in a consultative capacity on many other projects involving parallelizing existing numerical software, implementing new parallel/high-performance software, and developing new parallel algorithms.

Research included studying performance and scalability metrics for parallel algorithm-architecture combinations, analyzing the scalability of parallel algorithms for several problems on a variety of architectures, and designing an optimally scalable parallel sparse Cholesky factorization algorithm.

PUBLICATIONS

Books

1. *Introduction to Parallel Computing: Second Edition*, Addison Wesley, 2003 (with Ananth Grama, Vipin Kumar, and George Karypis).
2. *Introduction to Parallel Computing: Design and Analysis of Algorithms*, Benjamin Cummings, 1994 (with Vipin Kumar, Ananth Grama, and George Karypis).

Refereed Journal Articles

1. Haim Avron, Anshul Gupta, and Sivan Toledo. New Krylov-Subspace Solvers for Hermitian Positive Definite Matrices with Indefinite Preconditioners, submitted to *SIAM Journal on Matrix Analysis and Applications*.
2. Thomas George, Anshul Gupta, and Vivek Sarin. An Empirical Analysis of Iterative Solver Performance for SPD Systems, submitted to *ACM Transactions on Mathematical Software*.
3. Anshul Gupta and Thomas George. Adaptive Techniques for Improving the Performance of Incomplete Factorization Preconditioning, to appear in *SIAM Journal on Scientific Computing*.
4. Anshul Gupta. A Shared- and Distributed-Memory Parallel General Sparse Direct Solver, *Applicable Algebra in Engineering, Communication, and Computing*, 18(3):263–278, 2007.
5. Jun Sun, Pan Michaleris, Anshul Gupta, and Padma Raghavan. A Fast Implementation of the FETI-DP Method: FETI-DP-RBS-LNA and Applications in Large Scale Problems with Localized Nonlinearities, *International Journal for Numerical Methods in Engineering*, 63:833–858, 2005.
6. Olaf Schenk, Stefan Rollin, and Anshul Gupta. The Effects of Unsymmetric Matrix Permutations and Scalings in Semiconductor Device and Circuit Simulation, *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, 23(3):400–411, 2004.
7. Anshul Gupta. Improved Symbolic and Numerical Factorization Algorithms for Unsymmetric Sparse Matrices, *SIAM Journal on Matrix Analysis and Applications*, 24(2):529–552, 2002.
8. Anshul Gupta. Recent Advances in Direct Methods for Solving Unsymmetric Sparse Systems of Linear Equations, *ACM Transactions on Mathematical Software*, 28(3):301–324, 2002.
9. Gary Ditlow, Daria Dooling, Anshul Gupta, Richard Moore, David Moran, Paul Smith, Tom Walkins, and Ralph Williams. IMaD: A Tool for Global IC Simulations, *MicroNews*, 5(3):18–21, 1999.
10. Anshul Gupta, Fred Gustavson, Mahesh Joshi, and Sivan Toledo. The Design, Implementation, and Evaluation of a Banded Linear Solver for Distributed-Memory Parallel Computers, *ACM Transactions on Mathematical Software*, 24(1), March 1998.
11. Anshul Gupta. Fast and Effective Algorithms for Graph Partitioning and Sparse Matrix Reordering, *IBM Journal of Research and Development*, 41:171–183, January/March 1997.
12. Anshul Gupta, George Karypis, and Vipin Kumar. Highly Scalable Parallel Algorithms for Sparse Matrix Factorization, *IEEE Transactions on Parallel and Distributed Systems*, 8(5):502–520, May 1997.

13. Anshul Gupta, Vipin Kumar, and Ahmed Sameh. Performance and Scalability of Preconditioned Conjugate Gradient Methods on Parallel Computers, *IEEE Transactions on Parallel and Distributed Systems*, 6(5):455–469, May 1995.
14. Vipin Kumar and Anshul Gupta. Analyzing the Scalability of Parallel Algorithms and Architectures, *Journal of Parallel and Distributed Computing*, 22(3):379–391, September 1994.
15. Anshul Gupta and Vipin Kumar. The Scalability of FFT on Parallel Computers, *IEEE Transactions on Parallel and Distributed Systems*, 4(8):922–932, August 1993.
16. Ananth Grama, Anshul Gupta, and Vipin Kumar. Isoefficiency: Measuring the Scalability of Parallel Algorithms and Architectures, *IEEE Parallel and Distributed Technology*, 1(3):12–21, August 1993.
17. Anshul Gupta and Vipin Kumar. Performance Properties of Large Scale Parallel Systems, *Journal of Parallel and Distributed Computing*, 19:234–244, April 1993.

Selected Recent Conference Papers

1. Sparse Matrix Factorization on Massively Parallel Computers, submitted to *Supercomputing 2009* (with Seid Koric and Thomas George).
2. Demand-Driven Execution of Static Directed Acyclic Graphs Using Task Parallelism, submitted to *International Conference on Parallel Processing, ICPP'09* (with Prabhanjan Kambadur, Torsten Hoefler, and Andrew Lumsdaine).
3. A Recommendation System for Preconditioned Iterative Solvers, *International Conference on Data Mining, ICDM'09* (with Thomas George and Vivek Sarin).
4. All You Wanted to Know About Iterative Solver Performance but Were Afraid to Ask, *Supercomputing '08* (with Thomas George and Vivek Sarin).
5. An Incomplete Factorization Based Robust and High-Performance Preconditioner for SPD Systems, *10th Copper Mountain Conference on Iterative Methods*, 2008.
6. An Experimental Evaluation of Iterative Solvers for Large SPD Systems of Linear Equations, *10th Copper Mountain Conference on Iterative Methods*, 2008 (with Thomas George and Vivek Sarin).
7. Parallel, Effective, and Robust Preconditioning Based on Incomplete Factorization, *SIAM Conference on Mathematics for Industry*, 2007 (with Thomas George).
8. A Shared- and Distributed-Memory Parallel Sparse Direct Solver, *PARA'04 Workshop on State-of-the-Art in Scientific Computing*, 2004.
9. A Scalable Parallel Direct Solver for General Sparse Systems of Linear Equations, *SIAM Conference on Computational Science and Engineering*, 2003.
10. Recent Progress in General Sparse Direct Solvers, *International Conference on Computational Science*, 2001.
11. An Experimental Comparison of Some Direct Sparse Solver Packages, *International Parallel and Distributed Processing Symposium*, 2001 (with Yanto Muliadi).
12. A High-Performance GEPP-Based Sparse Solver, *PARCO*, 2001.
13. Fast Practical Algorithms for the Boolean-Product-Witness-Matrix Problem, *International Symposium on Symbolic and Algebraic Computations*, 2000 (with Pankaj Rohatgi and Ramesh Agarwal).

AWARDS AND HONORS

1. IBM Research RACE Plateau I award, 2007.
2. IBM Research Division award for technical accomplishment, 2005.
3. Runner up for the *ACM Doctoral Dissertation Award* in Computer Science, 1995.
4. *First Prize* in student paper competition, SuParCup '95, Mannheim, Germany.
5. *Best Student Paper Award*, Supercomputing '94, Washington, D.C..
6. *Graduate School Dissertation Award* for outstanding research, 1992-93 and 1993-94, University of Minnesota.
7. *National Talent Search Scholarship* from National Council for Educational Research and Training, India, 1982–88.
8. Merit Prizes and Certificates for being among the top 5% students in 4 of the 8 semesters at the Indian Institute of Technology, New Delhi, India.