

Robert B. Schnabel

Curriculum Vitae – January 2021

Education

Ph.D., 1977, Computer Science, Cornell University
M.S., 1975, Computer Science, Cornell University
A.B., 1971, Mathematics, Dartmouth College (summa cum laude)

Employment

University of Colorado, Boulder
College of Engineering Faculty Director for Entrepreneurship, 2018 - present
External Chair, Department of Computer Science, 2018 - present
Campus Thought Leader on Computing, 2018 – 2019
Professor, Department of Computer Science, 2018 - present
Association for Computing Machinery
Chief Executive Officer and Executive Director, November 2015 – November 2017
Indiana University
(Dean Emeritus, Nov 2015 – present)
Dean, School of Informatics and Computing, July 2007 – October 2015
Professor of Computer Science and of Informatics, 2007 – 2015
Interim Vice President for Research, August 2009 – July 2010
University of Colorado, Boulder
(Professor Emeritus, 2007 – 2017)
Vice Provost / Associate Vice Chancellor for Academic and Campus Technology,
1998 - 2007
Director, Alliance for Technology, Learning and Society (ATLAS) Institute, 1997 - 2007
Associate Dean for Academic Affairs, College of Engineering and Applied Science,
1995 - 1997
Chair, Department of Computer Science, 1990-1995
Professor, Department of Computer Science, 1988-2007
Associate Professor, Department of Computer Science, 1980-88 (tenured 1983)
Assistant Professor, Department of Computer Science, 1977-80
Chase Manhattan Bank, New York, N.Y., Programmer Analyst, Mar. 1972 – July 1973
New York Army National Guard, June 1971 – June 1977

Responsibilities and Accomplishments in ACM Position

CEO and Executive Director, ACM: ACM is the largest and oldest professional computing society in the US and the world. It has nearly 100,000 members (just under half from the US, with the largest non-US concentrations from Europe, India and China) and has significant interactions with 2-3 million people per year. ACM hosts nearly 200 conferences, and over 500 conferences plus workshops, per year. It publishes over 50 journals and magazines. Its annual budget is about \$65M/year, and it has very significant reserves. The CEO is responsible for the overall strategic and business leadership of the organization, working in partnership with the elected ACM presidents, volunteers who serves two-year terms. The CEO also serves as the point of connection and continuity to ACM's councils around the world and to all of its key boards and committees.

Selected accomplishments of ACM that I have led in first two years (some are preliminary):

- **Technical Directions:** Starting a process to assure that ACM's conferences and journals cover recent and emerging technical directions in the field. Emphasizing the evolution of computing to a socio-technical field and a field with myriad applications. As a first step, worked with the Association for the Advance of Artificial Intelligence to establish a joint conference series in Ethics, Society and AI that will commence in February 2018.
- **Financial Management:** Led financial management and planning for ACM; FY16 and FY17 both have ended with large surpluses. Have particularly concentrated on management of ACM's reserves, leading to changes (including allocation of funds and choice of investment manager) that should increase returns by at least \$1-2M/year.
- **Entrepreneurship:** Introduced an emphasis on interaction of ACM with the tech entrepreneurial community. Led planning process, and facilitated organization of pilot events including VC office hour at conferences and event at SXSW. Fuller roll-out starting in 2017-18.
- **Global Plan:** Led a global planning process, including data collection and suggestion of priorities. As a first step, worked with ACM President to focus ACM activities in Europe and China.
- **Leadership from Senior Members:** Suggested and led planning process for the established of an ACM "Fellows Society", to utilize the talents of the ACM Fellows for ACM and the computing community. Society has been chartered.
- **Policy:** Focusing, restructuring and resizing the ACM technology policy activities to align costs and benefits and to focus on policy impacts.
- **Computer Science Teachers Association:** Working closely with CSTA board and key sponsors to assure fiscal stability of CSTA, recruit new leadership, and focus vision.

Responsibilities and Accomplishments in Indiana University Position

Dean, School of Informatics and Computing: The School of Informatics and Computing includes components on both the Bloomington and Indianapolis (IUPUI) campuses. When I stepped down as dean, the school had about 115 tenure track faculty (90- Bloomington, 25+ IUPUI), about 150 total faculty, and about 3600 undergraduate and graduate students plus over 700 pre-majors. It encompassed the breadth of computing foundations, applications and societal implications, including B.S., M.S. and Ph.D. degrees in computer science on the Bloomington campus, B.S., M.S. and Ph.D. degrees in informatics and closely related fields on both campuses, M.S. and Ph.D. degrees in information science in Bloomington and M.S. degrees in library science on both campuses, M.S. in Data Science in Bloomington, and B.S. and Ph.D. in Intelligent Systems Engineering in Bloomington. Schools at Indiana University directly control their tuition and research revenues and deans have full discretion for financial and strategic leadership including designation of faculty positions. The overall budget when I left was nearly \$67M/year; research expenditures were about \$20M/year.

Selected accomplishments of the School of Informatics and Computing under my direction:

- Led school-wide strategic planning process that resulted in School's first strategic plan by end of first semester in dean position. Established emphases of school in education and research, economic development and entrepreneurship, and diversity.

- Led a successful faculty/staff process to merge the School of Library and Information Science and the School of Informatics, leading to presidential and Board of Trustees approval in October 2012 and merger in July 2013.
- Led process to establish Indiana University's first engineering program, with B.S. and Ph.D. degrees in Intelligent Systems Engineering, within the School. Approval from Indiana Commission on Higher Education obtained in August 2015.
- Led development of Data Science M.S. and graduate certificate in both residential and online forms; online certificate began Jan. 2014 in online form, full M.S. degree began Jan. 2015 in both residential and online formats. Program quickly grew to enroll hundreds of students.
- Significant, sustained increases in both undergraduate and graduate enrollment in both Bloomington and IUPUI portions of school. Number of undergraduate majors more than doubled overall and more than tripled in Bloomington, with informatics becoming the second largest undergraduate major at IU Bloomington. Graduate enrollment more than tripled. Enrollment growth led the campus often on each campus.
- Increased emphasis upon and culture of funded research and large scale research projects, including faculty leading several successful \$5-10M projects and nearly tripling new research awards. Annual research expenditures grew to \$20M range.
- Enhanced emphasis on economic development and entrepreneurship including ongoing School presence in the Bay Area, increased visibility of School in Indiana IT business community, and service on several economic development boards. In 2011 launched BEST (Building Entrepreneurs in Software and Technology) student start-up competition in which successful businesspeople invest \$250K/year in student-led companies, largest known amount for students of one university in the world.
- Greatly enhanced emphasis on fundraising for both capital projects and academic programs. In first part of tenure, successfully completed school's first fundraising campaigns including \$10M campaign for Bloomington portion of school. In 8+ years as dean, raised over \$20M (school had raised about \$2M in its first 7 years).
- Led fundraising and planning for Luddy Hall, a new \$125,000, \$42M building for a portion of the school that will open in Jan. 2018. Secured complete funding for the building from variety of sources including \$8M naming gift from Fred Luddy. Earlier, initiated and completed new building project on Bloomington campus that increased space by over 10%.
- Hired roughly half of the faculty on both campuses of the school at combination of junior and senior levels, significantly enhancing faculty quality.
- Worked extensively with Indianapolis portion of school, including placing and mentoring new leadership, to significantly improve what had been a demoralized faculty and staff and build higher academic standards.
- Enhanced emphasis on diversity including creation of assistant dean for diversity and education position, significant School role in NSF Broadening Participation in Computing program and in National Center for Women & Information Technology. Doubled number of women majors (from 75 to 150) in Bloomington from 2009 to 2011, fulfilling goal set as part of NCWIT Pacesetters program; more than doubled again by fall 2015.

Selected additional roles as dean:

- (Campus-wide, 2009 - 2011) Led process at IU-Bloomington to examine and improve environment for women faculty in STEM disciplines, and prepare campus for NSF ADVANCE proposal; helped create and advise campus-wide Center for Excellence in Women in Information Technology.
- (University-wide, Oct. 2010 – March 2011) At request of IU President, prepared a university-wide strategic plan for online education for Indiana University, consulting extensively across entire university. Plan served as basis for establishing IU Office of Online Education and IU's current online strategy.
- (University-wide, 2010-11) Member of university's New Academic Directions committee and chair of academic opportunities subcommittee. This process produced the academic strategic plan that has led to major academic innovations at IU in the subsequent years.
- (Campus-wide, 2014-2015) At request of IU President and IU Bloomington Provost, chaired task force that created a proposal for the formation of an engineering program at IU Bloomington.

Interim Vice President for Research (August 2009 – June 2010): This position has responsibility for all Indiana University research, including the Indianapolis (IUPUI) campus which includes the medical school, the Bloomington campus, and the regional campuses. This includes strategic leadership of large-scale and cross-campus research, research administration and compliance, and representation at the CIC (Big Ten) and federal levels. The vice president position did not exist immediately before I was appointed to it; it had been filled once several years earlier.

Selected accomplishments under my direction:

- Formulated overall structure for Office of Research: established university-wide research cabinet including Bloomington campus, IUPUI campus, School of Medicine, and Office of Research Administration; created financial and leadership structure for the office. Worked successfully to achieve close integration with research leadership in School of Medicine.
- Led development of broad IU and Indianapolis area health information technology research and economic development initiative involving medicine, informatics, computing, law, technology transfer, area hospitals and economic development organizations, investors and business community.
- Led examination of combined opportunities of Bloomington and IUPUI campuses in energy research, and creation of IU-wide energy institute.
- Led successful process to reorganize IU Cyclotron Facility into separate units addressing service (proton therapy) and high energy physics research functions.

Responsibilities and Accomplishments in University of Colorado Position

The position of Vice Provost for Academic and Campus Technology at the University of Colorado at Boulder contained two distinct sets of responsibilities:

- *Founding Director of the ATLAS (Alliance for Technology, Learning and Society) Institute, 1997-2007.* ATLAS is CU-Boulder's only campus-wide institute spanning curriculum, research and outreach, and the only one reporting to the Provost. During this period it involved all the schools and colleges at CU-Boulder; academic programs at the

undergraduate and graduate level; considerable research activities; a wide variety of external partnerships with other universities, industry, K-12 and government; a major capital construction project and fundraising; and a large emphasis on the participation of women and underrepresented minorities.

- *The first permanent Chief Information Officer on the Boulder campus, 1998-2007.* This included strategic leadership for all campus academic and support uses of information technology; leadership of the Information Technology Council spanning all areas of the campus; reporting responsibility and active oversight of the 150 employee (plus students), \$25M campus IT organization; and participation in the Chancellor's Executive Committee and the Chancellor/Vice Chancellor group. The position reported to the Provost (and Chancellor).

Selected accomplishments of the ATLAS Institute under my direction:

- Defined scope of institute beginning with campus-wide planning process involving approximately 100 faculty and staff members and five committees. Formed and drew leadership from ATLAS Faculty Fellows, a group of 25 faculty members from the full range of academic areas on the campus.
- Created six-course Technology, Arts and Media (TAM) certificate, campus' first and largest campus-wide undergraduate certificate program. Grew to enrollment of nearly 300 students, over 60% women, from all schools and colleges on the campus, with the majority coming from the arts, humanities, social sciences and journalism.
- Constructed and launched interdisciplinary Ph.D. program in Technology, Media and Society, awarded and administered by ATLAS, which provides a new campus model for broad, interdisciplinary Ph.D. education. (Begun in 2005; first graduate in 2009.)
- Led the formation of successful curricular and research partnerships with minority serving universities, including: a research partnership with Tuskegee University; a broad curricular, research, student and faculty partnership with Dillard University; with computer science, an NSF-funded alliance of five historically black colleges and universities and three research institutions to increase the number of African-Americans in computer science, particularly at the Ph.D. level.
- Led formation of and served as core organization for the National Center for Women & Information Technology (www.ncwit.org). This activity arose from ATLAS' ongoing emphasis on the participation of women and girls in computing, including several NSF-funded research projects on the participation of women in information technology, and K-12 partnerships. NCWIT has become a major national organization.
- Developed an extensive partnership with the Denver Public Schools' Computer Magnet program, including an annual summer camp to attract underrepresented minority girls to computing, and conducted related NSF-sponsored research.
- ATLAS' Evaluation and Research Group achieved a significant national reputation in the evaluation of programs aimed at increasing the participation of women and underrepresented minorities in computing fields, as well as in the evaluation of projects that assess the effectiveness of the use of technology in education.
- ATLAS' Collaborative Arts, Media and Performance (CAMP) program, a collaboration between Art, Film, Journalism, Music, Theatre & Dance and other disciplines, led the creation of interdisciplinary curriculum and creative work, and new academic programs in the new ATLAS Building.
- Led the construction of the ATLAS Building, a 66,000 square foot, \$31M building at the heart of the Boulder campus that opened in August 2006. The building is a center for

technology-enhanced, active student learning for the campus, and the home for all the ATLAS Institute programs, and provides outstanding facilities in the performing and creative arts including a black-box theater.

- Raised roughly \$20M in external funding for ATLAS programs and the ATLAS Building from federal, private and other sources, in addition to \$21M in student fee support and \$1.6M in State support for the ATLAS Building.

Selected accomplishments as CIO:

- Led a major re-organization of the campus' information technology departments, combining and integrating information technology services and telecommunications into one unified organization, creating a new management structure, and transitioning in new leadership.
- Led major campus-wide information technology strategic planning processes in 1998, 2002 and 2006, which led to numerous campus-wide innovations including a faculty computer replacement program, a group of distributed academic technology coordinators who assist faculty with the use of information technology in teaching and research, the next generation of campus network infrastructure, and student and faculty/staff portals.
- Instituted an information technology governance structure for the campus consisting of a high-level Information Technology Council (chaired by the CIO), a Faculty Advisory Committee on Information. Also established a CIO office that provides leadership and support in academic and support areas, including campus leadership for the effective use of educational technology by faculty.
- Led the campus in taking a pro-active role in information technology security issues including encrypted access to email and other key services, conversion away from the use of social security numbers as identifiers, and computer and data security.

Responsibilities and Accomplishments in Selected National Roles

Co-founder and executive team member, National Center for Women & Information Technology: Co-founded NCWIT with Lucy Sanders (CEO, NCWIT) and Telle Whitney (CEO, Anita Borg Institute for Women and Technology) in 2003; the three of us have served as NCWIT's executive team throughout. Served as principal investigator of initial \$3.25M NSF grant for NCWIT. NCWIT (www.ncwit.org) has become a major non-profit organization that includes over 500 academic and business partners, and is leading the movement in the U.S. for the full participation of girls and women in computing and information technology.

Chair, ACM Education Policy Committee. Chaired the EPC from its founding in 2007, under 2015. The EPC has led to the creation of the national, congressionally-sponsored Computer Science Education Week, to the introduction of the Computer Science Education Act in Congress, and to the formation of the industry / non-profit coalition Computing in the Core (www.computinginthecore.org) which leads the national effort for the full inclusion of computing education, particularly at the K-12 level, and the creation of two important reports that have influenced national policy.

Chair, Board of Trustees, Universities Space Research Association: Served as chair of board from 2003-2005, at a time when the USRA budget was roughly \$100M/year.

Research Interests

Numerical computation including numerical solution of unconstrained and constrained optimization problems, solution of systems of nonlinear equations, and nonlinear least squares; Applications of optimization to molecular chemistry; Parallel and distributed computation including parallel numerical languages and parallel numerical algorithms; Diversifying participation in information technology education and workforce; Information technology literacy.

Honors

Personal

ATLAS Lobby at U. Colorado named "Byyny-Schnabel Lobby", 2018
Indiana University President's Medal (for outstanding service to Indiana University), 2015
"Schnabel Scholars" Scholarship Program established and funded by School of Informatics and Computing Deans Advisory Council, Oct. 2015
TechPoint Trailblazer in Technology Award, 2014 (this is the main individual award given annually to one person by the Indiana professional IT organization)
Computing Research Association A. Nico Habermann Award (with Lucy Sanders and Telle Whitney), 2012 (this is the main diversity award in the computing community)
White House "Champion of Change", Women in STEM, Dec. 2011
ACM Fellow, 2010
SIAM Fellow (inaugural group), 2009
ATLAS Board Room at U. Colorado named "Schnabel Board Room", 2007
University of Colorado Boulder Faculty Service Award, 1998
ACM Recognition of Service Award, 1993
American Electronics Association Faculty Award, 1988
University of Colorado Boulder Faculty Teaching Award, 1987
University of Colorado Faculty Fellowship, 1982-83
University of Colorado Teaching Recognition Award, 1980
SIAM Visiting Lecturer, 1978-83
National Science Foundation Graduate Fellowship, 1974-77
Cornell First Year Graduate Fellowship, 1973-74
Phi Beta Kappa, 1970

ATLAS Institute

EDUCAUSE Systemic Progress in Teaching and Learning Award, 2003
University of Colorado Chancellor's Committee on Minority Affairs Diversity Service Recognition Award, 2004

Selected Professional Service

SIAM Review, Senior Editor, 2011 – 2013, Editor-in-Chief, 2005-2010, Education Section Editor, 1997-2004, Associate Editor, 1994-1996
SIAM Journal on Optimization, Associate Editor, 1990-2001
Mathematical Programming A, Co-Editor, 1989-1995, Associate Editor, 1995-1999
Mathematical Programming B, associate editor, 1988-1995
Operations Research Letters, associate editor, 1982-1989
CSEdResearch Board of Directors, 2021-present
CRA/CCC Computing Innovation Fellows Cohort Building Committee, chair, 2020-present

ACM/SIAM Computational Science and Engineering Award selection committee, 2020-present

Judge, Responsible Computer Science Challenge, 2018 - present

ACM Education Advisory Committee, 2018 – present

ACM Europe Informatics for All Committee, 2017 - present

Steering Committee, AAAI/ACM Conference on AI, Ethics and Society, 2017 – present

Funzeleo Board of Directors, 2019 - 2020

Computer Science Teachers Association Board of Directors, 2017 - present

ACM Education Policy Committee, chair, 2007-2015

National Center for Women & Information Technology, co-founder, 2003, member of executive committee, 2003 – present

Computing Alliance for Hispanic-Serving Institutions Advisory Board, chair, 2006 – 2015, 2019-present

code.org Board of Directors, 2013 – present

National Science Foundation CISE (Computing and Information Science and Engineering) Directorate advisory committee, 2012 – 2019

TechPoint Board of Directors, 2008 – 2015 (main Indiana IT industry organization)

University of Massachusetts NSF Advance external advisory board, 2019 - present

Georgia Tech School of Interactive Computing advisory board, 2013 - 2015

Kinsey Institute, Board of Trustees, 2008 – 2015, vice-chair, 2012-2014

Computing Research Association Government Affairs Committee, 2005 – present

MentorNet Board of Directors, 2012 - 2014

Bloomington Technology Partnership, advisory board, 2008 – 2012

Computing Research Association Board of Directors, 1999-2009

United Negro College Fund Institute for Capacity Building Advisory Committee, 2006-2010

Information Technology Deans, chair, 2002-2008

Universities Space Research Association Board of Trustees, 1998-2005, chair, 2003-2005, vice-chair, 2001-2003

Space Operations International Holdings Board of Directors, Chair, 2000-2007

RIACS Science Council (NASA Ames), 1992-1998, Convener, 1995-1998

SIAM Council, 1994-1999

ACM SIGNUM, Chair, 1989-1993

ACM SIGNUM Rocky Mountain Chapter, President 1981-1985, Vice President 1978-1981

ACM SIGNUM Board of Directors, 1983-1989

ACM Job Migration Task Force, 2004-2006, co-chair of education committee

ACM Distinguished Service Award selection committee, 2012 - 2015

Mathematical Programming Society Council, 1985-88

SIAM Activity Group on Optimization, Co-Founder and Vice-Chairman, 1986-88

Co-Chairman, First SIAM Conference on Numerical Optimization, 1984

Dartmouth College, Executive Advisory Committee for Institute for Security Technology Studies, chair, 2005-2007

United Arab Emirates University College of Information Technology Advisory Board, 2002-2008

Cornell University, Advisory Committee for the Parallel Processing Resource, 1993-2001, chair, 1993-1999

Middle Atlantic Consortium for Mathematics and its Applications Across the Curriculum, National Visiting Committee, 1996-1998

National Science Foundation I.T. Workforce PIs Conference, co-chair, 2001

Workshop on Languages, Compilers, and Run-Time Environments for Distributed Memory Multiprocessors, co-chair, 1992

National Science Foundation CISE CER/II Annual Meeting, Conference and Program Chair, 1989

(significant additional service on professional society committees)

Selected Indiana University Service

President's Cabinet, 2007 – 2015
Indiana University Research Technology Corporation, Board of Directors, 2007 – 2015, executive committee 2011-2015
Council of Deans, 2007 – 2015
Chair, Engineering Task Force (charged with creating proposal for engineering program at IU Bloomington, 2014
Center of Excellence for Women in Technology advisory council, 2013- 2015
Created IU Strategic Plan for Online Education at request of President McRobbie, 2010-11 (one-person assignment with wide consultation)
New Academic Directions Committee (21-person strategic planning committee for IU), member and academic opportunities subcommittee chair, 2010-2011
New Directions in Teaching and Learning Committee (9-person university-wide Leadership group for IU teaching and learning initiative), 2010 – 2011
Research Cabinet, chair, 2009 – 2010
Dean of Libraries Search Committee, co-chair, 2009

Selected University of Colorado Service

Department of Computer Science

External Chair, 2018 - present
Chair, 1990 - 1995
Executive Committee: 1979-1981, 1982-1989; 1990-1995, chair
Search Committee: 1978-1981, 1982-1989, 1990-1995;
chair 1981-82, 1988-89, 1990-1995
Department-wide Research Infrastructure Committee: 1982-2000;
chair 1982-1986, 1987-1991, 1995-2000

College of Engineering and Applied Science

Associate Dean for Academic Affairs: 1995-1997
Administrative Council: 1990-1997
Undergraduate Academic Affairs Committee: 1995-1997 (chair)
Diversity Planning Committee: 1993-1995, chair, 1994-1995
Ad Hoc Budget Committee: 1993, 1994, 1995 (chair)
Women in Engineering Study Committee: chair, 1992-93
Women in Engineering Faculty Advisory Board, 1997-2007
Minority Engineering Review Committee: chair, 1987-89

Campus Level

Vice Chancellors Advisory Committee (campus promotion and tenure), 2019 – present
Strategic Facilities Visioning Committee, 2018 - 2019
Vice Provost / Associate Vice Chancellor for Academic and Campus Technology, 1997-2007
Faculty Director, Alliance for Technology, Learning and Society (ATLAS), 1997-2007
Council of Deans, 1997-2007

Chancellor's Executive Committee, 1998-2007
Chancellor / Vice Chancellor Committee (cabinet), 2001-2006
Federal Relations Committee, 1999-2007
Information Technology Council, Chair, 1998-2007
Information Technology Exploratory Committee, co-chair, 2000-2001
Distance Learning Task Force, Chair, 1997-1998
Enrollment Management Team: 1995-1997
Campus Policy Board for Information Technology: 1995-1997
Interdisciplinary Telecommunications Study Committee: 1996
Assistant Vice Chancellor for Research Search Committee, Chair: 1996
Associate Vice Chancellor for Undergraduate Education Search Committee: 1996
Associate Vice Chancellor for Faculty Affairs Search Committee: 1996
Vice Chancellor's Differentiated Workload Committee: 1993-1994
Boulder Faculty Assembly: 1985-88

University of Colorado System

Educational Materials Intellectual Property Board, 2004-2007
Committee for the Advancement of Learning Innovations, 2004-2007
Student Information Services Executive Committee, 2006-2007
Working Group on Technology, 1997-2004
Colorado Institute of Technology coordinating group, 2001-2004
University Without Walls Planning Committee, 2002-2003
Total Learning Environment Implementation Team, 1997-1999

Thesis Students

Ph.D. Students

- G. Shultz (1983)
"Computationally practical globally convergent algorithms for unconstrained and linearly constrained optimization"
- P. Frank (1984)
"Tensor methods for solving systems of nonlinear equations"
- R. Rew (1987)
"The representation of highly parameterized families of software components"
- X. Zhang (1989)
"Parallel methods for block bordered nonlinear problems"
- T. Chow (1989)
"Derivative and secant tensor methods for unconstrained optimization"
- H. Khalfan (1989)
"Topics in quasi-Newton methods for unconstrained optimization"
- S. Smith (1991)
"Adaptive asynchronous parallel algorithms in distributed computation"
- M. Rosing (1991)
"Efficient language constructs for complex data parallelism on distributed memory multiprocessors"
- A. Bouaricha (1992)
"Solving large sparse systems of nonlinear equations and nonlinear least squares problems using tensor methods on sequential and parallel computers"
- R. Weaver (1992)

- "Supporting dynamic data structures at the language level on distributed memory machines"
- D. Feng (1993)
"Tensor methods for constrained optimization"
- R. Neves (1995)
"Threaded runtime support for the execution of fine grain code on coarse grain multiprocessors"
- T. Derby (1999)
"A Study of Language Ideas for Prototyping Numerical Computations"
- C.-S. Shao (1999)
"Task Migration for Parallel Scientific Computations in the Heterogeneous Network of Workstations Environment"
- B. Bader (2003)
"Tensor-Krylov Methods for Solving Large-scale Systems of Nonlinear Equations"
- A. Hinds (2007)
"Methodology for the Design of Algorithms for Signal Processing Applications"

M.S. Students

- C. Mohr (1980)
"A proposed algorithm for the real-time interpolation of meteorological radar data in 3-dimensional space"
- K. Stordahl (1980)
"Unconstrained minimization using conic models and exact second derivatives"
- B. Weiss (1980)
"A modular software package for solving unconstrained non-linear optimization problems"
- P. Frank (1982)
"A second-order local model for solution of systems of nonlinear equations"
- R. Back (1984)
"Conic models for numerical optimization"
- J. Donaldson (1985)
"Computational experience with confidence regions and confidence intervals for nonlinear least squares"
- A. Bouaricha (1986)
"A software package for solving systems of nonlinear equations and nonlinear least squares problems using tensor methods"
- C. Dert (1986, Erasmus University, The Netherlands)
"A parallel algorithm for global optimization"
- M. Rosing (1988)
"DINO: A language for writing numerical applications on distributed memory multiprocessors"
- B. Oldenkamp (1993, Erasmus University, The Netherlands)
"Parallel global optimization: applications to molecular configuration problems"
- A. van der Hoek (1994, Erasmus University, The Netherlands)
"Parallel global optimization of proteins"
- T. Ettes (1996, Erasmus University, The Netherlands)
"Algorithmic and parallelization issues for the global optimization of the protein folding problem"

Publications

Books

Numerical Methods for Unconstrained Optimization and Nonlinear Equations, Prentice Hall, Englewood Cliffs, N.J., 1983, 378 pages (with J.E. Dennis, Jr.). (Russian edition, Mir Publishing Office, Moscow, 1987, O. Burdakov, translator. Science Press, China, edition, 2009.) Re-published in SIAM Classics in Applied Mathematics series, SIAM, Philadelphia, 1996.

Books Edited

Numerical Optimization 1984, SIAM, Philadelphia, 1985, 287 pages (edited with P.T. Boggs and R.H. Byrd)

Proceedings Edited

Proceedings of the Workshop on Languages, Compilers, and Run-Time Environments for Distributed Memory Multiprocessors, *ACM SIGPLAN Notices*, 28, No. 1, 1993, 87 pages.

Technical Papers

1. "Minimum norm symmetric quasi-Newton updates restricted to subspaces," *Mathematics of Computation*, July 1978, pp. 829-837.
2. "Optimal conditioning in the convex class of rank-two updates," *Mathematical Programming*, Dec. 1978, pp. 247-260.
3. "Solving systems of nonlinear equations by Broyden's method with projected updates," *Nonlinear Programming 3*, O.L. Mangasarian, R.R. Meyer, S.M. Robinson eds., Academic Press, New York, 1978 (refereed proceedings) pp. 245-281 (with David M. Gay).
4. "Q-superlinear convergence of Biggs' method and related methods for unconstrained optimization," University of Colorado Technical Report CU-CS-133-78, Aug. 78.
5. "On the Q-superlinear convergence of self-scaling quasi-Newton methods," University of Colorado Technical Report CU-CS-144-78, Aug. 78 (#4 and #5 were accepted for publication by *Mathematical Programming* but withdrawn by author due to excessive editorial delay).
6. "Least change secant updates for quasi-Newton methods," *SIAM Review*, Oct. 1979, pp. 443-459, (with J.E. Dennis Jr.).
7. "Developing modular software for unconstrained optimization," *Performance Evaluation of Numerical Software*, L.D. Fosdick, ed., North-Holland, Amsterdam, 1979, pp.245-251.
8. "A new derivation of symmetric and positive definite secant updates," *Nonlinear Programming 4*, O.L. Mangasarian, R.R. Meyer, S.M. Robinson eds., Academic Press, New York, 1981, pp.167-199 (with J.E. Dennis, Jr.).
9. "Determining feasibility of a set of nonlinear inequality constraints," *Mathematical Programming Studies* 16, 1982, pp. 137-148.

10. "Comments on evaluating algorithms and codes for Mathematical Programming," in *Evaluating Mathematical Programming Techniques*, J.M. Mulvey, ed., Springer-Verlag, Berlin, 1982, pp. 166-169.
11. "Unconstrained Optimization in 1981," in *Nonlinear Optimization 1981*, M.J.D. Powell, ed., Academic Press, London, 1982, pp. 3-16.
12. "Finite difference derivatives - theory and practice," National Bureau of Standards report, 1982.
13. "Forcing sparsity by projecting with respect to a non-diagonally weighted Frobenius norm," *Mathematical Programming* 25, 1983, pp. 125-129.
14. "Conic methods for unconstrained minimization and tensor methods for nonlinear equations," in *Mathematical Programming, The State of the Art*, Bachem, M. Grotchel, B. Korte, eds., Springer-Verlag, Berlin, 1983, pp. 417-438.
15. "Tensor methods for nonlinear equations," *SIAM Journal on Numerical Analysis* 21, 1984, pp. 815-843 (with P. Frank).
16. "A family of trust region based algorithms for unconstrained minimization with strong global convergence properties," *SIAM Journal on Numerical Analysis* 22, 1985, pp. 47-67 (with R.H. Byrd and G.A. Shultz).
17. "Parallel computing in optimization," in *Computational Mathematical Programming*, K. Schittkowski, ed., Springer-Verlag, Berlin, 1985, pp. 357-381.
18. "A modular system of algorithms for unconstrained minimization," *ACM Transactions on Mathematical Software* 11, 1985, pp. 419-440 (with J.E. Koontz and B.E. Weiss).
19. "Quasi-Newton methods using multiple secant equations," University of Colorado Technical Report CU-CS-247-83.
20. "Continuity of the null space basis and constrained optimization," *Mathematical Programming* 35, 1986, pp. 32-41 (with R.H. Byrd).
21. "Computational experience with confidence regions and confidence intervals for nonlinear least squares," in *Computer Science and Statistics: Proceedings of the 17th Conference on the Interface*, D.M. Allen, ed., North-Holland, Amsterdam, 1986, pp. 83-93 (with J.R. Donaldson) (version of #22).
22. "Computational experience with confidence regions and confidence intervals for nonlinear least squares," *Technometrics* 29, 1987, pp. 67-82 (with J.R. Donaldson).
23. "A trust region algorithm for nonlinearly constrained optimization," *SIAM Journal on Numerical Analysis* 24, 1987, pp. 1152-1170 (with R.H. Byrd and G.A. Shultz).
24. "A stable and efficient algorithm for nonlinear orthogonal distance regression," *SIAM Journal on Scientific and Statistical Computing* 8, 1987, pp. 1052-1078 (with P.T. Boggs and R.H. Byrd).

25. "A comparison of two sphere fitting methods," *Proceedings of the Instrumentation and Measurement Technology Subgroup of the IEEE*, Boulder, CO., 1986 (with B.A. Jones).
26. "An efficient algorithm for orthogonal distance data fitting," *Computer Science and Statistics: Proceedings of the 18th Symposium on the Interface*, T.J. Boardman, ed., American Statistical Association, Washington, D.C., pp. 285-293, 1986 (with P.T. Boggs and R.H. Byrd) (version of #24).
27. "Solving systems of nonlinear equations by tensor methods," *The State of the Art in Numerical Analysis*, A. Iserles and M.J.D. Powell, eds., Clarendon Press, Oxford, 1987, pp. 245-271 (with P.D. Frank).
28. "DPUP: A distributed processing utilities package," *SIGNUM Newsletter* 21, 1986, pp. 5-19, (with T.J. Gardner, I.M. Gerard, C.R. Mowers, and E. Nemeth).
29. "Concurrent stochastic methods for global optimization," *Mathematical Programming* 46, 1990, pp. 1-30 (with R.H. Byrd, C.L. Dert, and A.H.G. Rinnooy Kan).
30. "Concurrent global optimization on a network of computers," *Parallel Processing and Medium-Scale Multiprocessors*, A. Wouk, ed., SIAM, Philadelphia, 1989, pp. 76-96 (with R.H. Byrd, C.L. Dert, and A.H.G. Rinnooy Kan) (version of #29).
31. "Concurrent function evaluations in local and global optimization," *Computer Methods in Applied Mechanics and Engineering* 64, 1987, pp. 537-552.
32. "Approximate solution of the trust region problem by minimization over two-dimensional subspaces," *Mathematical Programming* 40, 1988, pp. 247-263 (with R.H. Byrd and G.A. Shultz).
33. "ODRPACK - Software for weighted orthogonal distance regression," *ACM Transactions on Mathematical Software* 15, 1989, pp. 348-364 (with P.T. Boggs, R.H. Byrd, and J.R. Donaldson).
34. "Using parallel function evaluations to improve Hessian approximations for unconstrained optimization," *Annals of Operations Research* 14, 1988, pp. 167-193 (with R.H. Byrd and G.A. Shultz).
35. "A computational examination of orthogonal distance regression," *Journal of Econometrics* 38, 1988, pp. 169-201 (with P.T. Boggs, J.R. Donaldson, C.H. Spiegelman).
36. "A view of unconstrained optimization," *Handbooks in Operations Research and Management Science, Volume 1: Optimization*, G.L. Nemhauser, A.H.G. Rinnooy Kan, and M.J. Todd, eds., North-Holland, 1989, pp. 1-72 (with J.E. Dennis, Jr.).
37. "Parallel quasi-Newton methods for unconstrained optimization," *Mathematical Programming* 42, 1988, pp. 273-306 (with R.H. Byrd, G.A. Shultz).
38. "Using mathematical modeling to aid in parallel algorithm development," *Parallel Processing for Scientific Computation*, G. Rodrigue, ed., SIAM, Philadelphia, 1989, pp. 368-376 (with E. Eskow).

39. "An overview of DINO--A new language for numerical computation on distributed memory multiprocessors," *Parallel Processing for Scientific Computation*, G. Rodrigue, ed., SIAM, Philadelphia, 1989, pp. 312-316 (with M. Rosing).
40. "DINO: Summary and Examples," *The Third Conference on Hypercube Concurrent Computers and Applications*, G. Fox, ed., ACM, New York, 1988, pp. 472-481 (with M. Rosing and R. Weaver).
41. "Mathematical modeling of a parallel global optimization algorithm," *Parallel Computing* 12, 1989, pp. 315-325 (with E. Eskow).
42. "Parallel methods for block bordered nonlinear problems," *Transactions of the Sixth Army Conference on Applied Mathematics and Computing*, 1988, pp. 749-770 (with R. Byrd and X. Zhang).
43. "Sequential and parallel methods for unconstrained optimization," *Mathematical Programming, Recent Developments and Applications*, M. Iri and K. Tanabe, eds., Kluwer, Tokyo, 1989, pp. 227-261.
44. "A new modified Cholesky factorization," *SIAM Journal on Scientific and Statistical Computing*, Vol. 11, No. 6, November 1990, pp. 1136-1158 (with E. Eskow).
45. "Why are all us parallel numerical analysts doing parallel software tools?," *Opportunities and Constraints of Parallel Computing*, J. L. C. Sanz, ed., Springer-Verlag, New York, 1989, pp. 117-118.
46. "Expressing complex parallel algorithms in DINO," *Proceedings of the Fourth Conference on Hypercubes, Concurrent Computers, and Applications*, Vol. 1, 1989, pp. 553-560 (with M. Rosing and R. Weaver).
47. "Solving nonlinear block bordered circuit equations on a hypercube multiprocessor," *Proceedings of the Fourth Conference on Hypercubes, Concurrent Computers, and Applications*, Vol. 1, 1989, pp. 701-707 (with R. Byrd and X. Zhang).
48. "Tensor methods for unconstrained optimization using second derivatives," *SIAM Journal on Optimization*, Vol. 1, No. 3, 1991, pp. 293-315 (with T. Chow).
49. "Software for a new modified Cholesky factorization," *ACM Transactions on Mathematical Software*, Vol. 17, No. 3, 1991, pp. 306-312 (with E. Eskow).
50. "Adaptive, asynchronous stochastic global optimization algorithms for sequential and parallel computation," *Large Scale Numerical Optimization*, T. Coleman and Y. Li, eds., SIAM, Philadelphia, 1990, pp. 207-227 (with S. Smith and E. Eskow).
51. "Parallel methods for solving nonlinear block bordered systems of equations," *SIAM Journal on Scientific and Statistical Computing*, Vol. 13, No. 4, 1992, pp. 841-859 (with X. Zhang and R. Byrd).
52. "The DINO parallel programming language," *Journal of Parallel and Distributed Computing* 13, 1991, pp. 30-42 (with M. Rosing and R. Weaver).
53. "Massive parallelism and process contraction," *Parallel Processing for Scientific Computing*, J. Dongarra, P. Messina, D. C. Sorenson, and R. G. Voigt, eds., SIAM, 1990, pp. 364-369 (with M. Rosing and R. Weaver).

54. "An adaptive, asynchronous parallel global optimization algorithm," *Parallel Processing for Scientific Computing*, J. Dongarra, P. Messina, D. C. Sorenson, and R. G. Voigt, eds., SIAM, 1990, pp. 192-197 (with S. Smith and E. Eskow).
55. "A theoretical and experimental study of the symmetric rank one update," *SIAM Journal on Optimization* 3, 1993, pp. 1-24 (with R. H. Byrd and H. Khalfan).
56. "A software package for unconstrained optimization using tensor methods," *ACM Transactions on Mathematical Software* 20, 1994, pp. 518-530 (with T. Chow and E. Eskow).
57. "The DINO User's Manual," University of Colorado Technical Report CU-CS-501-90 (with T. Derby, E. Eskow, R. Neves, M. Rosing, and R. Weaver).
58. "Centralized and distributed dynamic scheduling for adaptive parallel algorithms," in *Unstructured Scientific Computation on Scalable Multiprocessors*, P. Mehrotra, J. Saltz, and R. Voigt, eds., MIT Press, Cambridge, Mass., 1992, pp. 301-321 (with S. Smith).
59. "Scientific programming languages for distributed memory multiprocessors : paradigms and research issues", *Languages, Compilers and Run-Time Environments for Distributed Memory Machines*, J. Saltz and P. Mehrotra, eds., North-Holland, Amsterdam, 1992, pp. 17-38 (with M. Rosing and R. Weaver).
60. "Parallel global optimization: numerical methods, dynamic scheduling methods, and applications to molecular configuration", *Parallel Computation*, B. Ford and A. Fincham, eds., Oxford University Press, 1993, pp. 187-207 (with R. Byrd, E. Eskow, and S. Smith).
61. "Flexible language constructs for large parallel programs", *Scientific Programming* 3, 1994, pp. 169-186 (with M. Rosing).
62. "Preliminary experience in developing a parallel thin-layer Navier Stokes code and implications for parallel language design", *Proceedings of Scalable High Performance Computing Conference*, IEEE Press, 1992, pp. 276-283 (with D. Olander).
63. "Automatic mapping and load balancing of pointer-based dynamic data structures on distributed memory machines", *Proceedings of Scalable High Performance Computing Conference*, IEEE Press, 1992, pp. 252-259 (with R. Weaver).
64. "Local convergence analysis of tensor methods for nonlinear equations", *Mathematical Programming* 62, 1993, pp. 427-459 (with D. Feng and P. Frank).
65. "Representations of quasi-Newton matrices and their use in limited memory methods", *Mathematical Programming* 63, 1994, pp. 129-156 (with R. Byrd and J. Nocedal).
66. "Dynamic scheduling strategies for an adaptive asynchronous parallel global optimization algorithm, University of Colorado Technical Report CU-CS-625-92, (with S. Smith).

67. "A programmable preprocessor approach to efficient parallel language design," *SIGPLAN Notices*, 28, Jan. 1993, pp. 76-78 (with M. Rosing and R. Weaver).
68. "A new large-scale global optimization method and its application to Lennard-Jones problems", University of Colorado Technical Report CU-CS-630-92 (with R. Byrd and E. Eskow).
69. "Globally convergent parallel algorithms for solving block bordered systems of nonlinear equations", *Optimization Methods and Software* 2, 1993, pp. 269-295 (with D. Feng).
70. "Parallel tensor methods for nonlinear equations and nonlinear least squares", *Proceedings of Sixth SIAM Conference of Parallel Processing for Scientific Computation*, SIAM, Philadelphia, 1993, pp. 639-643 (with A. Bouaricha).
71. "Parallel global optimization methods for molecular configuration problems", *Proceedings of Sixth SIAM Conference of Parallel Processing for Scientific Computation*, SIAM, Philadelphia, 1993, pp. 165-169 (with R. Byrd, T. Derby, E. Eskow, K. Oldenkamp, and C. Triantafillou).
72. "A new stochastic/perturbation method for large-scale global optimization and its application to water cluster problems", *Large-Scale Optimization: State of the Art*, W. Hager, D. Hearn, and P. Pardalos, eds., Kluwer Academic Publishers, 1994, pp. 71-84 (with R. Byrd, T. Derby, E. Eskow, and K. Oldenkamp).
73. "Efficient compile-time / run-time contraction of fine-grain data parallel codes", *Languages and Compilers for Parallel Computing*, U. Banerjee, D. Gelernter, A. Nicolau, and D. Padua, eds., Springer Verlag, 1994, pp. 430-448 (with R. Neves).
74. "Analysis of a symmetric rank-one trust region method", *SIAM Journal on Optimization* 6, 1996, pp. 1025-1039 (with R. Byrd and H. Favez Khalfan).
75. "Parallel nonlinear optimization: limitations, opportunities, and challenges", *Algorithms for Continuous Optimization: The State of the Art*, E. Spedicato, ed., Kluwer Academic Publishers, 1994, pp. 531-559 (preliminary version of #82)
76. "Tensor methods for equality constrained optimization", *SIAM Journal on Optimization* 6, 1996, pp. 653-673 (with D. Feng).
77. "EQ: Overview of a new language approach for prototyping scientific computation", *Languages and Compilers for Parallel Computing*, K. Pingali, U. Banerjee, D. Gelernter, A. Nicolau, P. Padua, eds., Springer-Verlag, 1995, pp. 391-405 (with T. Derby and B. Zorn).
78. "TENSOLVE: A software package for solving systems of nonlinear equations and nonlinear least squares problems using tensor methods", *ACM Transactions on Mathematical Software* 23, 1997, pp. 174-195 (with A. Bouaricha).
79. "Tensor methods for large sparse systems of nonlinear equations", *Mathematical Programming* 82, 1998, pp. 377-400 (with A. Bouaricha).
80. "A parallel global optimization method for solving molecular cluster and polymer conformation problems", *Proceedings of the Seventh SIAM Conference on Parallel*

Processing for Scientific Computing, SIAM, 1995, pp. 72-77 (with R. Byrd, E. Eskow, B. Oldenkamp, and A. van der Hoek).

81. "Runtime support for execution of fine grain parallel code on coarse grain multiprocessors", *Proceedings of Frontiers '95*, The Fifth Symposium on the Frontiers of Massively Parallel Computation, IEEE Computer Society Press, 1995, pp. 440-447 (with R. Neves)
82. "A view of the limitations, opportunities, and challenges in parallel nonlinear optimization", *Parallel Computing* 21, 1995, pp. 875-905.
83. "On optimality conditions for singular constrained optimization", submitted for publication (with R. Byrd and D. Feng).
84. "A New Language Design for Prototyping Numerical Computation", *Scientific Programming* 5, 1996, pp. 279-300 (with T. Derby and B. Zorn).
85. "The relationship between language paradigm and parallelism: the EQ prototyping language", *Languages, Compilers, and Run-Time Systems for Scalable Computers*, B. Szymanski and B. Sinharoy, eds., Kluwer Academic Publishers, 1995, pp. 329-332 (with T. Derby and B. Zorn).
86. "Global optimization methods for protein folding problems", *Global Minimization of Nonconvex Energy Functions: Molecular Conformation and Protein Folding*, P. Pardalos, D. Shalloway, and G. Xue, eds., American Mathematical Society, 1995, pp. 29-39 (with R. Byrd, E. Eskow, A. van der Hoek, C.-S. Shao, and Z. Zou).
87. "Local convergence analysis of tensor and SQP methods for singular constrained optimization", provisionally accepted for publication in *SIAM Journal on Optimization* (with D. Feng).
88. "A run-time system for executing fine grain data parallel codes on coarse grain parallel systems", *Journal of Parallel and Distributed Computing* 42, 1997, pp. 128-142 (with R. Neves).
89. "Global optimization for molecular cluster problems using a new smoothing approach", *Large-Scale Optimization with Applications, Part III: Molecular Structure and Optimization*, L. Biegler, T. Coleman, A. Conn and F. Santosa, eds., Springer, 1997, pp. 163-199 (with C.-S. Shao, R. Byrd, E. Eskow).
90. "Tensor methods for large sparse nonlinear least squares problems", *SIAM Journal on Scientific Computing* 21, 1999, pp. 1199-1221 (with A. Bouaricha).
91. "A stochastic/perturbation global optimization algorithm for distance geometry problems", *Journal on Global Optimization* 11, 1997, pp. 91-105 (with Z. Zou and R. Byrd).
92. "A revised modified Cholesky factorization algorithm", *SIAM Journal on Optimization* 9, 1999, pp. 1135-1148 (with E. Eskow).
93. "Global optimization for molecular clusters using a new smoothing approach", *Journal of Global Optimization* 16, 2000, pp. 167-196 (with C. Shao, R. Byrd, and E. Eskow).

94. "Retaining convergence properties of trust region methods without extra gradient evaluations" submitted for journal publication (with H. Khalfan and R. Byrd).
95. "A global optimization strategy for predicting protein tertiary structure: alpha-helical proteins", *New Trends in computational Methods for Large Molecular Systems*, in press (with S. Crivelli, R.H. Byrd, E. Eskow, R. Yu, T. Phillips and T. Head-Gordon).
96. "Predicting Protein Tertiary Structure Using a Global Optimization Algorithm with Smoothing", *Optimization in Computational Chemistry and Molecular Biology: Nonconvex Optimization and Its Applications*, C.A. Floudas and P.M. Pardalos, eds., Kluwer Academic Publishers, pp. 1-18, 2000 (with A. Azmi, R. Byrd, E. Eskow, S. Crivelli, T. Philip and T. Head-Gordon).
97. "A Task Migration System for Parallel Scientific Computations in Heterogeneous NOW Environments", *Proceedings of the Ninth SIAM Conference on Parallel Processing for Scientific Computing*, B. Hendrickson, K. Yelick, C. Bischof, I. Duff, A. Edelman, G. Geist, M. Heath, M. Heroux, C. Koelbel, R. Schrieber, R. Sincovec, and M. Wheeler, eds., CD-ROM, ISBN 8-89871-435-4 (with C.-S. Shao).
98. "A Hierarchical Approach for Parallelization of a Global Optimization Strategy for Protein Structure Prediction", *Proceedings of Euro-Par '99*, Lecture Notes in Computer Science Series, P. Amestoy, P. Berger, M. Dayde, I. Duff, V. Fraysse, L. Giraud, D. Ruiz, eds., Springer-Verlag, 1999, pp. 578-585 (with S. Crivelli, T. Head-Gordon, R. Byrd, and E. Eskow).
99. "A Large-Scale Stochastic-Perturbation Global Optimization Method for Molecular Cluster Problems", submitted for journal publication (with R. Byrd and E. Eskow).
100. "New smoothing techniques for global optimization in solving for protein conformation", *Global Optimization: Scientific and Engineering Case Studies*, J. Pinter, ed., Springer-Verlag, 2006 (with A. Azmi, R. Byrd, and E. Eskow).
101. "A physical approach to protein structure prediction", *Biophysical Journal* 82, 2002, pp. 36-49 (with S. Crivelli, B. Bader, R. Byrd, E. Eskow, V. Lamberti and T. Head-Gordon).
102. "Curvilinear linesearch for tensor methods", *SIAM Journal on Scientific Computing* 25, 2003, pp. 2004-2022 (with B. Bader).
103. "An optimization approach to the problem of protein structure prediction", *Mathematical Programming* 101, 2004, pp. 497-514 (with E. Eskow, B. Bader, R. Byrd, S. Crivelli, T. Head-Gordon, and V. Lamberti).
104. "On the performance of tensor methods for solving ill-conditioned problems", *SIAM Journal on Scientific Computing* 29, 2007, pp. 2329-2351 (with B. Bader).
105. "A preconditioned L-BFGS algorithm with an application to molecular energy minimization", submitted for publication (with L. Jiang, R. Byrd and E. Eskow).
106. "Educating Computing's Next Generation", *Communications of the ACM* 54, No. 4, 2011, p. 5.

107. "Pathways to Computing Careers", *Communications of the ACM* 57, No. 12, 2014, p. 5. (with J. White).

Software

UNCMIN, a modular system of algorithms for unconstrained minimization, distributed to many (well over 100) university, government, and industry sites, and included in the National Bureau of Standards software library, in at least two books, and in modified form in the IMSL mathematical software library (with J.E. Koontz and B.E. Weiss).

DPUP, a package that supports the use of a network of computers as a local memory multiprocessor, distributed to several sites (with T.J. Gardner, I.M. Gerard, C.R. Mowers, and E. Nemeth).

ODRPACK, a package for orthogonal distance regression and standard nonlinear least squares, distributed to many (well over 100) sites (with P.T. Boggs, R.H. Byrd, and J.R. Donaldson).

TENSOLVE, a package for nonlinear equations and nonlinear least squares using tensor and Newton methods, distributed to over 30 sites (with A. Bouaricha).

DINO, a programming language for parallel numerical computation on distributed memory multiprocessors, distributed to 10-20 sites (with T. Derby, E. Eskow, M. Rosing, R. Weaver).

TENMIN, a package for unconstrained optimization using tensor and Newton methods, distributed to over 30 sites (with T. Chow and E. Eskow)

Invited Conference Presentations

IFIP Working Conference on Performance Evaluation of Numerical Software, Baden, Austria, Dec. 1978.

Invited participant; talk on "Developing modular software for unconstrained optimization."

Short Course on Modern Computational Techniques for Nonlinear Unconstrained Optimization, Madison, Wisconsin, May 1979.

Invited 2-day short course at Mathematics Research Center (with J.E. Dennis, Jr.).

Tenth International Symposium on Mathematical Programming, Montreal, Canada, Aug. 1979.

Invited talk: "Determining whether a system of nonlinear inequality constraints has a feasible point."

ORSA/TIMS Joint National Meeting, Milwaukee, Wisconsin, Oct. 1979.

Invited talk: "Determining whether a system of nonlinear inequality constraints has a feasible point."

IMS Special Topics Meeting on Regression Analysis, Boulder, Colorado, Oct. 1979.

Invited talk: "Nonlinear least squares computations."

SIAM Summer Research Conference on Numerical and Statistical Analysis, Newark, Delaware, June 1980.

Invited talk: "Solving nonlinear least squares problems."

Mathematical Optimization, Oberwolfach, W. Germany, January 1981.

Invited participant: talk on "Unconstrained minimization using conic models and analytic second derivatives."

Advanced Research Institute on Nonlinear Optimization, Cambridge, England, July, 1981.

Main invited speaker (1 of 7): "Unconstrained optimization in 1981.";
Research talk: Nonstandard models in unconstrained optimization and nonlinear equations."

Eleventh International Symposium on Mathematical Programming, Bonn, W. Germany, Aug. 1982.

Invited "state-of-the-art tutorial" (plenary talk): "Conic models in unconstrained optimization and tensor models in nonlinear equations."

Invited talk: "An indefinite dogleg method for unconstrained minimizations."

Mathematical Optimization, Oberwolfach, W. Germany, January 1983.

Invited participant: talk on "Tensor models for nonlinear equations and unconstrained optimization."

ORSA/TIMS Joint National Meeting, San Francisco, California, May 1984.

Invited talk: "Computational experience solving systems of nonlinear equations."

SIAM Conference on Numerical Optimization, Boulder, Colorado, June 1984.

Invited one-day short course on numerical optimization (with P. Boggs).

NATO ASI on Computational Mathematical Programming, Bad Windsheim, W. Germany, July 1984.

Invited series of lectures on Parallel Computing in Optimization.

SIAM Conference on Frontiers in Statistical Computing, Boston, Massachusetts, October 1984.

Invited one-day short course on Nonlinear Optimization in Statistics (with P. Boggs).

Invited talk: "Computational experience with confidence regions and confidence intervals for nonlinear least squares."

Computer Science and Statistics: 17th Symposium on the Interface, Lexington, Kentucky, March 1985.

Invited talk: "Computational experience with confidence intervals and confidence regions for nonlinear least squares."

Twelfth International Symposium on Mathematical Programming, Boston, Massachusetts, August 1985.

Invited talk: "Concurrent numerical optimization in a distributed computing environment."

ARO Workshop on Parallel Processing and Medium-Scale Multiprocessing, Stanford, California, January 1986.

Invited talk: "Concurrent algorithm for global optimization on a network of computers."

Computer Science and Statistics: 18th Symposium on the Interface, Ft. Collins, Colorado, March 1986.

Invited talk: "Parallel computation for optimization problems."

IMA/SIAM Conference on the State of the Art in Numerical Analysis, Birmingham, England, April 1986.

Invited talk: "New methods for nonlinear equations and nonlinear least squares."

Cornell Supercomputer Seminar Institute, Ithaca, New York, August 1986.

Invited series of lectures on Parallel Optimization.

First World Congress on Computational Mechanics, Austin, Texas, September, 1986.

Invited talk: "Parallel Methods for Local and Global Optimization."

ORSA/TIMS Joint National Meeting, Miami, Florida, October 1986.

Invited talk: "Parallel Computing for Optimization Problems."

Forum on Supercomputing, Denver, Colorado, March 1987.

Invited talk: "Parallel Methods for Local and Global Optimization."

Workshop on Scientific Computing Using Parallel Architectures, College Park, Maryland, April 1987.

Invited talk: "Parallel methods for local and global optimization."

SIAM Conference on Numerical Optimization, Houston, Texas, May 1987.

Invited one-day short course on numerical optimization (with P.T. Boggs).

Summer Workshop in Parallel Computation, Boulder, Colorado, June 1987.

Invited talk: "Designing parallel algorithms."

Symposium on Parallel Optimization, Madison, Wisconsin, August 1987.

Invited talk: "Speculative function evaluation in parallel optimization."

SIAM National Meeting, Denver, Colorado, October 1987.

Invited one-day short course on parallel computing (with H. Jordan, O. McBryan).

Sixth Army Conference on Applied Mathematics and Computing, Boulder, Colorado, June 1988.

Invited talk: "New sequential and parallel methods for unconstrained optimization."

AMS-SIAM Summer Seminar on Computational Solutions of Nonlinear Systems of Equations, Ft. Collins, Colorado, July 1988.

Invited talk: "Tensor methods for nonlinear equations and unconstrained optimization."

Thirteenth International Symposium on Mathematical Programming, Tokyo, Japan, August 1988.

Invited "tutorial and survey lecture": "Sequential and parallel methods for unconstrained optimization."

ORSA/TIMS Joint National Meeting, Denver, Colorado, October 1988.

Invited panelist: talk on "Is parallel optimization interesting research?"

IBM/NSF Workshop on Opportunities and Constraints of Parallel Computing, San Jose, California, December 1988.

Invited participant: talk on "DINO--A new language for numerical computation on distributed memory multiprocessors."

Third SIAM Conference on Optimization, Boston, Massachusetts, April 1989.

Main invited talk (1 of 9): "Parallel methods for local and global optimization."

SIAM National meeting, San Diego, California, July 1989.

Invited talk: "Parallel methods for solving block bordered systems of nonlinear equations."

Workshop on Large Scale Numerical Optimization, Ithaca, New York, October 1989

Invited talk: "Adaptive stochastic global optimization methods for sequential and parallel computation."

Workshop on Languages, Computers, and Run-Time Environments for Distributed Memory Machines, Hampton, VA, May 1990.

Invited talk: "Programming Distributed Memory Multiprocessors: General Issues and DINO."

SIAM National Meeting, Chicago, Illinois, July 1990.

Invited talk: "A theoretical and experimental study of the symmetric rank one update."

Intel University Partners Technology Focus Conference, Mt. Hood, Oregon, April 1991.

Invited talk: "Programming Language Support for Numerical Conference on Distributed Memory Multiprocessors"

Conference on Recent Advances in Global Optimization, Princeton, New Jersey, May 1991.

Invited talk: "New stochastic methods for solving large scale global optimization problems"

Ninth Army Conference on Applied Mathematics and Computing, Minneapolis, Minnesota, June 1991.

Invited talk: "Tensor methods for large sparse systems of nonlinear equations"

Fourteenth International Symposium on Mathematical Programming, Amsterdam, The Netherlands, August 1991.

Invited talk: "Tensor methods for large sparse nonlinear equations and least squares"

IMA Conference on Parallel Computation, Oxford, England, September 1991.

Invited talk: "Some challenges in parallel methods for optimization problems"

AFOSR Workshop on Optimization Methods for Extended Systems, Edwards Air Force Base, California, October 1991.

Invited talk: "Stochastic global optimization"

Fourth SIAM Conference on Optimization, Chicago, May 1992.

Invited talk: "Global optimization methods for molecular configuration problems"

SIAM Annual Meeting, Los Angeles, July 1992.

Plenary invited talk: "Tensor methods for nonlinear equations and optimization"

Workshop on New Optimization Techniques for Large Compounds, Ames, Iowa, Jan. 1993.

Invited talk: "Stochastic/perturbation methods for global optimization of molecular configuration problems"

Conference on Large Scale Optimization Gainesville, Florida, Feb. 1993.

Invited talk: "New large-scale global optimization methods and their application to molecular configuration"

DIMACS Workshop on Future Directions for Parallel Optimization, New Brunswick, N.J., Apr. 1993.

Invited talk: "Parallel optimization: the good, the bad, and the ugly"

NATO Advanced Study Institute on Optimization, Il Ciocco, Italy, Sept. 1993

Invited series of talks: "Parallel nonlinear optimization"

ORSA-TIMS National Meeting, Phoenix, AZ, Nov. 1993

Invited tutorial lecture: "Parallel and global optimization"

Workshop on Optimization and Parallel Computation, U.A.E. University, Al-Ain, United Arab Emirates, May, 1994

Invited talks: "An overview of parallel architectures, algorithms, and languages", and "Global optimization methods for molecular configuration problems"

SIAM National Meeting, San Diego, CA, July 1994

Invited talk: "Global Optimization Methods for Molecular Configuration Problems"

Fifteenth International Symposium on Mathematical Programming, Ann Arbor, MI, August 1994.

Invited talk: "Global Optimization Methods for Molecular Conformation Problems"

DIMACS Workshop on Global Minimization of Nonconvex Energy Functions, New Brunswick, N.J., Mar. 1995

Invited talk: "Global Optimization for Protein Folding Problems"

IMA Workshop on Large-Scale Optimization, Minneapolis, July 1995

Invited talk: "Global Optimization Methods for Molecular Configuration Problems"

SIAM National Meeting, Charlotte, NC, Oct. 1995

Invited talk: "Global Optimization Methods for Molecular Configuration Problems"

Linear Algebra in Optimization Workshop, Albi, France, Apr. 1996

Invited talk: "Global Optimization, Parallel Optimization"

SIAM National Meeting, Stanford, CA, July 1997

Invited talk: "Global Optimization for Protein Folding"

IFIP Conference on Systems Modelling and Optimization, Detroit, July 1997

Invited talk: "Large-Scale Global Optimization Methods with Applications in Molecular Chemistry"

International Symposium on Mathematical Programming, Lausanne, Aug. 1997

Invited talk: "Global Optimization Methods for Protein Folding Problems"

International Symposium on Mathematical Programming, Atlanta, Aug. 2000

Invited talk: "Optimization applied to Protein Folding: Interrelationships and Recent Progress"

SIAM Conference on Scientific Computing, Washington D.C., Sept. 2000

Invited talk: "Protein Structure Prediction by Global Optimization Utilizing Secondary Structure Prediction"

EDUCAUSE Annual Meeting, Los Angeles, CA, Nov. 2003

Invited talk as recipient of Systemic Progress in Teaching and Learning Award: "The ATLAS Institute – Systemic Change"

Cornell Computer Science 40th Anniversary Symposium, Ithaca, NY, Oct. 2005

Invited talk (one of 11 speakers): "Competition, Compassion and Cruelty at Cornell, and the Future of Computer Science"

Computing Research Association Biennial Conference, Snowbird, UT, June. 2006

Invited panelist: "The Influence of Globalization on Computer Science Education"

(Subsequent invited conference talks and panel presentations related to diversity, computing education, and computing research directions not included here. These include additional presentations at Snowbird and a variety of ACM conferences.)

Research Funding

- Army Research Office Contract DAAG29-79-C-0023, "Improving the performance and analysis of quasi-Newton methods for unconstrained optimization and related problems," 1 June 1979-31 May 1981, \$41,960.
- Army Research Office Contract DAAG29-81-K-0108, "Trust region methods for minimization," 15 June 1981-14 June 1984, \$117,000.
(this proposal also funded by National Science Foundation Grant MCS81-15475, R. Byrd, principal investigator, 1 July 1981-30 June 1984, \$117,650.)
- Army Research Office Contract DAAG29-84-K-0140, "New methods for nonlinear optimization," 1 August 1984-31 July 1987, \$151,055.
- National Science Foundation Grant DCR-8403483, "Trust region methods for minimization," 1 August 1984- 31 January 1988, \$144,674 (co-principal investigator with R. Byrd, principal investigator).

- Air Force Office of Scientific Research Grant AFOSR-85-0251, "Concurrent algorithms for optimization/VLSI problems," 1 Sept. 1985-31 August 1989, \$492,689 (principal investigator; R. Byrd, G. Hachtel, M. Lightner, co-principal investigators).
- National Science Foundation Cooperative Agreement No. DCR-8420944, "A research facility for numerical computation and software environments," 1 Sept. 1985-31 August 1990, \$3,197,254, project manager and principal investigator (with L.J. Osterweil).
- Air Force Office of Scientific Research Grant AFOSR-87-0055, "Concurrent algorithms for numerical computation on a hypercube computer," 1 Oct. 1986-30 Sept. 1987, \$100,000 (equipment grant).
- National Science Foundation Grant CCR8702403, "New methods for nonlinear optimization," 1 August 1987-31 January 1990, \$228,841 (co-principal investigator with R. Byrd, principal investigator).
- Army Research Office Contract DAAL-03-K-0086, "New methods for nonlinear optimization," 15 May 1988 - 14 May 1991, \$165,000 (principal investigator; R. Byrd, co-principal investigator).
- National Science Foundation Grant 87-17773, "Concurrent processing methods for nonlinear structural dynamics," 15 July 1988-14 July 1990, \$292,698 (co-principal investigator; C. Farhat, principal investigator; R. Byrd, C. Felippa, H. Jordan, other co-principal investigators).
- Air Force Office of Scientific Research Grant AFOSR-90-0109, "Concurrent algorithms for optimization problems," 1 December 1989 - 30 November 1993, \$593,272 (principal investigator; R. Byrd, co-principal investigator).
- National Science Foundation Grant CCR-8920519, "Developing and understanding methods for nonlinear optimization," 1 April 1990 - 31 March 1992, \$119,726 (co-principal investigator with R. Byrd, principal investigator).
- National Science Foundation Institutional Infrastructure Grant CDA-8922510, "Effective use of parallel and distributed computing," 15 June 1990 - 30 November 1995, \$1,800,000 (principal investigator; R. King, C. Lewis, M. Main, G. Nutt, P. Smolensky, co-principal investigators).
- National Science Foundation Grant ASC-9015577, "Language support for parallel scientific computation on distributed memory multiprocessors," 1 October 1990 - 31 March 1994, \$264,846.
- Army Research Office Contract DAAL03-91-G-0151, "New methods for nonlinear optimization," 15 May 1991 - 14 May 1994, \$253,000 (principal investigator; R. Byrd, co-principal investigator).
- National Science Foundation Grant CCR-9101795, "Developing and understanding methods for nonlinear optimization," 1 July 1991 - 30 June 1994, \$135,857 (co-principal investigator with R. Byrd, principal investigator).
- Boeing Computer Services Contract W297551, "Design and implementation of a parallel thin-layer Navier-Stokes code," 1 June 1991 - 31 May 1992, \$29,888.

- Air Force Office of Scientific Research Grant F49620-94-1-0101, "Large-scale optimization methods for molecular chemistry problems," 15 December 1993 - 14 December 1996, \$663,105 (principal investigator; R. Byrd, co-principal investigator).
- National Science Foundation Grant ASC-9307315, "Symbiotic parallel language and application development for massively parallel scientific computation," 15 January 1994 - 14 January 1997, \$476,590.
- Army Research Office Contract DAAH04-94-G-0228, "Developing and understanding methods for large-scale nonlinear optimization," 15 May 1994 - 14 May 1997, \$226,220 (principal investigator; R. Byrd, co-principal investigator).
- National Science Foundation Grant CDA-9502956, "High Performance Infrastructure for Computational Science," 15 July 1995 - 15 July 2000, \$1,500,000 (principal investigator; D. Grunwald, O. McBryan, M. Schwartz, co-principal investigators).
- Air Force Office of Scientific Research Grant F49620-97-1-0164, "Large-scale optimization methods with a focus on chemistry problems," 1 April 1997 - 31 December 1999, \$478,275 (principal investigator; R. Byrd, co-principal investigator).
- Army Research Office Grant DAAG55-98-1-0176, "Developing and understanding methods for large-scale nonlinear optimization," 1 March 1998 - 28 February 2001, \$255,000 (principal investigator; R. Byrd, co-principal investigator).
- Air Force Office of Scientific Research Grant F49620-00-1-0162, "Large-scale optimization methods with a focus on chemistry problems," 15 January 2000 - 14 January 2003, \$225,000 (principal investigator; R. Byrd, co-principal investigator).
- Department of Education Grant P339Z000005, Sept. 1, 2000 – Aug. 31, 2005, \$1,849,996, "The ATLAS Partnership" (principal investigator; earmarked grant)
- National Science Foundation Grant EIA-0082915, "ITR: Research, Curriculum and Partnerships for Broadening the Information Technology Pipeline," 15 September 2000 - 30 August 2003, \$454,665 (principal investigator).
- National Science Foundation Grant EIA-0090026, "ITW: Attracting and Retaining Women in Information Technology Programs: A comparative Study of Three Programmatic Approaches," 15 September 2000 - 31 August 2003, \$715,321 (principal investigator; L. Barker, C. Lewis, E. Seymour, D. Sieber co-principal investigators).
- Department of Education Grant P116Z010122, Sept. 1, 2001 – Aug. 31, 2006, \$1,068,000, "The ATLAS (Alliance for Technology, Learning and Society) Project for Technology-Enhanced Learning" (principal investigator; earmarked grant)
- Colorado Institute of Technology Grant, "TechTAM: A Certificate Program for Non-Technical Students Who Wish To Switch Directions Before They Compete a Bachelor's Degree," Sept. 15, 2001 – Sept. 14, 2003, \$197,100 (principal investigator, D. Sieber, co-principal investigator)
- National Science Foundation Grant ??, "ADVANCE Institutional Transformation Award," Jan. 1, 2002 – Dec. 31, 2006, \$3,581,254 (co-principal investigator; P. Rankin, principal investigator, M. Shea, T. Gleeson, C. Lynch, additional co-PIs)

- Carnegie Corporation of New York Grant, “Enhancing Liberal Arts Education in a Technological Age Through Collaboration Between Diverse Universities,” \$550,000, Univ. Colorado share \$230,000, May 1, 2002 – June 30, 2003 (co-principal investigator; E. Pinkard, Dillard University, principal investigator)
- Army Research Office Contract DAAD19-02-1-0407, "Large-scale optimization problems with a focus on chemistry problems", Sept. 1, 2002-Nov. 30, 2005, \$270,000, (co-principal investigator with R. Byrd, principal investigator).
- National Science Foundation Grant CHE-0205170, "ITR: A Global Optimization Package for Protein Structure Prediction", Sept. 1, 2002-Aug. 31 2005, \$1,500,000 split with U.C. Berkeley, Univ. Colorado share: \$540,182. (co-principal investigator with R. Byrd, principal investigator).
- Department of Education Grant P116Z020241, Sept. 1, 2002 – Aug. 31, 2006, \$1,000,000, "The ATLAS (Alliance for Technology, Learning and Society) Project for Technology Enhancement" (principal investigator; earmarked grant)
- Carnegie Corporation of New York Grant, “Enhancing Liberal Arts Education in a Diverse and Digital Age Through Collaboration Between Diverse Universities,” \$350,000, June 1, 2003 – March 1, 2005 (principal investigator; E. Pinkard, Dillard University, co-principal investigator)
- Colorado Institute of Technology Grant, “Establishing a National Center for Women and Information Technology” July 16, 2003 – July 15, 2004, \$50,000 (principal investigator, L. Sanders, co-principal investigator)
- National Science Foundation Grant CNS-0335713, “Planning Grant for Establishing a National Center for Women and Information Technology,” Sept. 1, 2003 – Aug. 30, 2004, \$50,000 (principal investigator; L. Sanders, co-principal investigator)
- Colorado Institute of Technology Grant, “ATLAS and Computer Magnet Digital CUrrents Summer Outreach Program,” Jan.1, 2004 – Dec. 31, 2004, \$45,000 (co-principal investigator, L. Sanders, principal investigator)
- National Science Foundation Grant CNS-0413538, “Special Projects: National Center for Women and Information Technology,” Oct. 1, 2004 – Sept. 30, 2008, \$3,250,000 plus \$877,031 supplements (principal investigator; L. Sanders and T. Whitney, co-principal investigators)
- National Science Foundation Grant “HRD-0533580, “GSE/EXT: Collaborative Research: Mobilizing Implementation of Effective Practices to Increase Participation of Women in Computing,” Oct. 1, 2005 – Sept 30, 2010, \$1,523,514 (co-principal investigator; L. Sanders, principal investigator, L. Barker, additional co-PI; total grant size with collaborating institutions \$2.5M)
- National Science Foundation Grant CNS-0540522, “COLLABORATIVE RESEARCH: Alliance Between Historically Black Universities and Research Universities for Collaborative Education and Research in Computing Disciplines,” Mar. 1, 2006 – Feb. 28, 2009, \$372,998 (principal investigator; L. Barker, E. Jessup, C. Lewis, co-PIs; total grant size with collaborating institutions \$2.0M)

- National Science Foundation Grant CNS-0813956, “Special Projects: National Center for Women and Information Technology,” July 1, 2008 – June 30, 2012, \$5,842,000 (co-principal investigator; L. Sanders, principal investigator, L. Barker, additional co-PI)
- National Science Foundation Grant CNS-0940608, “BPC-AE: Collaborative Research: The Alliance for the Advancement of African-American Researcher in Computing (A4RC)”, Sept. 1, 2009 – Aug. 30, 2011, \$213,031 for first year (co-principal investigator; M. Biggers, principal investigator; total grant size with collaborating institutions \$720,771 for first year)
- National Science Foundation Grant CNS-0937060, “Computing Innovation Fellows Project,” May 15, 2009 – April 30, 2013, \$14,988,394 (principal investigator beginning April 30, 2010, steering committee member previously; A. Jones, R. Kasturi, A. Bernat, R. Libeskind-Hadas co-principal investigators; grant is to Computing Research Association)
- National Science Foundation Grant CNS-1203206, “Special Projects (CNS): National Center for Women and Information Technology (NCWIT) - Building the Computing Workforce of the 21st Century” Oct. 1, 2012 – Sept. 30, 2017, \$8,947,001 (co-principal investigator; L. Sanders, principal investigator,