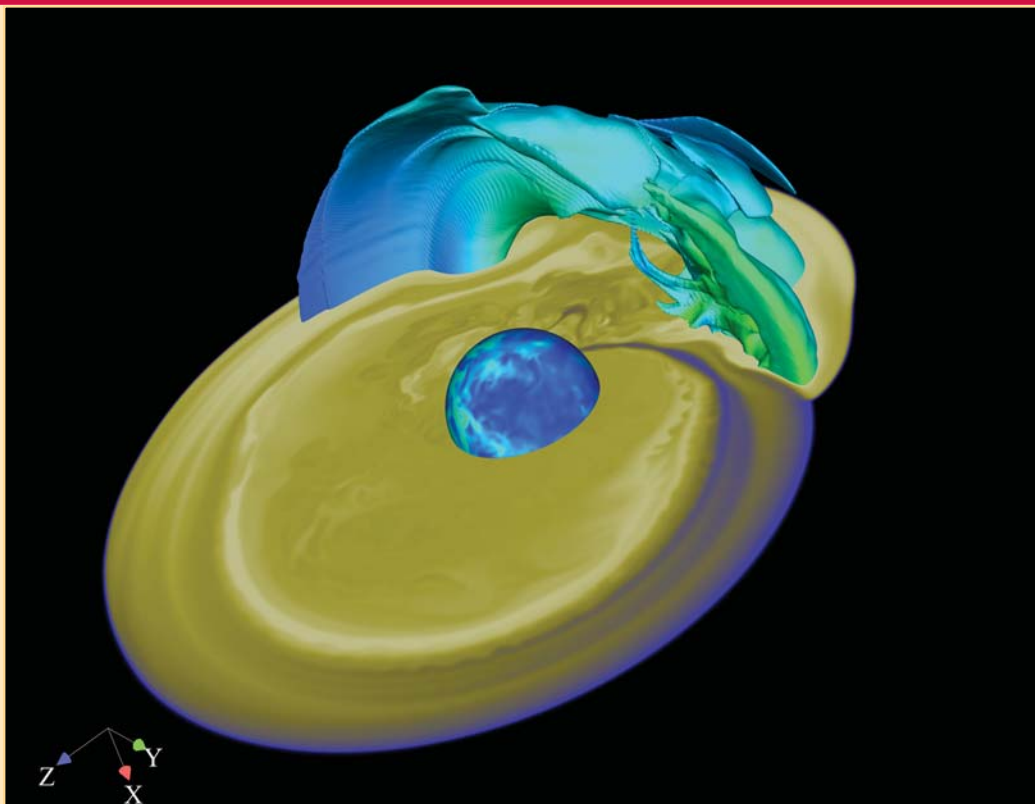


# RESEARCH

0 0 1 1 0 0 0 1 0 0 1 1 1 0 0 1 0 0 1 1 0 1 1 0 0 0 1 1 0 1 1 1

*This image was created by the REHCI@NCSU visualization team in the Center for Visualization and Analytics, a relatively new addition to the NC State Department of Computer Science. It is a visualization of an astrophysics computational model from the supernova research of Dr. John Blondin, NC State Physics department.*

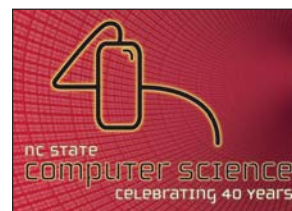
*Photo by Steve Chall & Theresa-Marie Rhyne*



## Research Highlights

NC State University's Department of Computer Science is celebrating its 40th birthday! The department was formally established in the fall of 1967 and is one of the oldest and largest computer science departments in the nation. We consistently rank among the leading producers of the computer science talent that fuels an economic engine anchored in the Research Triangle Park and extending across the globe.

2006-07 was an outstanding academic year for our department. Our faculty and students received a number of prestigious awards and recognitions, we experienced continuing significant growth in our graduate program and had a healthy 24 percent increase in research funding. We also added new and talented faculty and started several new centers.



Our research productivity again increased over the last year. We had over \$22M in active research grants. Research-related expenditures (from all sources) exceeded an estimated \$7.5M, and we received over \$4M in in-kind funding. Our research interests range from theory and algorithms to bioinformatics, high-performance and power-aware systems, artificial intelligence, graphics and visualization, networks, security, software engineering, and computer-based education. A list of

### 2006-2007

- Highlights
- Projects
- Faculty profiles

[www.csc.ncsu.edu](http://www.csc.ncsu.edu)

## Research Faculty

**Annie I. Antón, Associate Professor**

**PhD, Georgia Institute of Technology, 1997**

Software engineering, requirements engineering, information privacy and security, policy

**Kemafor Anyanwu, Assistant Professor**

**PhD, University of Georgia, 2007**

Semantic Web, databases, bioinformatics

**Dennis R. Bahler, Associate Professor**

**PhD, University of Virginia, 1987**

AI, machine learning, data mining, bioinformatics, applications to toxicology and environmental science

**Donald Bitzer, Distinguished University Research Professor, PhD, University of Illinois, 1960**

High-speed networks, satellite/land communications, computer-based education for teaching discrete math

**Franc Brglez, Research Professor**

**PhD, University of Colorado, 1970**

Scientific method and infrastructure for reliable performance evaluation of combinatorial algorithms

**Rada Y. Chirkova, Assistant Professor**

**PhD, Stanford University, 2002**

Database performance, query-processing efficiency by designing and materializing views

**Edward W. Davis, Professor**

**PhD, University of Illinois, 1972**

Computer architecture—emphasis on design and application of highly parallel computers

**Jon Doyle, SAS Professor of Computer Science**

**PhD, Massachusetts Institute of Technology, 1980**

Artificial Intelligence, mathematical and philosophical foundations, rational agents, decision making

**Rudra Dutta, Associate Professor**

**PhD, North Carolina State University, 2001**

Network design: optical, wireless sensor, mesh; future Internet design

**Robert Fomaro, Professor**

**PhD, The Pennsylvania State University, 1969**

Networks and applications of real-time embedded computer systems, wireless sensor systems

**Vincent Freeh, Associate Professor**

**PhD, University of Arizona, 1996**

Operating sys., compilers, programming languages, distributed & parallel computing, embedded systems

**Robert E. Funderlic, Professor Emeritus**

**PhD, University of Tennessee, 1970**

Scientific computing: design and implementation of algorithms for parallel computers; numerical methods

**Edward Gehringer, Associate Professor**

**PhD, Purdue University, 1979**

Hardware support for memory management, object-oriented software systems—performance studies

**Xiaohui Gu, Assistant Professor**

**PhD, University of Illinois, 2004**

Distributed and operating systems, computer networks, autonomic computing, system mining

**Khaled Harfoush, Assistant Professor**

**PhD, Boston University, 2002**

Computer networking, Internet measurements, peer-to-peer systems, routing protocols

**Christopher G. Healey, Associate Professor**

**PhD, University of British Columbia, Canada, 1996**

Computer graphics, scientific visualization perception and cognitive vision, color, texture, databases

## Highlights (cont.)

select representative projects is provided on the next page. During the past year, our faculty published over 59 refereed journal papers, 154 refereed conference and workshop papers, 2 books, and 15 book chapters and other edited works. They also produced over 60 other publications, tutorials, editorials, and news articles and made media appearances and gave over 180 professional talks related to their research and educational activities. We have 16 faculty serving as editors or on editorial boards of leading professional publications (27 functions). They also serve as members and officers in most of the prestigious professional societies and organizations in their areas of specialty.

Our graduate program continues to grow. During 2006–07, we conferred a record 18 PhD degrees; we expect more this year. We received 1,030 applications for admission to the graduate program in 2007 and estimate that the PhD enrollment will approach 150 and the overall graduate program will grow to over 430 for Fall 2007.

Our facilities house more than 30 research groups, laboratories and centers. Additions during the year include the Center for Open Software Engineering (COSE, pronounced “cozy”) under the direction of Dr. Laurie Williams, the Digital Games Research Center (DGRC) under the direction of Dr. Michael Young and NC State’s award-winning Virtual Computing Laboratory (VCL) development group, which is directed by Aaron Peeler. We celebrated the official grand opening of the Center for Visualization & Analytics (CVA), directed by Theresa-Marie Rhyne and housed in the Renaissance Computing Institute (RENCI) at NC State.

In 2006–07, faculty and students received a number of outstanding awards and accolades. Dr. Donald Bitzer was inducted into the Consumer Electronics Hall of Fame. Drs. Munindar Singh, Frank Mueller, Harry Perros, George Rouskas, Laurie Williams and Michael Young received prestigious IBM Faculty Awards. Dr. Annie Antón was appointed to serve on the Department of Homeland Security’s Data Privacy and Integrity Advisory Committee. In June, she testified at a Congressional Hearing on Social Security Number privacy held by the House Committee on Ways and Means Subcommittee on Social Security. Dr. Michael Young was named editor-in-chief of the *Journal of Game Development*. Graduate students Travis Breaux and Sarah Heckman received prestigious IBM PhD Fellowship awards, Nikhil Baradwaj and Lina Battestilli won the 2006 Pollock Best Thesis Awards, and Kristy Boyer and Laurie Jones received very prestigious NSF Graduate Research Fellowships. The Virtual Computing Laboratory was awarded the Computerworld Honors Program Laureate Medal for Technical Innovation.

We went through important personnel changes. Two of our faculty, Drs. Ed Davis and Alan Tharp (former department head), joined Dr. David McAllister in phased retirement. Dr. Robert Funderlic (emeritus, former department head), Ms. Joyce Hatch (director of Undergraduate Advising) and Ms. Carol Holloman (director of Finances) retired. Three faculty left for other venues, but remain affiliated with the department through their adjunct status: Dr. Jun Xu joined Google, Dr. Peter Wurman joined Kiva Systems, and Dr. Jaewoo Kang joined Korea University in Seoul.

We are very proud to announce that this fall two new faculty joined our department—Drs. Nagiza Samatova and Kemafor Anyanwu, and Dr. Xiaohui Gu will be joining us in January 2008. We now have 41 faculty involved in research, 16 lecturers and adjuncts, and about 25 research, information technology and administrative support staff.

I would like to take this opportunity to thank all our students, faculty and staff for making the last year a success, and our alumni for supporting us, and to wish them a wonderful new academic year.

Mladen Vouk  
Professor and Department Head

## Selected Research Projects

Complete list with abstracts is at

<http://www.csc.ncsu.edu/research/>

*HI-FIVES: Using Web-Based Gaming to Improve Student Comprehension of Information Technology in Science*, **R. Michael Young, Leonard Annetta, Deborah Mangum, Thomas Miller**. NSF (\$1,197,270, 9/1/2005–08/31/2008)

*Collaboration through Agile Software Development Practices: A Means for Improvement in Quality and Retention of IT Workers*, **Laurie Williams, Mladen Vouk, Jason Osborne, Winser Alexander, Sarah Berenson**. NSF (\$812,587, 6/15/2003–6/30/2008)

*Intelligent Human-Machine Interface and Control for Highly Automated Chemical Screening Processes*, **Robert St. Amant, David Kaber, Mo-Yuen Chow**. NSF (\$786,000, 10/1/2004–9/30/2007)

*Bayesian Pedagogical Agents for Dynamic High-Performance Inquiry-Based Science Learning Environments*, **James Lester, Hiller Spires, John Nietfeld**. NSF (\$605,436, 1/1/2007–12/31/2009)

*Collaborative Research: A Comprehensive Policy-Driven Framework for On-line Privacy Protection: Integrating IT, Human, Legal and Economic Perspectives*, **Ana Anton, Ting Yu, David Baumer, Michael Rappa**. NSF (\$534,000, 9/15/2004–8/31/2007)

*NeTS-NOSS: Exploring the Design Space of Sensor Networks Using Route-Aware MAC Protocols*, **Injong Rhee, Robert Fornaro**. NSF (\$584,999, 1/1/2005–12/31/2007)

*NSF Partnership in the Center for Advanced Computing and Communication*, **Dennis Kekas, Mladen Vouk**. CACC-NSF (\$492,240, 9/15/1999–8/31/2007)

*CAREER: Adaptive Automated Design of Stored Derived Data*, **Rada Chirkova**. NSF (\$489,810, 08/1/2005–07/31/2010)

*CAREER: New Directions in Managing Structured Peer-to-Peer Networks*, **Khaled Harfoush**. NSF (\$408,894, 3/15/2004–02/28/2009)

*CAREER: The Test-Driven Development of Secure and Reliable Software Applications*, **Laurie Williams**. NSF (\$405,889, 4/1/2004–03/31/2009)

*A Formal Approach to Traffic Grooming in Optical Networks with General Topologies*, **George Rouskas, Carla Savage, Rudra Dutta**. NSF (\$404,968, 9/1/2003–08/31/2007)

*CAREER: Transparent, Interactive Desktop Parallel Computing for Scientific Data Processing*, **Xiaosong Ma**. NSF (\$400,000, 3/1/2006–2/28/2011)

*CAREER: Exploiting Binary Rewriting to Analyze and Alleviate Memory Bottlenecks for Scientific Applications*, **Frank Mueller**. NSF (\$400,000, 6/1/2003–5/31/2008)

*CAREER: Towards Trustworthy and Resilient Sensor Networks*, **Peng Ning**. NSF (\$400,000, 7/1/2005–6/30/2010)

*Runtime/Operating System Synergy to Exploit Simultaneous Multithreading*, **Vincent Freeh, Frank Mueller**. NSF (\$380,000, 8/1/2004–7/31/2008)

*CAREER: Assisted Navigation in Large Visualization Spaces*, **Christopher Healey**. NSF (ACIR/ACR), (\$370,403, 2/1/2001–1/31/2008)

*A Bioinformatics Computing Cluster for NC State University*, **Steffen Heber**. NC Biotechnology Center (\$227,029, 2/1/2007–1/31/2008)

*CT-ER: Metamorphic Worm Detection*, **Douglas Reeves**. NSF (\$137,057, 8/15/2006–07/31/2008)

*CAREER: Managing Complexity: Fidelity Control For Optimal Usability in 3D Graphics Systems*, **Benjamin Watson**. NSF (\$59,153, 8/1/2006–1/31/2008)

*Improving Software Dependability Via Mining Properties For Software Verification*, **Tao Xie**. Army Research Office (\$50,000, 6/18/2007–3/17/2008)

*Dimensioning Access Networks Subject to Percentile End-to-End Delay SLAs*, **Harry Perros, Yannis Viniotis**. Center for Advanced Computing & Communication (\$40,000, 7/1/2007–6/30/2008)

## Faculty (cont.)

**Steffen Heber, Assistant Professor**  
PhD, Universität Heidleberg, Germany, 2001

Algorithms to compare and analyze gene order permutations, EST assembly, analysis of alternative splicing

**Thomas L. Honeycutt, Associate Professor**  
PhD, North Carolina State University, 1969

Management information systems, computer modeling and simulation, computer literacy

**S. Purushothaman Iyer, Professor**  
PhD, University of Utah, 1986

Programming and specification languages, software model-checking, probabilistic models of concurrency

**Jaewoo Kang, Assistant Professor (until Jan. 2007)**  
PhD, University of Wisconsin, 2003

Data integration, model management, query optimization, semi-structured data management, text mining

**James C. Lester, Associate Professor**  
PhD, University of Texas, 1994

Artificial intelligence, intelligent user interfaces, intelligent tutoring systems, computational linguistics

**Xiaosong Ma, Assistant Professor (joint appointment with ORNL)**, PhD, University of Illinois, 2003

High performance computing, parallel IO, storage systems, scientific data management

**Richard Mayr, Assistant Professor**  
PhD, TU-München, Germany, 1998

Formal verification, logic, automata theory, term rewriting, Markov chains, stochastic games

**David F. McAllister, Professor**  
PhD, UNC Chapel Hill, 1972

Stereo computer graphics, speech processing, online publishing, numerical analysis

**Frank Mueller, Associate Professor**  
PhD, Florida State University, 1994

Compilers and code optimization, concurrent and distributed/real-time and embedded systems

**Peng Ning, Associate Professor**  
PhD, George Mason University, 2001

Computer and network security: intrusion detection, security in sensor and ad hoc networks

**Harry Perros, Alumni Distinguished Graduate Professor, PhD, Trinity College, Ireland, 1975**

Performance analysis of optical networks, performance monitoring of grids, queueing networks

**Douglas S. Reeves, Professor**  
PhD, The Pennsylvania State University, 1987

Network security, peer-to-peer computing and overlay networks, real-time communication

**Injong Rhee, Associate Professor**  
PhD, UNC Chapel Hill, 1994

Computer/wireless/sensor networks, multimedia networking, distributed systems, operating systems

**Robert D. Rodman, Professor**  
PhD, University of California, Los Angeles, 1973

Spoken natural language dialogue and voice I/O sys., applying AI to error recovery in speech recognition

**George N. Rouskas, Professor**  
PhD, Georgia Institute of Technology, 1994

Network architectures and protocols, optical networks, grid computing, scheduling

**Nagiza Samatova, Associate Professor (joint apt. w/ORNL)**, PhD, Russian Acad. of Sci. (CCAS), 1993

Systems biology and bioinformatics, scalable data analytics, data management and data integration

## Faculty (cont.)

**Carla D. Savage, Professor**  
**PhD, University of Illinois, 1977**

Combinatorics, combinatorial algorithms, network algorithms, graph theory, discrete mathematics

**Munindar P. Singh, Professor**  
**PhD, University of Texas, 1993**

Multiagent systems, intelligent agents, agent communication languages and protocols

**Robert St. Amant, Associate Professor**  
**PhD, University of Massachusetts, Amherst, 1996**

Human-computer interaction, artificial intelligence, intelligent user interfaces, statistical expert systems

**Matthias Stallmann, Professor**  
**PhD, University of Colorado, 1982**

Algorithm design and analysis of both serial and parallel models of computation

**William J. Stewart, Professor**  
**PhD, Queen's University, Northern Ireland, 1974**

Performance evaluation of computer sys., approximate and numerical solution techniques for analysis

**Alan L. Tharp, Professor**  
**PhD, Northwestern University, 1969**

File and data structures, man-machine interfaces, database management systems

**David Thuente, Professor**  
**PhD, University of Kansas, 1974**

Communication systems, design, simulation, performance modeling; media access control protocol

**Mladen Vouk, Professor**  
**PhD, King's College, England, U.K., 1976**

Software engineering, scientific computing, computer-based education, high-perf. networks.

**Benjamin Watson, Associate Professor**  
**PhD, Georgia Institute of Technology, 1997**

Relationships between computer graphics and design

**Laurie Williams, Associate Professor**  
**PhD, University of Utah, 2000**

Software process, testing, reliability, and security; agile software development

**Peter Wurman, Associate Professor**  
**PhD, University of Michigan, 1999**

Artificial intelligence, e-commerce, market mechanisms, trading agent strategies

**Tao Xie, Assistant Professor**  
**PhD, University of Washington, 2005**

Automated software testing and verification, mining software engineering data

**Jun Xu, Assistant Professor (until Jan. 2007)**  
**PhD, University of Illinois, 2003**

Computer system security and dependability

**R. Michael Young, Associate Professor**  
**PhD, University of Pittsburgh, 1997**

AI, natural language generation, computational models of interactive narrative, computer games

**Ting Yu, Assistant Professor**  
**PhD, University of Illinois, 2003**

Security, trust management and privacy protection in open systems, semi-structured databases

NC State University  
Department of Computer Science  
Box 8206  
Raleigh, NC 27695-8206

## Senior Faculty Profiles



**Robert J. Fornaro** received his B.A. in mathematics from St. Vincent College, Latrobe, PA and his M.A. in mathematics and Ph.D. in computer science from Penn State in 1969. Fornaro joined the department in 1969 as one of its first Ph.D.s. In addition to teaching, Dr. Fornaro directed a variety of research projects involving real time operating systems and data communications. He also served for nine years as director of Undergraduate Programs. In 1994, along with Dr. Alan Tharp, he formed the Senior Design Center. Fornaro is currently a professor and director of the Senior Design Center. Local industries support the Center financially in the form of unrestricted gift contributions to the Excellence In Undergraduate Computer Science Education Fund. To-date contributions to the Center, including endowments, are well in excess of \$1M. In 2005 and 2006, Dr. Fornaro mentored award-winning project teams that took First Place in the IEEE Computer Society International Design Competition. This was the first time that students from any university in the world placed first in the competition in two consecutive years. Dr. Fornaro's current teaching and research activities focus on operating systems and application software for wireless sensor systems.



**Mladen A. Vouk** received his B.S. and Ph.D. from the King's College, University of London, U.K. and an M.S. in computer science from NC State. He joined the faculty at NC State in 1985. He became associate vice provost for Information Technology in 2002 and was appointed Computer Science department head in 2006, after serving two years as interim department head.

Dr. Vouk is known for his work in improving math and science education through computer-assisted instruction and environments, as well as his work in the areas of software reliability engineering and scientific computing. He is co-founder and former co-director of the department's first Software Engineering Laboratory, founder and former director of the NC State Multimedia and Networking Laboratories, and former technical director of the NC State Center for Advanced Computing and Communication. Dr. Vouk is an IEEE Fellow and member of the IEEE IFIP on Numerical Software (recipient of the IFIP Silver Core); the IEEE Reliability, Communications, Computer and Education societies; the IEEE TC on Software Engineering; ACM; ASQ; and Sigma Xi.

## New Faculty Profiles



**Dr. Nagiza Samatova** - August 2007. B.S. from Tashkent State University, Uzbekistan in 1991. Ph.D. in mathematics from Russian Academy of Sciences, Moscow in 1993. M.S. in computer science from University of Tennessee, Knoxville in 1998. She is also a senior research scientist at Oak Ridge National Laboratory. Research interests include systems biology and bioinformatics, scalable data analytics, data management.



**Dr. Kemafor Anyanwu** - August 2007. B.S. in biochemistry from University of Nigeria, Nsukka, Nigeria in 1989 and Ph.D. in computer science from the University of Georgia in 2007. Her research interests are semantic Web, databases and bioinformatics. Her research results have been published in the World-Wide Web conferences and other venues.



**Dr. Xiaohui Gu** - January 2008. B.S. from Peking University, Beijing, China in 1999. Ph.D. in computer science from the University of Illinois in 2004. She was a research staff member at IBM T. J. Watson Research Center 2004-2007. Research interests include all areas of computer systems, with focus on data stream processing, autonomic computing, peer-to-peer and service overlay networks.

Contributions from Steve Chall, Kristen Jeffers and Theresa-Marie Rhyne  
Edited by Ken Tate and Fay Ward  
3,000 copies of this document were printed at a cost of \$0.316 per copy.