

RESEARCH

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An artistic visualization built from simulated paint strokes showing historic weather conditions over Alaska and Canada during January (stroke color represents temperature, brightness represents wind speed, spatial density represents cloud coverage, and orientation represents rainfall)

photo: Christopher Healey



Research Highlights

As we approach our 40th anniversary in 2007, the NC State Department of Computer Science (CSC) has much to celebrate. Significant growth in our graduate program, a substantial increase in research expenditures, the addition of several new and extremely talented faculty, and a move to our new state-of-the-art home on Centennial Campus all provide our department great momentum for future success. This issue overviews some of the successes, summarizes funded research projects, and provides profiles of new faculty and two of our senior faculty.

The Department of Computer Science now has 44 faculty involved in research and a number of research staff members. Since June 2004, we have welcomed three new faculty and two new staff members. After 12 years of dedicated service, Dr. Alan Tharp stepped down as department head in June 2004. Dr. Mladen Vouk is serving as interim department head. We are conducting a national search for a new department head and hope to finalize our decision by August 2006.

The graduate program has grown significantly and now includes over 130 Ph.D. and 240 M.S., M.S. in Computer Networking and M.CS students. We received 625 applications for admission to the graduate program in 2005, with 120 new students accepting our offer to join the department.

Engineering Building II (EB2), the new Centennial Campus home of both the NC State Department of Computer Science and the Department of Electrical and Computer Engineering, is nearing completion. Classes began in EB2 in August; faculty and research lab moves should be completed early in the Spring 2006 semester. This new state-of-the-art teaching and research



EB2, the new Computer Science and Electrical and Computer Engineering Building, which opened in the Fall 2005 semester

spring 2006

- Highlights
- Projects
- Faculty profiles

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

**Dennis R. Bahler, Associate Professor
PhD, University of Virginia, 1987**

Artificial intelligence, machine learning, hybrid neural-symbolic computing

**Donald Bitzer, Distinguished University
Research Prof., PhD, Univ. of Illinois, 1960**

High-speed networks, satellite/land communications, bioinformatics, computer-based ed

**Franc Brglez, Research Professor
PhD, University of Colorado, 1970**

Distrib/collaborative workflows, databases, graph-based algorithms, signal processing

**Rada Y. Chirkova, Assistant Professor
PhD, Stanford University, 2002**

Databases, computational logic

**Edward W. Davis, Professor
PhD, University of Illinois, 1972**

Computer architecture, parallel processing

**Jon Doyle, SAS Prof. of Computer Science
PhD, Mass. Institute of Technology, 1980**

Artificial intelligence, rationality, mathematical foundations, knowledge discovery

**Rudra Dutta, Assistant Professor
PhD, North Carolina State University, 2001**

Traffic grooming, fault tolerance, optical networks, ad-hoc wireless networking

**Robert Fornaro, Professor
PhD, Pennsylvania State University, 1969**

Concurrent prog in computer graphics, robotics, signal processing, operating systems

**Vincent Freeh, Assistant Professor
PhD, University of Arizona, 1996**

Operating systems, compilers, programming languages, distributed & parallel computing

**Robert E. Funderlic, Professor
PhD, University of Tennessee, 1970**

Scientific and parallel computing, numerical methods

**Edward Gehringer, Associate Professor
PhD, Purdue University, 1979**

Object-oriented software, parallel processing

**Khaled Harfoush, Assistant Professor
PhD, Boston University, 2002**

End-to-end network diag, topologies, routing protocols, ad-hoc and peer-to-peer networks

**Christopher G. Healey, Associate Prof., PhD,
Univ. of British Columbia, Canada, 1996**

Visualization, computer graphics, perception

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

Computational biology, bioinformatics

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

MIS, modeling & simulation, computer literacy

Highlights (cont.)

facility provides CSC close to 40,000 sq. ft. of space, allowing us to consolidate most of our faculty, graduate students and research activities into three buildings: EB2 and Monteith Engineering Research Center (MRC) on Centennial Campus, and Daniels Hall on historic main campus.

Facilities house over 30 research centers and laboratories. The three most recent research support initiatives are the Center for Visualization and Analytics (CVA) under direction of Theresa-Marie Rhyne; Design Graphics Laboratory (DGL) under direction of Ben Watson, and Virtual Computing Laboratory (VCL) under direction of Aaron Peeler. CVA will function as an integrating research environment, a venue for domain experts from areas such as engineering, physics, and education to collaborate with visualization and analytics scientists on application-specific projects. It is also at the heart of our collaboration with the UNC Renaissance Computing Institute and part of the SAS analytics initiative. DGL will bring a design perspective to computer graphics research, treating digital imagery as designed artifacts and studying the depiction of man-made objects, including entire cities. VCL (<http://vcl.ncsu.edu>) is a production-level utility computing facility that, along with NC State High-Performance Computing (HPC) facilities, provides on-demand short-term and long-term computational support and virtual test-bed facilities for NC State students, faculty and research projects. VCL is a key interface to virtualization, services, and software performance research with the IBM Center for Advanced Studies, and the SAS Institute analytics initiative.

In the 2004-2005 academic year, department research expenditures exceeded \$6 million, and the total for active research grants exceeded \$19 million. Granting agencies include ARO, DARPA, DOE, DOI, NSA and NSF; as well as industry and local research centers. Current research focus is in the areas of theory and algorithms, bioinformatics, high-performance and power-aware systems, artificial intelligence, graphics and visualization, networks, security, software engineering, and computer-based education. A list of select projects is on the next page.

Our faculty and students have received many research-related awards and recognitions. The department boasts 14 current faculty who have received NSF CAREER awards. Recent winners are Dr. Khaled Harfoush, Dr. Laurie Williams, Dr. Peng Ning, and Dr. Rada Chirkova. Dr. Xiaosong Ma received the prestigious DOE Early Career Primary Investigator Award. Dr. Perros, now Alumni Distinguished Graduate Professor, was chosen to serve on the National LambdaRail (NLR) Networking Research Council. Dr. George Rouskas received the Alcoa Foundation Engineering Research Award. Dr. Annie Antón has become a member of the NSF CISE (Computer & Information Science & Engineering) Advisory Committee, and Dr. Laurie Williams is co-director of the NC State e-commerce initiative. Dr. Anton was presented the "Women of Influence" award by the Executive Women's Forum. Our faculty were instrumental in getting NC State University re-designated a Center of Academic Excellence in Information Assurance Education by the National Security Agency (NSA). Our students have also been very successful. Dr. Laura Jackson received the 2004 Nancy G. Pollock PhD Dissertation Award for the College of Engineering. One of our undergraduate Senior Design teams (directed by Dr. Robert Fornaro and Ms. Margaret Heil) won first place in the 2005 IEEE CS International Design Competition. Their project combined GPS and wireless sensor technologies to track endangered animals in the wild. They were the first U.S. team to win this competition. Our graduate students have been awarded significant scholarships and research fellowships from corporate partners such as Cisco, IBM, Microsoft, and GlaxoSmithKline.

Mladen Vouk

Professor and Interim Department Head

Selected Research Projects

The following is a representative list of active research projects. A complete list with abstracts is viewable at

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

HI-FIVES: Using Web-Based Gaming to Improve Student Comprehension of Information Technology in Science; **Leonard Annetta, Deborah Mangum, R. Michael Young, Thomas Miller.** NSF (\$1,197,270, 9/1/2005–8/31/2008)

Tracing Attacks Through Non-Cooperative Networks and Stepping Stones with Timing-Based Watermarking, **Douglas Reeves, Peng Ning.** US Department of Interior. (\$1,179,321, 9/29/2003–11/30/2006)

Center for Scientific Data Management-Agent Technology Enabling Communication Among Tools and Data, **Mladen Vouk.** U.S. Department of Energy (\$906,987, 8/15/2001–8/14/2006)

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.** NSF (\$693,859, 6/15/2003–6/30/2007)

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

Collaborative Research: A Comprehensive Policy-Driven Framework for Online 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)

CAREER: Adaptive Automated Design of Stored Derived Data, **Rada Chirkova.** NSF (\$489,810, 8/1/2005–7/31/2010)

CAREER: Plan-Based Integration of Control and Coherence in Intelligent Exploratory Environments, **R. Michael Young.** NSF (\$480,695, 3/15/2001–2/28/2006)

ITR: Integrating Intrusion Detection with Intelligent Visualization and Interaction Strategies; **Peng Ning, Christopher Healey, Robert St. Amant.** NSF (\$415,099, 8/15/2002–8/31/2006)

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, 4/1/2004–3/31/2009)

A Formal Approach to Traffic Grooming in Optical Networks with General Topologies; **George Rouskas, Carla Savage, Rudra Dutta.** NSF (\$404,968, 9/1/2003–8/31/2007)

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)

Comparative and Web-Enabled Virtual Screening; **Robert Funderlic, Jacqueline Hughes-Oliver, Gary Howell, Morteza Khaledi.** NIH (\$385,126, 9/23/2005–7/31/2007)

Runtime/Operating System Synergy to Exploit Simultaneous Multithreading, **Vincent Freeh and Frank Mueller.** NSF (\$380,000, 8/1/2004–7/31/2007)

Principles of Commitment Protocols, **Munindar Singh.** NSF (\$345,000, 5/15/2002–4/30/2006)

CAREER: Automated Synthesis of Bidding Strategies for Trading Agents, **Peter Wurman.** NSF (\$300,010, 8/1/2001–7/31/2006)

Runtime Data Management for Data-Intensive Scientific Applications, **Xiaosong Ma.** U.S. Department of Energy (\$299,992, 8/15/2005–8/14/2008)

Faculty (cont.)

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

Formal methods—distributed and embedded systems, progr. languages, concurrency theory

Jaewoo Kang, Assistant Professor
PhD, University of Wisconsin, 2003

Data mining, query optimization, data integration

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

Artificial intell., multimedia, knowledge-based learning environments, computational linguistics

Xiaosong Ma, Assistant Professor
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, tableau systems

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

Computer graphics, speech processing

Frank Mueller, Assistant Professor
PhD, Florida State University, 1994

Compilers, concurrent, distributed, real-time, & embedded systems, sensor network systems

Peng Ning, Assistant Professor
PhD, George Mason University, 2001

Network security, intrusion detection, cryptography, temporal databases, data mining

Harry Perros, Alumni Distinguished Graduate Prof., PhD, Trinity College, Ireland, 1975

High-speed communication. systems, queuing theory, simulation, numerical analysis

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

Network security, protocols, and peer-to-peer computing

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

Computer networks, internet protocol design, congestion control, multimedia networking

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

Forensic speaker identification, automatic emotion detection, lip synchronization

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

Network architectures and protocols, optical networks, performance evaluation

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

Algorithms, combinatorics, discrete mathematics

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

Multiagent systems, trust, service-oriented computing

Faculty (cont.)

Robert St. Amant, Associate Professor
PhD, Univ of Massachusetts, Amherst, 1996
HCI, artificial intelligence, intelligent user interfaces, statistical expert systems

Matthias Stallmann, Associate Professor
PhD, University of Colorado, 1982
Experimental algorithmics, combinatorial optimization, NP-hard problems, graph algorithms

William J. Stewart, Professor, PhD, Queen's University, Northern Ireland, 1974
Perf analysis, queuing networks, linear algebra, operating sys, parallel architectures

Alan L. Tharp, Professor
PhD, Northwestern University, 1969
File structures, man-machine interfaces, databases

David Thuente, Professor
PhD, University of Kansas, 1974
Communication system design, simulation, performance modeling, media access control

Mladen Vouk, Professor
PhD, King's College, England, U.K., 1976
Software engineering, scientific computing, high-perf netwks, computer-based education

Benjamin Watson, Associate Professor
PhD, Georgia Institute of Technology, 1997
Computer graphics, design, interaction

Laurie Williams, Assistant Professor
PhD, University of Utah, 2000
Collaborative/pair programming, software dev, e-commerce, agile software, software testing

Peter Wurman, Associate Professor
PhD, University of Michigan, 1999
Artificial intelligence, e-commerce, auctions

Tao Xie, Assistant Professor
PhD, University of Washington, 2005
Software testing, verification, reuse

Jun Xu, Assistant Professor
PhD, University of Illinois, 2003
Computer security and reliability

R. Michael Young, Assistant Professor
PhD, University of Pittsburgh, 1997
Artificial intelligence, planning, natural language processing, interactive narrative

Ting Yu, Assistant Professor
PhD, University of Illinois, 2003
Security, trust management, privacy protection

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

Faculty advisor—Christopher Healey
Edited by Ken Tate and Fay Ward

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Senior Faculty Profiles



Dr. William J. Stewart received his undergraduate degree in Applied and Pure Mathematics at The Queen's University of Belfast, Northern Ireland in 1970. M.Sc. in 1971 and Ph.D. in 1974. Dr. Stewart spent five years as a Research Associate at the Université de Rennes in France before coming to NC State in 1978.

For more than 30 years, he has been at the forefront of research into all aspects of generating, solving and analyzing Markov chains. In 2006, he will host an international conference to honor the 150th anniversary of Markov's birth and the 100th anniversary of the publication of Markov's seminal papers on chains. Dr. Stewart's software package, *MARCA: Markov Chain Analyzer*, assists scientists and engineers in developing and solving large scale Markov models. His text, *An Introduction to the Numerical Solution of Markov Chains*, is the primary reference work for solving Markov chains numerically.



Dr. Alan L. Tharp received a B.S. in Science Engineering from Northwestern University. His work as a research chemist at Monsanto led him to appreciate the vast opportunities in computer science. He returned to Northwestern for his M.S. and Ph.D. in Computer Science. Prior to joining NCSU in 1969, he worked with Texas Instruments and Aerospace Corporation. During several summers while at NCSU, he worked with Data General (new EMC). Dr. Tharp served as interim, then department head from July 1992–June 2004. During that period, 29

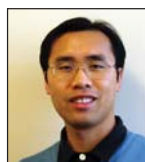
tenure-track faculty were recruited (17 of them received the NSF CAREER development award); the department established an active Strategic Advisory Board, Senior Design Center, Corporate Education Program, and ePartners Program.

Dr. Tharp's research interests include data and file structures for new technologies, and computer-user interfaces. He received the NCSU Alumni Association's Distinguished Undergraduate Professorship Award in 1985. He has been associated with computer science accreditation for nearly 20 years. He is currently an ABET/CAC (Computing Accreditation) commissioner.

New Faculty Profiles



Dr. Richard Mayr - August 2004. Master's and Ph.D. from Technische Universität München, Germany—1994 and 1998. Postdoc Fellowships at Université Paris 7 and Edinburgh University. Assistant Professor at Universität Freiburg, Germany. His research interests include formal verification, logic, automata theory, term rewriting, tableau systems, and exotic computing devices at borders of decidability.



Dr. Tao Xie - August 2005. B.S. from Fudan University in Shanghai, China in 1997; M.S. from Peking University in Beijing, China in 2000; and M.S. and Ph.D. from the University of Washington in 2002 and 2005. His research interests include software engineering with emphasis on software reliability and dependability.



Dr. Benjamin Watson - January 2006. B.S. from University of California—Irvine in 1987, Ph.D. from Georgia Institute of Technology in 1997. Assistant Professor at University of Alberta in Edmonton, Canada, and Northwestern University in Evanston, Illinois. His research examines the intersection between design and computer graphics and spans perception, interaction, visualization and computer games.