NC STATE UNIVERSITY

computer science
R E S E A R C H

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Healthcare IT is a national priority. However, healthcare IT presents challenges as the software must be secure, privacy-preserving, reliable, and interoperable. **Dr. Laurie Williams,** *associate professor of computer science, is director of the center for* **Open Software Engineering (COSE),** *an organization at the NC State Computer Science Department that performs basic research, education and outreach to enable software technology gains and to bridge the gap between the state of the art and the state of the practice of software engineering in interdisciplinary application areas. COSE does this by understanding the needs of domain practitioners and by formulating, implementing and validating effective software-intensive solutions. Its current primary domain of study is healthcare IT.*

In June, **Williams** *coordinated the* **NC State Healthcare Information Technology (IT) Business Forum.** *The department hosted* **Congressman Bob Etheridge** *(D-Lillington), the only North Carolina member on the House Ways and Means Committee. The forum also included presentations from members of the medical community and others involved in research and development of solutions to healthcare IT issues.*

Leading the way in healthcare IT research, just another example of how the NC State Department of Computer Science is providing socially relevant solutions that address real-world problems.

2008–2009

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www.csc.ncsu.edu

Research Highlights

The NC State University Department of Computer Science, one of the oldest and largest computer science departments in the nation, is a leader in innovative research to address real-world needs, and we've had a busy and productive year. The department's research efforts were recognized nationally when the Computerworld Honors Program named NC State University a 2009 Laureate in the education category for its VCL-based Cloud Computing Services case study. This was the second time NC State has received this national recognition. The university was honored as a 2007 Laureate in the education category for its Virtual Computing Laboratory (VCL) project.

The department's research productivity continues to grow with annual research expenditures in the range of $8 to $9 million, and we now have more than $30 million in active research grants. This ranks us well within the top 20 for sponsored research funding among computer science departments in colleges of engineering. Faculty research interests range from theory and algorithms, bioinformatics, high-performance and power-aware systems, to advanced analytics research, to artificial intelligence, serious games, graphics and visualization, networks, security, software engineering, and computer-based education. Please see the list of select representative research projects that appear on page three of this newsletter.

In the 2008-2009 academic year, faculty as a group published 51 refereed journal papers, 165 refereed conference and workshop papers, four books and seven book chapters and other edited works. They also produced over 102 other publications, tutorials, editorials, news articles, or media appearances. Over the academic year, faculty gave over 112 professional talks related to their research and educational activities. Seventeen of our faculty serve as editors, and on editorial boards of leading professional publications (44 functions), and as members and officers in the most prestigious professional societies and organizations in their areas of specialty.

Research Faculty

Annie I. Antón, 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 computing: semantic Web, databases, data mining, information retrieval, services computing

Dennis R. Bahler, Associate Professor
PhD, University of Virginia, 1987
AI: constraint processing, machine learning, hybrid neural-symbolic computing

Donald Bitzer, Distinguished University Research Professor, PhD, University of Illinois, 1960
Convolutional codes, signal processing for biological systems, computer-based education

Franc Brglez, Research Professor
PhD, University of Colorado, 1970
Distributed and collaborative workflows, databases, and groupware for the Internet

Rada Y. Chirkova, Associate Professor
PhD, Stanford University, 2002
Database performance, query-processing efficiency by designing and materializing views

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 and mesh networks; future Internet design

Robert Fornaro, 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

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 systems, operating systems, computer networks

Khaled Harfoush, Associate 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
Visualization & computer graphics: methods for rapidly, accurately, effectively visualizing lg. complex datasets

Steffen Heber, Assistant Professor
PhD, Universität Heidleberg, Germany, 2001
Algorithms to compare and analyze gene order permutations, animation dev. for bioinformatics education

Thomas L. Honeycutt, Associate Professor
PhD, North Carolina State University, 1969
Management information systems, computer modeling and simulation, computer literacy

Highlights (cont.)

Undergraduate enrollment increased in the fall of 2008, and again in the fall of 2009, for the first time in several years, and the number of females increased slightly, which can be attributed to an increased focus on outreach efforts. A concentration in game development was added to the undergraduate curriculum. Despite the downturn in the nation's economy, demand for our undergraduates continues to be very strong, and the average annual starting salary for our undergraduates increased this year to over $56,000.

Our graduate program continues to grow with an overall enrollment of over 494 students. Applications for admission to the graduate program for fall 2009 are up 12% over last year. Applications for the PhD program alone are up 25% over fall 2008. In 2008-2009 we awarded 160 masters (25 with thesis), and 21 PhD degrees, a rate in line with that in the top 30 computer science departments in the nation. At the fall 2008 diploma ceremony, we awarded the largest number of advanced degrees ever by the department in a single ceremony.

Our facilities house more than 30 research groups, laboratories and centers, and our faculty play an integral role in the University's new Institute for Advanced Analytics, which opened in 2007. In 2008 we were one of the first in the country to receive the National Security Agency's National Center of Academic Excellence in Information Assurance Research (CAE-R) designation.

In 2008-2009 our faculty received a number of prestigious awards and honors: Dr. Munindar Singh became the department's 4th IEEE Fellow, Drs. Ting Yu and Tao Xie became the department's 18th and 19th NSF CAREER Award winners; nine faculty including Drs. Kemafor Anyanwu, Rada Chirkova, Patrick Dreher, Helen Gu, Christopher Healey, Xiaosong Ma, Mladen Vouk, Laurie Williams, and Tao Xie received 2009 IBM Faculty Awards totaling $267,000; Dr. R. Michael Young was named an Outstanding Extension Service Award recipient for the college of engineering (the first from the department of computer science), and was also inducted into the Academy of Outstanding Faculty Engaged in Extension; Dr. Robert Rodman was elected to the American Academy of Forensic Sciences (AAFS) as an associate member in the Engineering Sciences section; Dr. Laurie Williams won the first ever Association for Computing Machinery (ACM) 2009 SIGSOFT Influential Educator Award; and Dr. Annie Antón, in addition to being re-elected to a three-year term on the Computing Research Association (CRA) Board of Directors, has been named one of ten distinguished academics to the non-resident Fellows Program for the Center for Democracy & Technology.

Our students were recognized as well: graduate students Sarah Heckman, Travis Breaux and Brian Bouterse were awarded prestigious IBM PhD Fellowship Awards; doctoral student Chris Zimmer received the "Best Presentation Award" for his talk and paper at the FREEDM Systems Center Annual Conference in May; sophomore Kamar Galloway was selected to attend the 2009 Google Computer Science Summer Institute; and senior Bellanov Apilli was selected to participate in the Distributed Research Experiences for Undergraduates program. Apilli was also chosen to participate in the ACM's Student Research Competition at the 2009 Richard Tapia Celebration of Diversity in Computing Conference.

The department experienced several faculty changes during the year. We welcomed research scientist Dr. Brad Mott in December 2008. Dr. Edward Davis completed his phased retirement period in June 2009 and has been named Professor Emeritus. After 24 years of service, Carol Miller retired at the end of the 2008-2009 academic year. Dr. Thomas Honeycutt has entered into a 3-year phased retirement, and Dr. Purush Iyer, who was on a leave of absence with the US Army Research Office, has taken a permanent position there. We now have 40 tenure/tenure-track faculty, 10 lecturers and adjuncts, and about 26 research, development, information technology and administrative staff.

Finally, the department mourns the death of Dr. Robert E. Funderlic, Professor Emeritus, former department head (1986-1992), and well recognized numerical analysis researcher. Dr. Funderlic provided critical leadership during the formative years of the department, and he laid the foundations of the department we know today. He will be greatly missed.

Mladen Vouk
Professor and Department Head

Selected Research Projects

Complete list with abstracts is at http://www.csc.ncsu.edu/research/

Secure Open Systems Initiative, **Dennis Kekas, Peng Ning, Mladen Vouk, Rudra Dutta. $3,336,000 by Army Research Office**

NOAA Interdisciplinary Scientific Environmental Technology (ISET) Cooperative Research and Education Center, **Vince Freeh (Co-PI), Fredrick Semazzi (PI), Lian Xie, Jingpu Liu. $978,528 by NC A & T State University via the National Oceanic & Atmospheric Administration**

ITR: Encoding Rights, Permissions, and Obligations: Privacy Policy Specification and Compliance, **Annie Antón, Julie Earp, Lynda Aiman-Smith, David Baumer. $932,000 by the National Science Foundation**

Major: The Narrative Theatre - A Creativity Enhancement Environment, **James Lester, Hiller Spires. $804,868 by the National Science Foundation**

CAREER: Adaptive Automated Design of Stored Derived Data, **Rada Chirkova. $489,810 by the National Science Foundation**

CAREER: Trust and Privacy Management for Online Social Networks, **Ting Yu. $450,000 by the National Science Foundation**

CAREER: Cooperative Developer Testing with Test Intentions, **Tao Xie. $425,000 by the National Science Foundation**

CAREER: The Test-Driven Development of Secure and Reliable Software Applications, **Laurie Williams. $413,764 by the National Science Foundation**

CAREER: New Directions in Managing Structured Peer-to-Peer Networks, **Khaled Harfoush. $408,894 by the National Science Foundation**

CT-ISG: Understanding Botnet C&C Communication Protocols, **Xuxian Jiang. $400,000 by the National Science Foundation**

CAREER: Transparent, Interactive Desktop Parallel Computing for Scientific Data Processing, **Xiaosong Ma. $400,000 by the National Science Foundation**

CAREER: Exploiting Binary Rewriting to Analyze and Alleviate Memory Bottlenecks for Scientific Applications, **Frank Mueller. $400,000 by the National Science Foundation**

CAREER: Towards Trustworthy and Resilient Sensor Networks, **Peng Ning. $400,000 by the National Science Foundation**

Toward Cognitive Habile Agents, **Robert St. Amant. $375,266 by the National Science Foundation**

CPATH CB: Computing Across Curricula, **George Rouskas, Lisa Bullard, Jeffrey Joines, Lawrence Silverberg, Eric Wiebe. $274,749 by the National Science Foundation**

REU Site: Design Tech: Sparking Research in Interactive Visual Design, **Benjamin Watson, Christopher Healey, R. Michael Young, Patrick Fitzgerald. $268,763 by the National Science Foundation**

CT-ISG: The Origin of the Code: Automated Identification of Common Characteristics in Malware, **Doug Reeves. $268,510 by the National Science Foundation**

Joint Faculty Agreement, **Nagiza Samatova. $238,125 by Oak Ridge National Laboratories - UT Battelle, LLC**

Policy-Based Governance for the OOI Cyberinfrastructure, **Munindar Singh. $163,386 by the University of California-San Diego**

Centennial Outdoor Wireless Mesh Network Testbed For Research and Education (CentMesh), **Rudra Dutta, Mihail Sichitiu. $149,960 by the Army Research Office (US Dept of Defense)**

Formal Models of Belief Change in Cultural Context, **Jon Doyle. $83,377 by MIT**

Enhancing Bioinformatics Education, **Steffen Heber. $80,146 by the North Carolina Biotechnology Center**

Enumeration and Structure in Combinatorial Families Defined By Linear Inequalities, **Carla Savage. $77,186 by the National Security Agency (DOD)**

Research Faculty (cont.)

S. Purushothaman Iyer, Professor
PhD, University of Utah, 1986
Programming and specification languages; software model-checking, probabilistic models of concurrency

Xuxian Jiang, Assistant Professor
PhD, Purdue University, 2006
Virtual machines and security

James C. Lester, Professor
PhD, University of Texas, 1994
Artificial intelligence, intelligent user interfaces, intelligent tutoring systems, computational linguistics

Xiaosong Ma, Associate Professor (joint appointment with ORNL), PhD, University of Illinois, 2003
High performance computing, parallel I/O, storage systems, scientific data management

Brad Mott, Research Scientist
PhD, NC State University, 2006
Artificial intelligence, game-based learning environments, computational models of interactive narrative

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: new techniques for building trustworthy systems and wireless security

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
Internet protocols, multimedia computing and networking, information security, computer org.

Injong Rhee, 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
Computational forensic linguistics, 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
Graph theory & algorithms, bioinformatics, systems biology, data management, data integration

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, service oriented computing, agent 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

Senior Faculty Profiles

Dr. George N. Rouskas, professor of Computer Science, has research interests including network architectures and protocols, optical networks, grid computing, and scheduling. He received his PhD and MS degrees in Computer Science from the Georgia Institute of Technology in 1994 and 1991, respectively, and his undergraduate degree in Computer Engineering from the National Technical University of Athens (NTUA), Athens, Greece, in 1989. Dr. Rouskas maintains an active and well-funded research program in computer networking, and has created several computer science courses and taught thousands of students. During the 2000-2001 academic year he spent a sabbatical term at Vitesse Semiconductor, Morrisville, NC, and in May 2000, December 2002, and July 2006 he was an Invited Professor at the Laboratoire de Méthodes Informatiques, University of Evry, France. He has received many awards including the 2004 ALCOA Foundation Engineering Research Achievement Award, the 2003 NCSU Alumni Outstanding Research Award, a 1997 NSF Faculty Early Career Development (CAREER) Award, and the 1994 Graduate Research Assistant Award from the College of Computing, Georgia Tech. He is a co-author of three papers that received Best Paper Awards at the 1998 SPIE conference on All-Optical Networking, the 2006 CSNDSP conference, and the 2007 IEEE/IFIP EVGM workshop. Dr. Rouskas is especially proud of his teaching awards, including his induction in the NCSU Academy of Outstanding Teachers in 2004, and the Computer Science Department Outstanding New Teacher Award in 1995. Dr. Rouskas founded and serves as co-editor-in-chief of Optical Switching and Networking (OSN), an Elsevier journal, and has served on the editorial boards of several other journals. He also served as the founding director of the Masters of Science in Computer Networking (MSCN) degree program at NC State. He is a senior member of the IEEE, a member of the ACM, and a member of the Technical Chamber of Greece.

Dr. Munindar Singh obtained a B.Tech. in Computer Science and Engineering from the Indian Institute of Technology, Delhi in 1986 and his MS and PhD degrees from the University of Texas at Austin in 1988 and 1993, respectively. From 1989-1995, he was with the Microelectronics and Computer Technology Corporation (MCC). He joined the department in 1995, and currently serves as a professor of Computer Science. His research interests include multiagent systems and service-oriented computing, wherein he addresses the challenges of trust, service discovery, and business processes and protocols in large-scale open environments. Dr. Singh is a recognized authority on multiagent systems, and is best known for his research into agent interaction protocols, agent-based engineering, and large-scale information systems. During his career he has received many honors including being named an IEEE Fellow in 2009. In 2007 he received the Intel Research Council Faculty Award; IBM Partnership Awards in 1996, 1997, 1998, 2000 and 2007; a Cisco University Research Award in 2001; and a National Science Foundation CAREER Award in 1996. Dr. Singh is widely published -- over 250 articles, including 35 IEEE Internet Computing columns. His book "Multiagent Systems," was published by Springer-Verlag in 1994, and he co-authored a text, "Service-Oriented Computing" published by Wiley in 2005. Dr. Singh was the editor-in-chief of IEEE Internet Computing from 1999 to 2002, and a founding member of the editorial boards of IEEE Internet Computing, Journal of Autonomous Agents and Multiagent Systems, Journal of Web Semantics, and Service-Oriented Computing and Applications. Previously, he served on the founding steering committee for the IEEE Transactions on Mobile Computing. He serves on the founding board of directors of IFAAMAS, the International Foundation for Autonomous Agents and MultiAgent Systems. He was general cochair of the 2005 International Conference on Autonomous Agents and MultiAgent Systems and a program cochair of the 2008 IEEE International Conference on Web Services.

New Faculty Profile

Dr. Brad Mott joined the faculty in December, 2008. Dr. Mott received his BS, MCS, and PhD in Computer Science from NC State. Mott serves as the lead architect for Crystal Island, a learning environment project that was first launched as part of his dissertation research in 2005. As the original developer of Crystal Island, he designed and developed the first version of the system. He oversees all R&D activities for our National Science Foundation (NSF)-funded project on intelligent game-based learning environments.