

RESEARCH



Imagine a team of humans, dogs, robots and drones swooping onto the scene in the aftermath of a disaster and working together to find and rescue anyone trapped in collapsed buildings. That's the goal of a team of researchers from around the US working on what they call the Smart Emergency Response System (SERS).

NC State researchers, Drs. David Roberts (pictured here with Diesel) and Alper Bozkurt, have developed a high-tech dog harness equipped with sensors and other devices that will make dogs more effective at collecting information and incorporate the dogs into the larger network of coordinated disaster response.

The harness includes new sensors developed by Bozkurt and Roberts that monitor a dog's behavior and physiology, such as heart rate. These sensors will allow both dog handlers and the emergency response command center to remotely track a dog's well-being and to determine if the animal has picked up a scent or found a specific object or area of interest.

Communication technologies on the harness will allow handlers to relay commands to a dog remotely. Bozkurt and Roberts have incorporated audio communication, via speakers, into the vest. However, they think the more reliable remote communication will come via "tactile inputs" – they're training dogs to respond to gentle "nudges" that come from within the electronic harness itself. "I want to be clear that these are not aversive punishments, but slight, tactile nudges from motors in the vest – like a vibrating cell phone. We're using exclusively reward-based training techniques," Roberts says.

Bozkurt, Roberts and the rest of the SERS team participated in the Smart America Challenge event in Washington, D.C., this summer.



Dogs, Technology and the Future of Disaster Response

Research Highlights

Welcome to another issue of *Research*, our annual synopsis of the status of research in the NC State Computer Science Department. Research is crucial to the success of our department, and we are pleased to report that research productivity continues to grow, with annual expenditures reaching a record of more than \$14M. And, we currently have more than \$53M in active research grants. This ranks us in the top ten departments for sponsored research funding among computer science departments in colleges of engineering in the United States. Some research highlights are below (A list of select representative research projects appears on page three of this newsletter.):

- NC State is partnering with the National Security Agency (NSA) to create the **Laboratory for Analytic Sciences (LAS)**. The \$60 million lab will bring together some of the brightest minds from government, academia and industry to address the most challenging big-data problems; Additionally, the NSA funding for the **Science of Security Lablet (SoSL)** has been extended three years;
- NC State is one of three Triangle universities that have received cybersecurity research awards totaling \$3 million from the National Science Foundation (NSF). NC State will be working with Duke University and UNC-Chapel Hill to develop new solutions to bolster the security of our digital infrastructure;
- **Dr. James Lester** and other researchers in the Computer Science Department are developing interactive software aimed at helping teens reduce alcohol use and the risks associated with drinking alcohol;
- **Dr. Nagiza Samatova** is one of nine faculty members in six departments spanning three colleges that are involved in a five-year, \$25 million grant by the National Nuclear Security Administration's (NNSA) Office of Defense Nuclear Non-proliferation Research and Development. The goal of the project is to develop the next generation of leaders with practical experience in technical fields related to nuclear nonproliferation;
- **Dr. William Enck** and other researchers have developed a modification to the core Android operating system that allows developers and users to take advantage of new security tools.

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2013–2014

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www.csc.ncsu.edu

Research Faculty

Randy Avent, Professor

PhD, University of North Carolina, 1986

Defense analytics, dealing with unstructured and semi-structured data mining and exploitation

Dennis R. Bahler, Associate Professor

PhD, University of Virginia, 1987

Artificial intelligence: constraint processing, machine learning, hybrid neural-symbolic computing

Tiffany Barnes, Associate Professor

PhD, North Carolina State University, 2003

Educational data mining, serious games for education, health and energy, broadening computing participation

Lina Battestilli, Teaching Assistant Professor

PhD, North Carolina State University, 2005

Computer science education, cloud computing and datacenter networks, networking architecture

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

Convolutional codes, signal processing for biological systems, computer-based education

Kristy Boyer, Assistant Professor

PhD, North Carolina State University, 2010

Artificial intelligence, computational linguistics, intelligent tutoring systems, computer science education

Franc Brglez, Visiting Research Professor

PhD, University of Colorado, 1970

Distributed and collaborative workflows, databases, and groupware for the Internet

Min Chi, Assistant Professor

PhD, University of Pittsburgh, 2009

Machine learning, artificial intelligence, cognitive science and learning science

Rada Y. Chirkova, Associate Professor

PhD, Stanford University, 2002

Database performance, query-processing efficiency, data sciences

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, Professor

PhD, North Carolina State University, 2001

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

William Enck, Assistant Professor

PhD, The Pennsylvania State University, 2011

Systems security, mobile operating systems security

Vincent Freeh, Associate Professor

PhD, University of Arizona, 1996

Operating systems, compilers, programming languages, storage

Edward Gehringer, Associate Professor

PhD, Purdue University, 1979

Memory management, object-oriented software systems, computer-aided education

Xiaohui (Helen) Gu, Associate 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, Professor

PhD, University of British Columbia, Canada, 1996

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

Steffen Heber, Associate Professor

PhD, Universität Heidelberg, Germany, 2001

Algorithms to compare and analyze gene order permutations, animation dev. for bioinformatics education

Highlights (cont.)

This fall we welcomed four new faculty: **Dr. Tim Menzies**, professor of computer science, whose area of specialty is software engineering; **Dr. Chris Parnin**, assistant professor, whose specialty is also software engineering; **Dr. Xipeng Shen**, associate professor in the Chancellor's Faculty Excellence Data Driven Sciences Cluster, whose area of specialty is systems and extreme-scale data-intensive computing; and **Dr. Ranga Raju Vatsavai**, associate professor in the Chancellor's Faculty Excellence Geospatial Analytics Cluster, and Associate Director for Computational Methods in the new NC State Center for Geospatial Analytics. Vatsavai's areas of specialty are advanced data sciences and geospatial analytics.

Our faculty continue to represent the department well with their involvement in prestigious professional events, and by publishing papers in flagship journals and conferences. Many serve in various professional roles at the university, state, and national levels. A number have received prestigious awards and professional recognitions in 2013-2014: **Dr. Douglas Reeves** was named Interim Assistant Dean for the College of Engineering Graduate Program; **Dr. George Rouskas** was named Director of Graduate Programs for the Computer Science Department; **Dr. James Lester** was elected Fellow of the Association for the Advancement of Artificial Intelligence (AAAI); **Dr. Michael Young** was awarded Senior Member Status of the AAAI. He was also named a 2013 Distinguished Scientist by the Association for Computing Machinery (ACM); **Dr. Mladen Vouk** received the 2013 MCNC Robyn Render Endeavor Award; **Dr. Nagiza Samatova** received a 2013 Distinguished Contributions to Public Service in a Pre-College Environment Award from the IEEE Computer Society; **Dr. Blair Sullivan** was named a 2014 National Consortium for Data Sciences (NCDS) Data Science Faculty Fellow; **Dr. Laurie Williams** was named a 2013-2014 NC State University Faculty Fellow; and **Drs. Rada Chirkova, Vince Freeh, David Thunte, Mladen Vouk** and **Mr. John Streck** all received prestigious IBM Faculty Awards.

Educating our students and preparing them to succeed professionally is another key component of the department's mission. In fall 2013, we enrolled 1,515 students – 895 undergraduates and 620 graduate students (182 PhDs). In 2013-2014 we awarded 161 undergraduate degrees, and 212 graduate degrees. Demand for our graduates continues to be extremely high with many receiving multiple job offers. Starting salaries for those graduating with a BS degree averaged \$64K. Students graduating with an MS or PhD fared well too – the average starting salary for our master's degree students was \$94K, while starting salaries for our PhD students was closer to \$120K. Our students began employment with companies like **Amazon, IBM, Cisco, Microsoft, EMC, SAS** and **NetApp**.

The Computer Science Department and students received numerous awards and honors this year: the Engineering Online Computer Science and Networking program at NC State has been ranked fourth nationally in the *US News and World Report's* 2014 list of the Best Online Graduate Computer Information Technology programs; Engineering Online was ranked ninth nationally on the magazine's list of the Best Online Graduate Programs; NC State's Video Game Design Program has been recognized as one of the Top 25 Undergraduate Schools to Study Game Design for 2014 in the US and Canada on The Princeton Review's Top Schools to Study Video Game Design for 2014 list. (This is the fourth consecutive year that NC State's program has been recognized.); PhD student **Sean Mealin** was selected to receive a prestigious and highly competitive NSF Graduate Research Fellowship; **Zhe Zhang** was awarded the IBM PhD Fellowship Award for the third consecutive year; **Pat Morrison** was awarded an IBM PhD Fellowship Award for the second year; and **Andy Smith** was awarded a Presidential Service Award for Volunteerism (Gold Level) for his work with the STARS Leadership Corps.

Finally, we are especially grateful for the generous financial support from our alumni, friends and corporate partners (~\$800K in total unrestricted cash contributions from all sources.) This unrestricted funding allows the department to continue to grow in emerging areas of computer science while providing the highest quality educational experience for our students.

Mladen A. 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. \$5,644,306 by Army Research Office.

Growing The Science of Security Through Analytics, Laurie Williams, Munindar Singh. \$2,255,237 by National Security Agency via US Department of Defense.

Collaborative Research: Understanding Climate Change: A Data Driven Approach, Nagiza Samatova, Frederick Semazzi. \$1,815,739 by National Science Foundation.

ENGAGE: Immersive Game-Based Learning for Middle Grade Computational Fluency, James Lester, Kristy Boyer, Bradford Mott, Eric Wiebe. \$1,047,996 by National Science Foundation.

Collaborative Research: Research in Student Peer Review: A Cooperative Web-Services Approach, Edward Gehringer. \$1,034,166 by National Science Foundation.

CPS: Synergy: Integrated Sensing and Control Algorithms for Computer-Assisted Training (Computer-Assisted Training Systems (CATS) for Dogs, David Roberts, Alper Bozkurt (ECE), Barbara Sherman (CVM). \$999,103 by National Science Foundation.

Collaborative Research: A Self-Adaptive Personalized Behavior Change System for Adolescent Preventive Healthcare, James Lester. \$952,818 by National Science Foundation.

Co-Design of Hardware/Software for Predicting MAV Aerodynamics, Frank Mueller. \$799,999 by Virginia Polytechnic Institute and State University (US Air Force).

Scalable Data Management, Analysis, and Visualization (SDAV) Institute, Nagiza Samatova, Anatoli Melechko. \$750,000 by US Department of Energy.

TWC: Frontier: Collaborative: Rethinking Security in the Era of Cloud Computing, Mladen Vouk, Peng Ning. \$749,996 by National Science Foundation.

NeTS: Large: Collaborative Research: Network Innovation Through Choice, Rudra Dutta, George Rouskas. \$643,917 by National Science Foundation.

Educational Data Mining for Individualized Instruction in STEM Learning Environments, Min Chi, Tiffany Barnes. \$639,401 by National Science Foundation.

Comprehension-Driven Program Analysis (CPA) for Malware Detection in Android Phones, Xuxian Jiang. \$556,488 by Iowa State University/US Air Force-Research Laboratory.

CAREER: Expanding Developers' Usage of Software Tools by Enabling Social Learning, Emerson Murphy-Hill. \$495,721 by National Science Foundation.

Detection and Transition Analysis of Engagement and Affect in a Simulation-Based Combat Medic Training Environment, James Lester, Bradford Mott. \$478,592 by Columbia University/US Army Research Laboratory.

CAREER: Enable Robust Virtualized Hosting Infrastructures via Coordinated Learning, Recover, and Diagnosis, Xiaohui (Helen) Gu. \$450,000 by National Science Foundation.

III: Small: Optimization Techniques for Scalable Semantic Web Data Processing in the Cloud, Kemafor Anyanwu Ogan. \$446,942 by National Science Foundation.

CAREER: Secure OS Views for Modern Computing Platforms, William Enck. \$400,000 by National Science Foundation.

Collaborative Research: FRABJIOUS CS – Framing a Rigorous Approach to Beauty and Joy for Outreach to Underrepresented Students in Computing at Scale, Tiffany Barnes. \$352,831 by National Science Foundation.

HCC: Small: Collaborative Research: Integrating Cognitive and Computational Models of Narrative for Cinematic Generation, R. Michael Young. \$352,696 by National Science Foundation.

Hobbes: OS and Runtime Support for Application Composition, Frank Mueller. \$300,000 by Sandia National Laboratories via US Department of Energy.

NeTS JUNO: Service Offering Model and Versatile Network Resource Grooming for Optical Packet and Circuit Integrated Networks, Rudra Dutta. \$291,956 by National Science Foundation.

Research Faculty (cont.)

Sarah Heckman, Teaching Assistant Professor
PhD, North Carolina State University, 2009

Computer science and software engineering education, open educational resources

Xuxian Jiang, Associate Professor
PhD, Purdue University, 2006

Virtual machines and security

James C. Lester, Distinguished Computer Science Professor, PhD, University of Texas, 1994

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

Tim Menzies, Professor (starting 8/2014)
PhD, University of New South Wales, 1995

Artificial intelligence, data-mining and search-based software engineering

Frank Mueller, Professor
PhD, Florida State University, 1994

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

Emerson Murphy-Hill, Assistant Professor
PhD, Portland State University, 2009

Software engineering, esp. the intersection of human-computer interaction and software engineering.

Peng Ning, Professor
PhD, George Mason University, 2001

Computer and network security: new techniques for building trustworthy systems and wireless security

Kemafor Anyanwu Ogan, Associate Professor
PhD, University of Georgia, 2007

Semantic computing: semantic Web, databases, data mining, information retrieval, services computing

Chris Parnin, Assistant Professor (starting 8/2014)
PhD, College of Computing, Georgia Tech, 2014

Graphics and computer interaction, software engineering, programming languages

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

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

Michael Rappa, Distinguished University Professor, PhD, Univ. of Minnesota, 1987

Analytics, e-commerce, open courseware, open educational content, technology management

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

David Roberts, Assistant Professor
PhD, College of Computing, Georgia Tech, 2010

Machine learning and artificial intelligence and their application to interactive technological experiences

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, 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

Research Faculty (cont.)

Xipeng Shen, Associate Professor (starting 8/2014)
PhD, University of Rochester, 2006
Architecture and operating systems, extreme-scale data-intensive computing

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., numerical linear algebra, computer operating systems

David Sturgill, Teaching Assistant Professor
PhD, Cornell University, 1996
Parallel computation and its application to computationally hard problems, parallelism, machine learning

Blair Sullivan, Assistant Professor (joint apt. w/ ORNL) PhD, Princeton University, 2008
Algorithms and theory of computation, scientific and high performance computing, and analytics

David Thuent, Professor
PhD, University of Kansas, 1974
Denial of service and security for wireless systems; media access control protocols

Ranga Vatsavai, Associate Professor (starting 8/2014)
(joint apt. w/ORNL) PhD, University of Minnesota, 2008
Advanced data sciences, geospatial analytics

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

Benjamin Watson, Associate Professor
PhD, Georgia Institute of Technology, 1997
Relationships between computer graphics and design

Laurie Williams, Professor
PhD, University of Utah, 2000
Agile software processes, software security, open software systems, healthcare information technology

R. Michael Young, Professor
PhD, University of Pittsburgh, 1997
AI: planning & plan recognition, natural language processing, dev. of human-computer interaction

Emeritus Faculty

Wushow Chou, Professor Emeritus
PhD, University of California - Berkeley, 1968

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

Robert Fomaro, Professor Emeritus
PhD, Pennsylvania State University, 1969

Thomas L. Honeycutt, Associate Professor Emeritus
PhD, NC State University, 1969

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

Woodrow Robbins, Professor Emeritus
PhD, Syracuse University, 1971

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

NC State University Department of Computer Science

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Senior Faculty Profiles



Dr. Rudra Dutta, a professor of Computer Science, joined NC State in 2001. He received a B.E. in Electrical Engineering from Jadavpur University, Kolkata, India, in 1991, an ME in Systems Science and Automation from Indian Institute of Science, Bangalore, India in 1993, and a PhD in Computer Science from NC State University in 2001. From 1993-1997, Dutta worked for IBM as a software developer and programmer in various networking related projects. His current research interests focus on design and performance optimization of large networking systems, Internet architecture, wireless networks, and network analytics. His research is supported currently

by grants from the National Science Foundation, the National Security Agency, and industry, including a recent GENI grant and a FIA grant from NSF. He has served as a reviewer for many premium journals, on NSF, DOE, ARO, and NSERC (Canada) review panels, as part of the organizing committee of many premium conferences, including Program Co-chair for the Second International Workshop on Traffic Grooming. Most recently, he has served as Program Chair for the Optical Networking Symposium at IEEE Globecom 2008, General Chair of IEEE ANTS 2010, on the Steering Committee of IEEE ANTS 2013, and as guest editor of a special issue on Green Networking and Communications of the Elsevier *Journal of Optical Switching and Networking*. Currently, he is serving on the editorial board of the Elsevier *Journal of Optical Switching and Networking*.



Dr. Nagiza Samatova, a professor of Computer Science, specializes in computational biology and high-performance data mining, knowledge discovery, and statistical data analysis. A senior research scientist in the Computational Biology Institute at Oak Ridge National Laboratory, Samatova is the author of more than 200 publications, two patents, and the book "Practical Graph Mining with R." She received her BS degree in Applied Mathematics in 1991 from Tashkent State University, Uzbekistan; a PhD in Mathematics from the Russian Academy of Sciences, Moscow in 1993; and an MS in Computer Science from the University of Tennessee, Knoxville in 1998.

She joined the NC State Computer Science Department in 2007. Samatova has supervised dozens of young researchers, and three high school teams she mentored were national finalists in the Siemens Competition in Math, Science and Technology. She was recently honored by the IEEE Computer Society with a 2013 Distinguished Contributions to Public Service in a Pre-College Environment Award.

New Faculty Profiles



Dr. Tim Menzies joined the department as a full professor of Computer Science in fall 2014. His general area of expertise is software engineering. He received his BS in Computer Science and PhD in AI and Advanced Modeling at the University of New South Wales, Australia in 1984 and 1985 respectively. Most recently, Menzies was a full professor in the Lane Department of Computer Science and Electrical Engineering, West Virginia University.



Dr. Chris Parnin joined the department as an assistant professor of Computer Science in fall 2014. His general area of specialty is software engineering. He received his BS, MS, and PhD from Georgia Tech in 2003, 2006, and 2014 respectively. Most recently, Parnin was a software engineer at the Georgia Research Institute.



Dr. Xipeng Shen joined the department as an associate professor in the Chancellor's Data Driven Sciences Cluster in fall 2014. His general area of specialty is systems and extreme-scale data-intensive computing. He received his BS in Industry Automation from the North China University of Technology in 1986; his MS in Pattern Recognition and Intelligent Systems from the Chinese Academy of Sciences in 2001; and his MS and PhD in Computer Science from the University of Rochester in 2003 and 2006, respectively.



Dr. Ranga Raju Vatsavai joined the department as an associate professor in the Chancellor's Faculty Excellence Geospatial Analytics Cluster, and an associate professor for Computational Methods in the new NC State Center for Geospatial Analytics. Vatsavai's general areas of specialty are Advanced Data Sciences and Geospatial Analytics. He received his MS in Computer and Information Science in 2003, and his PhD in Computer Science in 2008, both from the University of Minnesota.