NC STATE Engineering

COMPUTER SCIENCE

RESEARCH

2014 – 2015

Dr. Christopher G. Healey, professor of computer science at NC State, works with students to study connections between tweets discussing climate change. A tweet affinity graph shows tweets in green and blue, hash tags in yellow, Twitter users in orange, and URLs in red. The graph is displayed on Hunt Library's iPearl Immersion Theater, a 21x7-foot MicroTile video wall. Interested readers are encouraged to explore the tweet visualization software, available online at go.ncsu.edu/tweet-viz.

Research Highlights

Greetings, and welcome to the 2014-2015 issue of Research, our annual synopsis of research activities in the NC State Department of Computer Science. Research is an integral part of the department, and with 12 research centers and more than 35 labs and research groups, we are proud to be one of the oldest and largest computer science departments in the nation.

Our research productivity continues to grow with more than $53 million in active research grants, and annual expenditures in the $15 million range. This ranks us in the top ten departments for sponsored research funding among computer science departments in colleges of engineering in the United States.

On the following page you will see some of our research highlights, and a list of select representative projects appears on page 4 of this newsletter. We invite you to visit our website at www.csc.ncsu.edu to learn more about the department, our faculty and staff, and our game-changing research.

INSIDE:

Research Highlights

- The Computer Science Department received formal university approval for the **Center for Educational Informatics** under the direction of **Dr. James Lester**, Distinguished Professor of Computer Science.
- Security technology developed by **Dr. Peng Ning**, called TIMA, has been sub-licensed to Samsung through CellSentry, ad NC State start-up with support from the NC State Office of Technology Transfer. The TIMA technology is one of the core components and part of the innermost security layer of the Samsung Knox platform deployed in their mobile phones and tablets.
- The Gordon and Betty Moore Foundation has selected **Dr. Blair Sullivan** for a $1.5 million Moore Investigator Award – one of only 14 nationally – as part of its Data-Driven discovery Initiative. Her work focuses on transforming theoretical algorithms into practical tools that can be used in fields ranging from biomedical science and social media research to business analytics and online retailing.
- **Dr. David Roberts** and other researchers at NC State have developed a suite of technologies that can be used to enhance communication between dogs and humans, which has applications in everything from search and rescue to service dogs, to training our pets. They have developed a platform for computer-mediated communication between humans and dogs that opens the doors to interpreting dogs' behaviorial signals and sending them clear and unambiguous cues in return. The platform itself is a harness that fits comfortably onto the dog, and which is equipped with a variety of technologies.
- **Dr. R. Michael Young** and colleagues in the College of Textiles, and the College of Design, are working on IC-Crime, a multidisciplinary project that gives law enforcement a tool that creates a virtual crime scene that investigators can use to process a crime scene.
- **Dr. William Enck**, along with other researchers from NC State and Technische Universität Darmstadt/CASED in Germany, have developed a modification to the core Android operating system that allows developers and users to plug in new security enhancements. The new Android Security Modules (ASM) framework aims to eliminate the bottleneck that prevents developers and users from taking advantage of new security tools.
- The University of North Carolina General Administration has awarded six three-year grants totaling nearly $9 million to support game-changing faculty research areas of strategic importance to the state – and NC State is a partner in five of the six research initiatives. Each of the funded projects involves faculty partners from two or more UNC campuses.

Over the last year, our department has continued to experience exciting growth. Enrollments continue to increase – in fall 2014 we enrolled 1,558 students – 875 undergraduates and 683 graduate students (198 PhD students). In 2014-2015, we awarded 178 undergraduate degrees and 227 graduate degrees. Demand for our graduates continues to be extremely high with starting salaries for those graduating with a BS degree averaging almost $67,000. The average starting salary for our master's degree students is in the $102,000 range, and for PhD students, it's even higher. For many years we have been one of the top suppliers of new graduates to companies like IBM, Cisco, SAS, NetApp, Amazon, Fidelity Investments, and other industry giants.

We have received numerous accolades and professional recognitions. The Engineering Online Computer Science and Networking programs have been ranked 7th nationally in the *U.S. News and World Report's* 2015 list of the Best Online Graduate Computer Information Technology Programs; Engineering Online has again been recognized as one of the top online engineering programs in the United States coming in 11th nationally on the *U.S News and World Report's* list of Best Online Graduate Engineering Programs; according to the *U.S. News and World Report*, the NC State Computer Science graduate program is ranked 29th among public universities; and, according to the American Society for Engineering Education (2013-14 data), we are ranked #1 in tenure-track female faculty among all computer science departments in colleges of engineering. We are ranked 10th in research expenditures, 13th, 7th, and 14th, in awarded PhD, MS and BS degrees, respectively.

Finally, we'd like to thank our alumni, friends and corporate partners for making this a record year for unrestricted support (~$1.1 million)! This unrestricted funding allows the department to continue to grow in emerging areas of comptuer science while providing the highest quality educational experience for our students.

Mladen A. Vouk
Professor and Department Head

Selected Projects

Consortium for Nonproliferation Enabling Capabilities, **Nagiza Samatova** *(pictured at right),* **Robin Gardner. $4,838,661 by US Department of Energy.**

Moore Foundation Data-Driven Discovery Investigator, **Blair Sullivan. $1,500,000 by Gordon and Betty Moore Foundation.**

The Effectiveness of Intelligent Virtual Humans in Facilitating Self-Regulated Learning in STEM with MetaTutor, **James Lester, Roger Azevedo. $1,365,603 by National Science Foundation.**

Tutorial Planning with Markov Decision Processes for Counterinsurgency Training Environments, **James Lester** *(pictured at right),* **Bradford Mott, Jonathan Rowe. $1,072,237 by US Army Research Laboratory**.

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** *(pictured bottom right),* **Alper Bozkurt (ECE), Barbara Sherman (CVM). $999,103 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)**.

Transcriptional Nodes Coordinate patterning and Cellular Proliferation During Carpel Margin Meristem Development, **Steffen Heber, Robert Franks. $771,784 by National Science Foundation**.

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

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

CSR: Medium: Collaborative Research: Holistic, Cross-Site, Hybrid System Anomaly Debugging for Large Scale Hosting Infrastructures, **Xiaohui (Helen) Gu. $518,000 by National Science Foundation**.

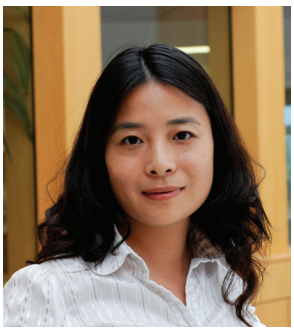
CAREER: Fostering Collaborative Dialogue for Rigorous learning and Diverse Student Retention in Computer Science, **Kristy Boyer. $497,149 by National Science Foundation**.

CHS: Small: Direct Physical Grasping, Manipulation, and Tooling of Simulated Objects, **Robert St. Amant, Christopher Healey. $496,858 by National Science Foundation**.

CAREER: Expanding Developers' Usage of Software Tools by Enabling Social Learning, **Emerson Murphy-Hill** *(pictured at right).* **$495,721 by National Science Foundation**.

SHF: Small: Improving Memory Performance on Fused Architectures Through Compiler and Runtime Innovations, **Xipeng Shen, Frank Mueller. $470,000 by National Science Foundation**.

SHF: Medium: Collaborative Transfer Learning in Software Engineering, **Tim Menzies. $464,609 by National Science Foundation**.



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

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

Collaborative Research: FRABJOUS 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.**

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.**

Senior Faculty

DR. CHRISTOPHER HEALEY

Professor of Computer Science

Healey received a B.Math, from the Department of Computer Science at the University of Waterloo, Waterloo, Canada in 1990; an M.Sc. in Computer Science in 1992, and a PhD in 1996, all from the Department of Computer Science at the University of British Columbia, Vancouver, Canada. From 1996-1998, he was a Postdoctoral Fellow in the Department of Computer Science at the University of California at Berkeley. He joined the NC State Computer Science Department in 1998.

His primary research areas are visualization and visual analytics, specifically the development of methods for visualizing large, multidimensional datasets to support rapid and accurate exploration, analysis, validation, and discovery. His investigations focus on issues at the forefront of visualization, in particular, the application of perception, artificial intelligence, and data analytics to improve the effectiveness of techniques to visualize "big data." Past and current work on human vision, assisted visualization, and intelligent data management targets these areas. His research is built on a fundamental investigation of how our visual system perceives the world around us. Understanding what we see and how we see it is critical to any attempt to harness, enhance, predict or stimulate human vision.

DR. FRANK MUELLER

Professor of Computer Science

Mueller earned his BS from the Technical University Berlin, Berlin, Germany in 1987, his MS and PhD (all in Computer Science) from Florida State University in 1991 and 1994, respectively. He joined the faculty of NC State in 2001. Prior to NC State, Mueller was an assistant professor at Humboldt University Berlin, Berlin, Germany from 1995-2000, and he also conducted research as a computer scientist at the Lawrence Livermore National Laboratory in California in 2001.

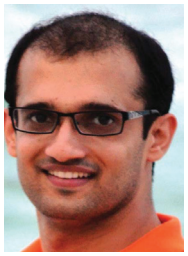
His research interests range from parallel and distributed systems over embedded and real-time systems to compilers. His current work focuses on power-aware computing, big data and cloud/high-performance computing, resilience, accelerators with extreme levels of parallelism, predictable manycore computing, domain-specific languages and deep hierarchies of novel memory technology.

He was named a Distinguished Member of the Association of Computing Machinery (ACM) in 2011, and was named a Golden Core Member of the Institute of Electrical and Electronics Engineers-Computer Society (IEEE-CS) in 2012. He recently received a prestigious Humboldt Research Award for a one-year research visit in Germany that began in June 2014. He was recognized for being an international expert on fault-tolerance and performance analysis/tuning in high-performance computing.

New Faculty Profiles

GUOLIANG JIN

joined the department in spring 2015 as an assistant professor in computer science. His general area of specialty is software system reliability. He received his PhD in Computer Science from the University of Wisconsin-Madison in 2014.



MUHAMMAD SHAHZAD

joined the department in fall 2015 as an assistant professor in computer science. Shahzad's general area of specialty is computer networking. He received his PhD degree in Computer Science from Michigan State University, in May of 2015.

JESSICA STADDON

joined the department in fall 2015 as an associate professor in computer science. Her general area of specialty is privacy. She received her BA in Applied Math in 1990, and her PhD in Mathematics in 1997 from the University of California, Berkeley. She most recently was a research scientist and manager at Google.

Research Faculty

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

Suzanne Balik, Teaching Assistant Professor
PhD, North Carolina State University, 2014
Graphics, human computer interaction

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, NC 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, NC 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 protocolsa

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 Heidleberg, Germany, 2001
Algorithms to compare and analyze gene order permutations, animation dev. for bioinformatics education

Sarah Heckman, Teaching Associate Professor
PhD, NC State University, 2009
Computer science and software engineering education, open educational resources

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

Guoliang Jin, Assistant Professor
PhD, University of Wisconsin-Madison, 2014
Architecture and operating systems, parallel and distributed systems, software engineering and programming languages

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

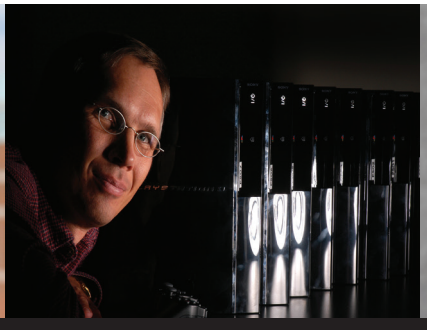
Frank Mueller, Professor
PhD, Florida State University, 1994
Compilers and code optimization, concurrent and distributed, real-time and embedded systems

Emerson Murphy-Hill, Associate 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 artifical 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

Muhammad Shahzad, Assistant Professor
PhD, Michigan State, 2015
Embedded and real-time systems, networking and performance evaluation, cyber security

Xipeng Shen, Associate Professor
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

Jessica Staddon, Associate Professor
PhD, University of California, Berkeley, 1997
Privacy, security, user experience, data mining, human computer interaction

Matthias Stallmann, Professor
PhD, University of Colorado, 1982
Algorithm design and analysis of 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 Thuente, Professor
PhD, University of Kansas, 1974
Denial of service and security for wireless systems; media access control protocols

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

Mladen Vouk, Distinguished Computer Science 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, heathcare 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

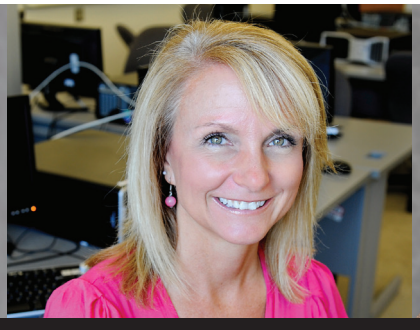
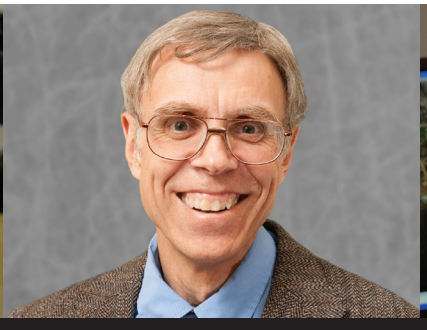
Robert Fornaro, Professor Emeritus
PhD, The Pennsylvania State University, 1969

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


Computer Science Research

Our key research areas are in **Theory** *(Algorithms, Theory of Computation),* **Systems** *(Computer Architectures and Operating Systems, Embedded and Real-Time Systems, Parallel and Distributed Systems, Scientific and High Performance Computing),* **Artificial Intelligence** *(Intelligent Agents; Data-Mining, Information and Knowledge Discovery, Engineering and Management; eCommerce Technologies; Information Visualization, Graphics and Human-Computer Interaction),* **Networks** *(Networking and Performance Evaluation),* **Security** *(Software and Network Systems Security, Information Assurance, Privacy),* **Software Engineering** *(Requirements, Formal Methods, Reliability Engineering, Process and Methods, Programming Languages), and* **Computer-Based Education**. *The department has a number of teaching and research laboratories, centers and other facilities that support its educational and teaching mission.*

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