

RESEARCH

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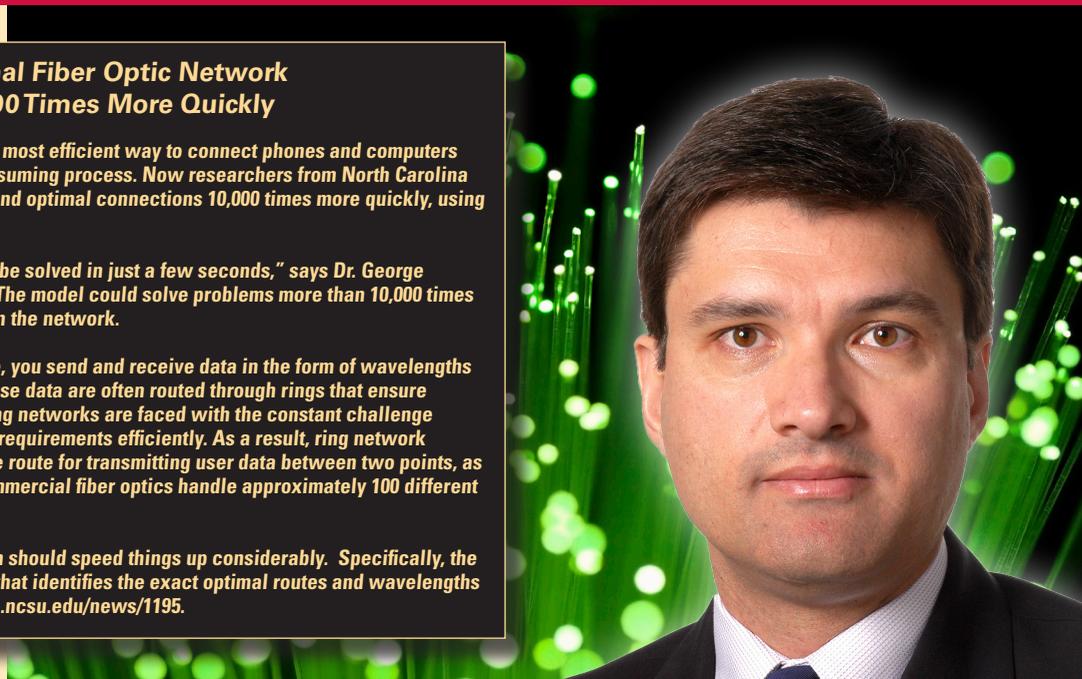
Model Finds Optimal Fiber Optic Network Connections 10,000 Times More Quickly

Designing fiber optic networks involves finding the most efficient way to connect phones and computers that are in different places -- a costly and time-consuming process. Now researchers from North Carolina State University have developed a model that can find optimal connections 10,000 times more quickly, using less computing power to solve the problem.

"Problems that used to take days to solve can now be solved in just a few seconds," says Dr. George Rouskas, computer science professor at NC State. The model could solve problems more than 10,000 times faster when data is routed through larger "rings," in the network.

Every time you make a phone call or visit a website, you send and receive data in the form of wavelengths of light through a network of fiber optic cables. These data are often routed through rings that ensure the information gets where it needs to go. These ring networks are faced with the constant challenge of ensuring that their system design can meet user requirements efficiently. As a result, ring network designers try to determine the best fiber optic cable route for transmitting user data between two points, as well as which wavelength of light to use. Most commercial fiber optics handle approximately 100 different wavelengths of light.

The new model developed by Rouskas and his team should speed things up considerably. Specifically, the researchers have designed a mathematical model that identifies the exact optimal routes and wavelengths for ring network designers. Read more at www.csc.ncsu.edu/news/1195.



Research Highlights

The NC State University Department of Computer Science is one of the oldest and largest computer science departments in the nation, and research is central to the success of the department. This year has been especially rewarding in terms of research funding. In 2010 our active research grants exceeded \$44 million, our new external funding exceeds \$10 million, and our annual external funding expenditures exceeded \$8 million (and overall, in the range of \$12 million). The department also received close to \$1 million in gift funds. 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. A list of select research projects appears on page three of this newsletter.

In the 2010-2011 academic year, faculty as a group published over 40 refereed journal papers, more than 150 conference and workshop papers, one book, eight book chapters, and a number of other edited works. They also produced over 55 publications, tutorials, editorials, news articles, or media appearances. Faculty gave over 130 professional talks related to their research and educational activities. A number of our faculty serve as editors, and on editorial boards of leading professional publications, and as members and officers in the most prestigious professional societies and organizations in their areas of specialty. Our faculty continue to be both organizers and participants in a number of prestigious professional events, as well as delivering services and functions to the university, professional societies, the state, and the nation.

Both our undergraduate and graduate programs are nationally recognized and received numerous accolades. Our graduate program is very highly ranked among computer science departments in public universities (cca 28th by *US News & World Report*, and in the top 20 by ASEE). In the fall of 2010 our undergraduate program successfully underwent

2010-2011

- Highlights
- Projects
- Faculty Profiles

www.csc.ncsu.edu

Research Faculty

Annie I. Antón, Professor

PhD, Georgia Institute of Technology, 1997

Software and requirements engineering, information privacy, compliance

Kemafor Anyanwu, Assistant Professor

PhD, University of Georgia, 2007

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

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

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, 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

William Enck, Assistant Professor

PhD, Pennsylvania State University, 2011

Systems security, mobile operating systems security

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

Edward Gehringer, Associate Professor

PhD, Purdue University, 1979

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

Xiaohui (Helen) 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, Associate Professor

PhD, Universität Heidelberg, Germany, 2001

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

Highlights (cont.)

ABET/CAC accreditation review, and our game development concentration is ranked among the top 15 undergraduate video game design and development programs in the US and Canada by the *Princeton Review*.

In the fall of 2010, the department had 1163 students (629 undergraduates and 534 graduates (with 168 of these PhD students)). The graduating class of 2010-2011 included 25 PhD, 167 MS and 131 BS degrees. When compared to other departments in the country, we are among the top 20 in the number of awarded bachelor's degrees and among the top 10 in the number of awarded master's degrees in computer science.

Demand for our graduating students continues to be very strong, and the average annual starting salary for our undergraduates averages almost \$58,000 (one of the highest in the NC State College of Engineering for May 2011 undergraduates), and over \$78,000 for our MS graduates. The top employers for this year's students are Fidelity Investments, IBM, NetApp, Cisco and SAS.

In 2010-2011 our faculty received a number of prestigious awards and honors: Dr. Mladen Vouk received an IEEE Distinguished Service Award, and was named a member of IEEE Golden Core; Dr. Vouk also was reappointed for a second five-year term as Head of the Department; Dr. Barbara Adams is a 2011 recipient of the George H. Blesis Outstanding Undergraduate Advisor Award; Dr. Annie Antón testified (for the second time) before the US Congress on matters of policy and privacy; Drs. Rada Chirkova, Patrick Dreher, Xiaohui (Helen) Gu, Christopher Healey, Michael Rappa, Mladen Vouk, Laurie Williams and Tao Xie received IBM Faculty Awards totaling over \$203,500; Dr. Peng Ning received a 2011 IBM Open Collaborative Faculty Award valued at \$75,000; Dr. Injong Rhee received a Google Research Award totaling over \$65,532; Dr. Tao Xie was named an IEEE Computer Society Distinguished Visitor for 2011-2013, and an ACM Distinguished Speaker; Dr. Laurie Williams received a 2010 IBM Smarter Planet Innovation Faculty Award valued at \$10,000; Dr. Tao Xie received a 2011 Microsoft Research Software Engineering Innovation Foundation Award valued at \$17,500; Dr. Xiaohui (Helen) Gu received her second Google Research Award – this one in the amount of \$61,000; and Dr. Emerson Murphy-Hill received a Google Research Award in the amount of \$61,000.

Our students received numerous honors and awards as well: the STARS Student Leadership Corps was awarded the Deborah S. Moore Service Award for Non-Service Club of the Year; Rogelio Cardona-Rivera received a prestigious Department of Energy Computational Science Graduate Fellowship; Ben Smith received a highly competitive 2011 IBM Ph.D. Fellowship for the second consecutive year; Brittany Strachan was selected to the ACC Women's Basketball All-Academic Team for the second consecutive year; Brittany also was selected to the Capital One second team Academic All-District women's basketball team, and was awarded the ACC/Weaver-James-Corrigan Award for postgraduate study; a textbook titled, "Practical Graph Mining with R", written entirely by students in Dr. Nagiza Samatova's CSC 422/522 course is to be published with proceeds benefitting the NC State Computer Science Department; Xusheng Xiao was selected as one of 10 recipients of the Cascadia Innovation Fellowship; and Kellie Jones and Natalie Kerby were awarded Donald L. Bitzer Creativity Awards.

In August 2011 the department welcomed several new faculty: Dr. Randy Avent, professor; Drs. Kristy Boyer and William Enck, assistant professors; and Dr. David Sturgill, assistant teaching professor. We now have 43 tenure/tenure-track faculty, 12 lecturers and adjuncts, and about 33 research, development, information technology and administrative staff.

Finally, the department mourns the death of Dr. Norman F. Williamson, former acting department head (1973-1974) and professor. Dr. Williamson was on the committee to establish the original curriculum for the Computer Science Department at NC State, and was on the search committee to choose the original chair of the department. He will be greatly missed.

Mladen A. Vouk
Professor and Head of the Department

Selected Research Projects

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

The Leonardo Project: An Intelligent Cyberlearning System for Interactive Scientific Modeling in Elementary Science Education, **James Lester, Bradford Mott, Michael Carter, Eric Weibe.** \$3,499,410 by National Science Foundation.

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

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

Emerging Research-Empirical Research-An Integrated Model of Cognitive and Affective Scaffolding for Intelligent Tutoring Systems, **James Lester, Eric Wiebe.** \$1,542,275 by National Science Foundation.

TC: Large: Collaborative Research: Trustworthy Virtual Cloud Computing, **Peng Ning, Xuxian Jiang, Mladen Vouk.** \$1,523,685 by National Science Foundation.

IC-CRIME: Interdisciplinary Cyber-Enabled Crime Reconstruction Through Innovative Methodology and Engagement, **David Hinks, Michael Young, Timothy Buie.** \$1,400,000 by National Science Foundation.

Computer-aided Human Centric Cyber Situation Awareness, **Peng Ning, Michael Young.** \$979,463 by Pennsylvania State University.

Scientific Data Management Center for Enabling Technologies, **Mladen Vouk.** \$885,000 by the U.S. Department of Energy.

NetSE: Large: Collaborative Research: Platys: From Position to Place in Next Generation Networks, **Injong Rhee, Munindar Singh.** \$706,167 by National Science Foundation.

Quality of Information-Aware Networks for Tactical Applications (QUANTA), **Munindar Singh.** \$669,029 by Pennsylvania State University (Army Research Laboratory).

II: NEW: ARC: A Root Cluster for Systems Research into Scalable Computing, **Frank Mueller, Vincent Freeh, Xiaohui (Helen) Gu, Xuxian Jiang, Xiaosong Ma.** \$549,999 by National Science Foundation.

CAREER: Cooperative Developer Testing with Test Intentions, **Tao Xie.** \$525,727 by National Science Foundation.

HCC: Small: Plan-Based Models of Narrative Structure for Virtual Environments, **Michael Young.** \$513,860 by National Science Foundation.

Collaborative Research: Automatic Extraction of Parallel I/O Benchmarks from HEC Applications, **Xiaosong Ma, Frank Mueller.** \$499,999 by National Science Foundation.

TC: Small: Defending against Insider Jammers in DSSS- and FH-Based Wireless Communication Systems, **Peng Ning, Huaiyu Dai, ECE.** \$499,064 by National Science Foundation.

GENI IMF: Integrated Measurement Framework and Tools for Cross Layer Experimentation, **Rudra Dutta, George Rouskas.** \$479,259 by Global Environment for Network Innovations (National Science Foundation).

III: Small: MOSAIC - Semantic Querying Techniques for Supporting Problem Solving Tasks on the Structured Web, **Kemafor Anyanwu-Ogan.** \$477,713 by National Science Foundation.

Ultrascale Computational Modeling of Phenotype-Specific Metabolic Processes in Microbial Communities, **Nagiza Samatova, Anatoli Melechko.** \$454,311 by Oak National Laboratories - UT Battelle (DOE).

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

CAREER: Towards Exterminating Stealthy Rootkits - A Systematic Immunization Approach, **Xuxian Jiang.** \$424,166 by National Science Foundation.

CSR: Small: Online System Anomaly Prediction and Diagnosis for Large-Scale Hosting Infrastructures, **Xiaohui (Helen) Gu.** \$405,000 by National Science Foundation.

CSR: Medium: Collaborative Research: Providing Predictable Timing for Task Migration in Embedded Multi-Core Environments (TIME-ME), **Frank Mueller.** \$390,000 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

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

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, 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

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, 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

Research Faculty (cont.)

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

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

David Thunte, Professor
PhD, University of Kansas, 1974

Denial of service and security for wireless systems; media access control protocols

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

Software engineering, scientific computing, computer-based education, and high-performance networks

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

Tao Xie, Associate Professor
PhD, University of Washington, 2005

Automated software testing and verification, mining software engineering data

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

AI: planning & plan recognition, natural language processing, dev. of human-computer interaction

Ting Yu, Associate Professor
PhD, University of Illinois, 2003

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

Emeritus Faculty

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

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

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

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Senior Faculty Profiles



Dr. James Lester, professor of Computer Science and respected authority on intelligent tutoring systems and game-based learning environments, earned his PhD, MScS and BA degrees in computer science from the University of Texas at Austin. He joined the Computer Science Department at NC State soon after receiving his PhD in 1994, and has been here ever since. Lester is head of the IntelliMedia Group at NC State, where research focuses on intelligent tutoring systems and game-based learning environments that leverage interactive digital media to create effective, engaging learning experiences. By fusing human language technologies and adaptive reasoning techniques from artificial intelligence with new media and game technologies, the Group develops and evaluates high-impact interactive learning systems. Lester is a member of the NC State Academy of Outstanding Teachers. He serves as editor-in-chief of the *International Journal of Artificial Intelligence in Education*, and serves on the steering committees of *IEEE Transactions on Affective Computing*, and the *International Conference on Intelligent Tutoring Systems*. He is program co-chair of the Fourth International Conference on Interactive Digital Storytelling (ICIDS-2011), and chair, Virtual Agents Track, of the Tenth International Conference on Autonomous Agents and Multiagent Systems (AAMAS-2011).



Dr. Matthias Stallman, professor of Computer Science, earned his PhD in computer science from the University of Colorado, Boulder, his MS in computer science from Yale University, and his BA in mathematics and computer science from Yale University. Stallman joined the NC State computer science department in 1984, and, in addition to his teaching and research responsibilities, serves as the accreditation coordinator for the department. Since 2004, he has been the assessment coordinator for the department providing ongoing assessment of learning outcomes for courses, preparation for accreditation visits, coordination with the COE ABET team, and controlled experiments to validate new teaching ideas. In 2010 he guided the undergraduate program through a successful ABET/CAC accreditation. This spring he served as a member of the recruiting committee for TAP, and he is a participant/investigator in the NSF CPATH Project called *Incorporating Communication Outcomes into the Computer Science Curriculum*. He serves as the NC State Coordinator for the AccessComputing Project, and in May 2011, he was an invited participant in the Dagstuhl Seminar 11191, *Graph Drawing with Algorithm Engineering Methods*. He holds membership in the Association for Computing Machinery, the Society for Industrial and Applied Mathematics, Omega Rho, and the American Society for Engineering Education.

New Faculty Profiles



Dr. Randy Avent joined the faculty as professor in August 2011. He received his BS in Zoology from the University of North Carolina in 1980. He received an MS degree from NC State University in Electrical Engineering in 1986, and MS and PhD degrees from the University of North Carolina in Biomedical Engineering and Mathematics in 1984 and 1986, respectively. His particular research interests are in defense analytics, which deals with unstructured and semi-structured data mining and exploitation.



Dr. Kristy Boyer joined the faculty as assistant professor in August 2011. She received her BS in Mathematics and Computer Science from Valdosta State University in 1999. She received her MS in Applied Statistics from the School of Industrial and Systems Engineering at the Georgia Institute of Technology in 2000, and her PhD in Computer Science from NC State University in 2010. Her research interests include artificial intelligence and computational linguistics, with an emphasis on natural language dialogue.



Dr. William Enck joined the faculty as assistant professor in August 2011. Enck received his BS degree in Computer Engineering from Pennsylvania State University in 2004; and his MS and PhD degrees in Computer Science and Engineering from Penn State in 2006 and 2011, respectively. His expertise is in systems security, with a focus on the design, optimization, and measurement of security for operating systems, specifically on mobile phones, and the complex environments in which they operate.



Dr. David Sturgill joined the faculty as a teaching assistant professor in August, 2011. He received his BS degree from the University of South Carolina in Computer Science and Math in 1989. He received his MS and PhD in Computer Science from Cornell University in 1993 and 1996, respectively. His primary research interest is in parallel computation and its application to computationally hard problems, including work on search techniques, parallelism, machine, and collaborative learning.