

# COMPUTER SCIENCE RESEARCH BROCHURE



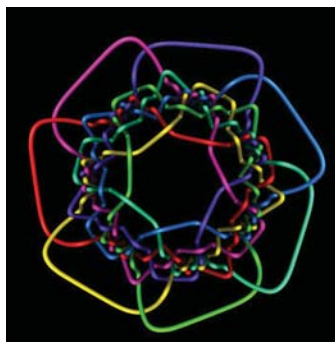
FALL 2002

*Dr. Donald Bitzer demonstrates a Fujitsu high definition widescreen system based on plasma display technology he developed in the early 1960s*

Welcome to the Computer Science Department at North Carolina State University. The Fall 2002 Research Brochure highlights some of our recent progress in faculty hiring, sponsored research, the graduate program, and new laboratories and building plans.

**Research Faculty.** The Computer Science Department has grown to include 35 tenure and tenure-track research faculty. We welcomed two new faculty members this year: Dr. Rada Chirkova from Stanford University, and Dr. Khaled Harfoush from Boston University, and six new faculty members in 2001: Dr. Rudra Dutta from North Carolina State University, Dr. Frank Mueller from Lawrence Livermore National Laboratory, Dr. Peng Ning from George Mason University, Dr. David Thuente from Indiana University-Purdue University Fort Wayne, Dr. Laurie Williams from the University of Utah, and Dr. Jon Doyle as the SAS Professor of Computer Science from the Massachusetts Institute of Technology. Jon holds a chaired position created in part through a \$1 million endowment from SAS Institute. We hope to recruit at least three additional faculty members for 2003, with an emphasis on operating systems, databases, and formal methods.

**Sponsored Research.** Sponsored research grants within the department currently total \$12 million. More importantly, we continue to improve our annual increase in research funding. Granting agencies include traditional venues like the National Science Foundation, DARPA, the Army Research Office, NASA, and the US Department of Energy, as well as local industry and research centers. We expect to achieve an intermediate goal of



*Symmetric Venn diagram by Savage and Winkler, image from A Survey of Venn Diagrams by Frank Ruskey*

\$20 million within the next four years.

**Graduate Program.** The department's graduate program includes 330 graduate students enrolled in M.S., M.S. in Computer Networking, and Ph.D degrees. We received 574 applications for Fall 2002 admission to the Masters and PhD programs, with 118 new students accepting our offer to join the department. We are also increasing the number of US students we attract,



*Students work on a pair programming project in the Laboratory for Collaborative System Development, equipped in part with an IBM SUR grant*

in part through an active recruiting program that invites the best US applicants to visit the department and meet with our faculty. Support for this program comes from the College of Engineering, and from Cisco

Systems and IBM, who provide personnel and funding to help run the program each year.

**Building Plans.** Rapid growth continues to strain our available physical resources. Nine faculty members moved this year into three new research labs (Collaborative Benchmarking and Experimental Algorithmics, Knowledge Discovery, and Collaborative Systems Development) that make up a 7,100 square-foot acquisition in research facilities on Centennial Campus. Architectural plans for a new Computer Science building are now being finalized. Current estimates anticipate 52,850 square feet, with an expected move-in date of mid 2005.

*Dr. Alan L. Tharp  
Professor and Department Head*

**CAREER: Towards Estimating Requirement Coverage: Managing Goals and Scenarios During Requirements Evolution**

A. I. Antón. NSF (\$220,000, 2000-2004)

**Aligning Societal Values, Privacy Policy, and IT Requirements**

A. I. Antón, C. Potts. NSF (\$334,886, 2001-2003)

**Modeling and Visualization of Sun Exposure Effects on the Human Anatomy**

R. J. Fornaro. US EPA (\$100,000, 2001-2004)

**The Centroid Method and Other Approximations to the SVD**

R. Funderlic, M. Chu. NSF (\$510,000, 2002-2006)

**Interactive Exploration of Complex Datasets Via the Effective Generation of Text and Graphics**

C. G. Healey, R. St. Amant, R. M. Young. NSF (\$569,338, 2000-2003)

**A Perceptual Visualization Architecture**

C. G. Healey. NSF (\$354,000, 2000-2003)

**CAREER: Assisted Navigation in Large Visualization Space**

C. G. Healey. NSF (\$370,403, 2001-2006)

**Automatic Analysis of Probabilistic Systems**

S. P. Iyer. ARO (\$258,648, 2001-2004)

**Automated Analysis of Probabilistic Open Systems**

S. P. Iyer, R. Cleaveland. NSF (\$215,000, 2001-2003)

**Symbolic Representation Based Partial Order Methods**

S. P. Iyer. NSF (\$160,000, 2002-2004)

**A Data Mining Approach for Building Cost-Sensitive and Light Intrusion Detection Models**

W. Lee, D. Reeves. DARPA (\$2,001,056, 2000-2003)

**Reducing Frequency Via Speculation and Fall-Back Recovery**

F. Mueller, E. Rotenberg. NSF (\$300,000, 2002-2005)

**SPAN: Shared-Memory Performance Analysis**

F. Mueller. LLNL (\$76,999, 2002-2003)

**ITS-EPA: E-Security and High Performance Computing**

P. Ning, A. I. Anton, J. Doyle. DynCorp (\$1,381,137, 2002-2009)

**Correlating Alerts Using Prerequisites of Intrusions Towards Reducing False Alerts and Uncovering High Level Attacks**

P. Ning, D. Reeves. ARO (\$198,929, 2002-2004)

**Reduce False Alerts, Uncover High-Level Attack Strategies and Predict Attacks in Progress Using Prerequisites of Intrusions**

P. Ning, D. Reeves. NSF (\$330,000, 2002-2005)

**Jumpstart: Performance Analysis and Alternate Routing for Just In Time Optical Burst Switching Networks**

H. Perros, G. N. Rouskas. MCNC (\$437,645, 2002-2003)

**CAREER: Investigation of Error Recovery Techniques for Interactive Video Transmission over Wireless Networks**

I. Rhee. NSF (\$269,075, 1999-2003)

**CAREER: Towards an All-Optical Network Infrastructure: Interconnection of Photonic WDM Broadcast-and-Select Local Area Networks**

G. N. Rouskas. NSF (\$200,000, 1998-2002)

**Computational Principles of Trust**

M. P. Singh. NSF (\$476,574, 2000-2003)

**Principles of Commitment Protocols**

M. P. Singh. NSF (\$345,000, 2002-2005)

**User Interface Softbots**

R. St. Amant. NSF (\$497,384, 2000-2003)

**Modeling Marine Corp Applications and WANS**

D. Thuyente, D. Reeves. US Marine Corps (\$520,000, 2002-2003)

**Center for Scientific Data Management-Agent Technology Enabling Communication Among Tools and Data**

M. Vouk. US DOE (\$538,987, 2001-2004)

**Women and Information Technology: A Comparative Study of Young Women from Middle Grades through High School and into College**

M. Vouk, S. Berenson, J. Michael. NSF (\$500,027, 2002-2005)

**Pair-Learning in Undergraduate Computer Science Education**

L. Williams. NSF (\$227,000, 2001-2003)

**CAREER: Automated Synthesis of Bidding Strategies for Trading Agents**

P. Wurman. NSF (\$300,010, 2001-2006)

**CAREER: Plan-Based Integration of Control and Coherence in Intelligent Exploratory Environments**

R. M. Young. NSF (\$465,695, 2001-2006)

## RESEARCH PROFILES

*ITR: Aligning Societal Values, Privacy Policy, and IT Requirements*, Dr. Annie I. Antón, Dr. Colin Potts. NSF (\$334,886, 2001-2003)

This research project focuses on how society uses, values, and protects citizens' personal information. From the perspective of system design, software engineers need methods and tools to build systems



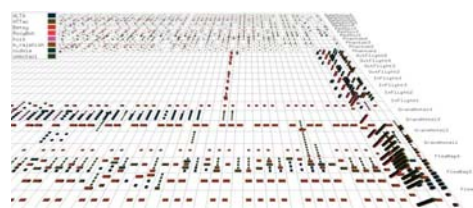
*Software engineering group meeting*

that reflect these values and protect personal information. This research examines how privacy considerations and value systems influence the design, deployment and consequences of IT. We are studying the motivations and barriers to the use of IT when it requires the user to provide Personally Identifiable Information (PII). An action-oriented set of conceptual tools, including guidelines and privacy-relevant policy templates are being constructed, validated, documented, and illustrated on the project web site.

*Symbolic Representation Based Partial Order Methods*, Dr. S. Purushothaman Iyer. NSF (\$160,000, 2002-2004)

Symbolic representations are used in analysis of finite and infinite state concurrent system. However, they could be subjected to constraint explosion much like state explosion in analysis of finite state designs of concurrent systems. The reason for both of these explosions is the consideration of all interleavings, of a concurrent system, during their analysis. Partial-order techniques depend upon the notion of independence among actions to avoid considering all possible interleavings. This research investigates the notion of unfolding, which aids both in discovery of independent actions and in succinctly representing the state space of systems. This will aid in faster, and more complete, analysis of infinite state concurrent systems than is currently possible.

*CAREER: Automated Synthesis of Bidding Strategies for Trading Agents*, Dr. Peter Wurman. NSF (\$300,010, 2001-2006)



*Tracking trading agent activity within a simulated e-commerce auction environment*

The fragmented nature of the Internet market-place represents a dynamic and challenging environment; a particular product will often be offered for sale in a variety of pricing formats, often including auctions. In this project, trading agents are designed to ascertain the rules of auctions of interest and dynamically construct a decision representation. A strategy generation engine converts user preferences, auction rules, and models of other agents into a decisionable format. Game theory and Markov Decision Processes are among the tools being studied.



## SENIOR FACULTY PROFILES



*Dr. Donald Bitzer  
Distinguished University  
Research Professor*

Dr. Donald L. Bitzer received his B.Sc, M.Sc, and Ph.D degrees from the University of Illinois at Urbana-Champaign in 1955, 1956, and 1960. Following graduation, Bitzer joined the UIUC Electrical and Computer Engineering Department as Assistant Professor (1960-1963), Associate Professor (1963-1967), and Professor (1967-1989). In 1960 Bitzer and Gene Slottow invented the plasma display panel, a precursor to today's high-resolution display systems. In 1961 Bitzer designed PLATO, the world's first time-shared computer-based education

system, and home to the world's first on-line community.

Bitzer was elected to the National Academy of Engineering in 1974, and inducted as an IEEE Fellow in 1976. In 1991 the plasma display was recognized as one of the most significant research developments by the Army Research Office. In 2002 Bitzer became a National Associate of the National Academies of Science, Engineering, the Institute of Medicine, and the National Research Council.

Don Bitzer moved to our department in 1989 as a Distinguished University Research Professor, the highest distinction the university bestows to recognize outstanding research contributions. His research interests include convolutional decoding for high-speed networks, error-free communication channels for satellite and land communications, applications of information theory to genetics and bioinformatics problems, and computer-based education approaches to teaching mathematics in Computer Science.



*Dr. Jon Doyle  
SAS Professor of Computer Science*

Dr. Jon Doyle, a native of Houston, Texas, studied physics and music before receiving his baccalaureate summa cum laude in Mathematics in 1974 from the University of Houston with a thesis on non-repetitive sequences. In graduate work at the Massachusetts Institute of Technology as a Hertz Graduate Fellow and student of Gerald Jay Sussman, he received his masters degree in 1977 for his work on truth maintenance systems, invented nonmonotonic logic the following spring with Drew McDermott, and

received his doctorate in 1980 for a dissertation on controlling reasoning and action through dialectical deliberation and introspection, with McDermott, Marvin Minsky, and Peter Szolovits joining Sussman as readers.

Over the next twenty years, Doyle worked on developing the mathematical, computational, physical, and economic foundations of artificial intelligence, holding research faculty appointments in the computer science departments of Stanford University and Carnegie Mellon University, and in the Laboratory for Computer Science at MIT. AAAI elected Doyle to the rank of Fellow in 1991 for "fundamental contributions to the fields of nonmonotonic reasoning, truth maintenance, metareasoning, and the philosophical foundations of artificial intelligence," and to the office of Councillor in 1996.

Jon Doyle joined our department in 2001 to serve as SAS Institute Distinguished Professor of Computer Science. His current research interests include qualitative decision theory and the representation of preference information; the structure and interpretation of rational reasoning and behavior; mechanical theories of psychology and economics; knowledge discovery, representation, and adaptation; event recognition; and information security.

**Annie I. Antón, Assistant Professor**  
PhD, Georgia Institute of Technology, 1997

*Software engineering, requirements engineering, software processes, Internet privacy*

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

*Artificial intelligence, machine learning, hybrid neural-symbolic computing*

**Donald Bitzer, Distinguished University Research Professor**  
PhD, University of Illinois, Urbana-Champaign, 1960

*High-speed networks, satellite and land communications, bioinformatics, computer-based education*

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

*Distributed and collaborative workflows, databases, groupware, graph-based algorithms, signal processing*

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

*Databases, computational logic*

**Wushow Chou, Professor**

PhD, University of California, Berkeley, 1968

*Computer communications, network optimization*

**Edward W. Davis, Professor**

PhD, University of Illinois, Urbana-Champaign, 1972

*Computer architecture, parallel processing*

**Jon Doyle, SAS Professor of Computer Science**

PhD, Massachusetts Institute of Technology, 1980

*Artificial intelligence, mathematical and philosophical foundations, rational knowledge discovery, security*

**Rudra Dutta, Assistant Professor**

PhD, North Carolina State University, 2001

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

**Robert Fornaro, Professor**

PhD, Pennsylvania State University, 1969

*Concurrent programming in computer graphics, robotics, signal processing, operating systems*

**Robert E. Funderlic, Professor**

PhD, University of Tennessee, 1970

*Scientific and parallel computing, numerical methods*

**Edward Gehring, Associate Professor**

PhD, Purdue University, 1979

*Object-oriented software, parallel processing*

**Khaled Harfoush, Assistant Professor**

PhD, Boston University, 2002

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

**Christopher G. Healey, Assistant Professor**

PhD, University British Columbia, Canada, 1996

*Scientific visualization, computer graphics, perception*

**Thomas L. Honeycutt, Associate Professor**

PhD, North Carolina State University, 1969

*MIS, modeling and simulation, computer literacy*

**S. Purushothaman Iyer, Associate Professor**

PhD, University of Utah, 1986

*Formal methods for distributed and embedded systems, programming languages, concurrency theory*

**James C. Lester, Associate Professor**

PhD, University of Texas, Austin, 1994

*Artificial intelligence, multimedia, knowledge-based learning environments, computational linguistics*

**David F. McAllister, Professor**

PhD, University of North Carolina, Chapel Hill, 1972

*Computer graphics, speech processing*

## NEW FACULTY PROFILES

**Frank Mueller, Assistant Professor**

**PhD, Florida State University, 1994**

*Compilers, concurrent, distributed, real-time, and embedded systems, programming languages*

**Peng Ning, Assistant Professor**

**PhD, George Mason University, 2001**

*Network security, intrusion detection, e-commerce, cryptography, temporal databases, data mining*

**Harry Perros, Professor**

**PhD, Trinity College, Ireland, 1975**

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

**Douglas S. Reeves, Professor**

**PhD, Pennsylvania State University, 1987**

*Real-time communication, network quality of service, network security*

**Injong Rhee, Associate Professor**

**PhD, University of North Carolina, Chapel Hill, 1994**

*Synchronization in distributed, parallel, and real-time systems, network security, multimedia networking*

**Robert D. Rodman, Professor**

**PhD, University of California, Los Angeles, 1973**

*Spoken natural language dialog systems, voice I/O*

**George N. Rouskas, Professor**

**PhD, Georgia Institute of Technology, 1994**

*Lightwave high-speed networks, distributed systems, multicasting*

**Carla D. Savage, Professor**

**PhD, University of Illinois, Urbana-Champaign, 1977**

*Algorithms, combinatorics, discrete mathematics*

**Munindar P. Singh, Associate Professor**

**PhD, University of Texas, Austin, 1993**

*Multiagent systems, trust, Web services*

**Robert St. Amant, Associate Professor**

**PhD, University of Massachusetts, Amherst, 1996**

*HCI, artificial intelligence, intelligent user interfaces, statistical expert systems*

**Matthias Stallmann, Associate Professor**

**PhD, University of Colorado, 1982**

*Experimental algorithmics, combinatorial optimization, NP-hard problems, data structures, graph algorithms*

**William J. Stewart, Professor**

**PhD, Queen's University, Northern Ireland, 1974**

*Performance analysis, queueing networks, numerical linear algebra, operating systems, parallel architectures*

**Alan L. Tharp, Professor**

**PhD, Northwestern University, 1969**

*File structures, man-machine interfaces, databases*

**David Thuente, Associate Professor**

**PhD, University of Kansas, 1974**

*Communication system design, simulation, performance modeling, media access control*

**Mladen Vouk, Professor**

**PhD, King's College, England, U.K., 1976**

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

**Laurie Williams, Assistant Professor**

**PhD, University of Utah, 2000**

*Collaborative and pair programming, software development, e-commerce, agile software, software testing*

**Peter Wurman, Assistant Professor**

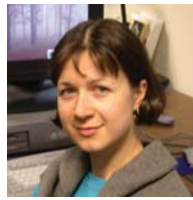
**PhD, University of Michigan, 1999**

*Artificial intelligence, e-commerce, market mechanisms, trading agent strategies, multi-agent systems*

**R. Michael Young, Assistant Professor**

**PhD, University of Pittsburgh, 1997**

*Artificial intelligence, planning, natural language processing, interactive narrative*



*Dr. Rada Chirkova*

**Dr. Rada Chirkova** joined the department in August 2002. She received a B.Sc and M.Sc from Moscow State University, Russia in 1991 and 1995, and an M.Sc and Ph.D from Stanford University in 2000 and 2002. Dr. Chirkova's research interests include databases and computational logic, with focus on view design.



*Dr. Rudra Dutta*

**Dr. Rudra Dutta** joined the department in August 2001. He received a B.Eng from Javadpur University, India in 1991, an M.Eng from the Indian Institute of Science in 1993, and a Ph.D from North Carolina State University in 2001. Dr. Dutta's research interests include traffic grooming and fault tolerance, performance and management of optical networks, and ad-hoc wireless networking.



*Dr. Khaled Harfoush*

**Dr. Khaled Harfoush** joined the department in August 2002. He received a B.Sc and M.Sc from Alexandria University, Egypt in 1992 and 1995, and a Ph.D from Boston University in 2002. Dr. Harfoush's research interests include end-to-end network diagnosis, network measurement techniques, network topologies, routing protocols, ad-hoc and peer-to-peer networks.



*Dr. Frank Mueller*

**Dr. Frank Mueller** joined the department in August 2001. He received a B.Sc from the Technical University of Berlin in 1987, and an M.Sc and Ph.D from Florida State University in 1991 and 1994. Dr. Mueller's research interests include compilers and code optimization, concurrent and distributed systems, real-time and embedded systems, architecture, and programming languages.



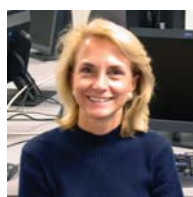
*Dr. Peng Ning*

**Dr. Peng Ning** joined the department in August 2001. He received a B.Sc and M.E from the University of Science and Technology of China in 1994 and 1997, and a Ph.D from George Mason University in 2001. Dr. Ning's research interests include network security, intrusion detection, secure and reliable e-commerce, applied cryptography, temporal databases, and data mining applications.



*Dr. David Thuente*

**Dr. David Thuente** joined the department in August 2001. He received a B.Sc from Lorse College in 1967, and an M.Sc and Ph.D from the University of Kansas in 1969 and 1974. Dr. Thuente's research interests include communication system design, simulation, and performance modeling, media access control protocols, systems engineering, and mathematical programming.



*Dr. Laurie Williams*

**Dr. Laurie Williams** joined the department in August 2001. She received a B.Sc from Lehigh University in 1984, an MBA from Duke University in 1990, and a Ph.D from the University of Utah in 2000. Dr. Williams's research interests include collaborative and pair programming, software development, e-commerce, agile software development practices, and software testing.