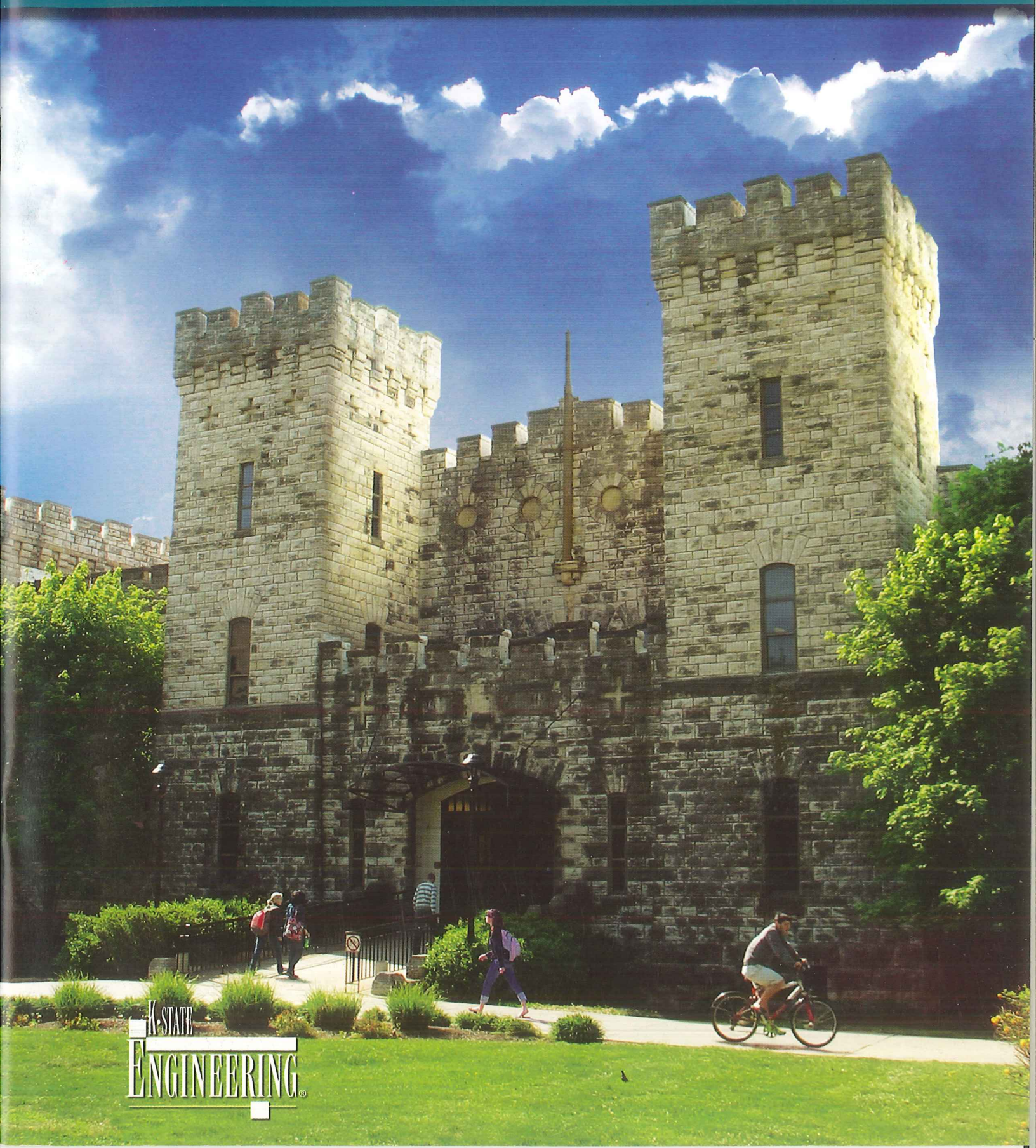
Annual Report 2009

Computing and Information Sciences

KANSAS STATE UNIVERSITY



K-STATE ENGINEERING

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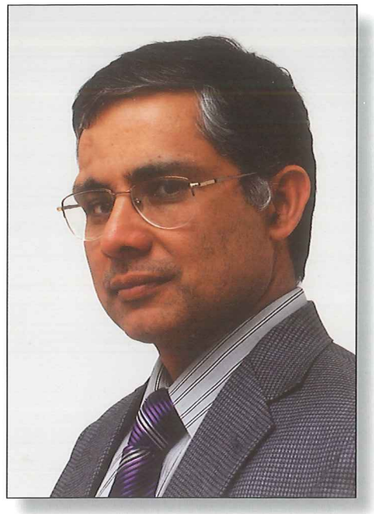
Message from the Department Head



It is with great pleasure that I share with you the 2009 annual research report for the Kansas State University Department of Computing and Information Sciences (CIS). First of all, I want to thank Dr. Virg Wallentine for his excellent leadership over the years in building a strong research and teaching-focused department. It has been a challenging year, given that I started at the department head position last year amid the budgetary constraints imposed due to the current economic environment. However, the CIS department had a great momentum moving forward under Dr. Wallentine and I am happy to report that we continue to move forward strongly. Our faculty is highly productive in research; our graduate program continues to grow and our students are in high demand; and we have strong interdisciplinary teaching and research programs.

Our faculty continue to excel in conducting research at the forefront of the computing and information sciences, with all full-time faculty members having extramural funding last year. In the area of security, Dr. John Hatcliff led a team of researchers from K-State and Princeton University, funded by a five-year $3 million grant from the Air Force Office of Scientific Research to work on development and verification technologies to address security challenges. This team includes CIS faculty Dr. Torben Amtoft, Dr. Robby and Dr. Simon Ou. They are also collaborating with researchers at Rockwell Collins where Dr. Hatcliff took a sabbatical last year. Another exciting focus area is that of health information technology. A team of researchers from K-State and the University of Pennsylvania, led by Dr. Hatcliff, was awarded a $1.5 million grant from NSF to study technologies linked to medical device coordination. Dr. Walletine took a sabbatical at the University of Oklahoma Health Sciences Center to work in this area as well.

CIS has considerable involvement in interdisciplinary research in areas such as high-performance computing, veterinary telemedicine, bio-informatics, and health information technology. The Beocat cluster with more than 1000 cores, managed by Dr. Dan Andresen, is supporting research in several departments from engineering, science, and agriculture. Dr. Doina Caragea is actively involved in developing the bio-informatics program.

Our undergraduate and graduate teaching programs are strong and our Ph.D. program is growing. We instituted a new Ph.D. fellowship program which has attracted a larger pool of applicants. We have developed several tracks in our undergraduate program which include games programming, security, embedded systems, robotics, data mining and bio-informatics. The outreach program is targeting K-12 education as well as state and national industries.

Because the 2009 report cannot cover all of the CIS accomplishments for the year, please visit our Website at http://www.cis.ksu.edu for a more complete picture.

Gurdip Singh
Department Head
Computing and Information Sciences
Kansas State University

Security

FEATURE

CAREER: Finding sustainable solutions to the cybersecurity problem

Cyber security is an asymmetric warfare: the attackers only need to find one hole to compromise a system, whereas the defenders have to plug them all. The Argus group (http://people.cis.ksu.edu/~xou/argus/) led by Dr. Simon Ou of the CIS department at Kansas State University seeks to find scientific methodologies to tilt the playground towards the cyber defenders' advantage.

Ou has been focusing on network security defense ever since his Ph.D work at Princeton University. Enterprise networks have become essential to the operation of companies, laboratories, universities, and government agencies. As they continue to grow both in size and complexity, their security has become a critical concern. Vulnerabilities are regularly discovered in software applications which are exploited to stage cyber attacks. Currently, management of security risk of an enterprise network is more an art than a science. System administrators operate by instinct and experiences rather than relying on scientific methods and metrics to guide and justify decision making.

Two actively pursued research thrusts of the Argus group are network risk mitigation based on quantitative security metrics, and evidential reasoning to automatically apprehend intrusions and breaches. Both thrusts center on the theme of reasoning under uncertainty in cyber security.

"Incomplete, vague knowledge and inaccurate information is an inconvenient truth for cyber security," said Ou. "We wish to have absolute judgments like 'this system is secure.' But in reality there can never be an absolutely secure system. People constantly balance risk and cost, but in cyber space the risks are not always easy to see let alone measure."

To make things even more difficult, there is virtually no useful data publicly available for this type of security research. To tackle these challenges, Ou and his team have been adopting a somewhat unorthodox approach in their pursuit.

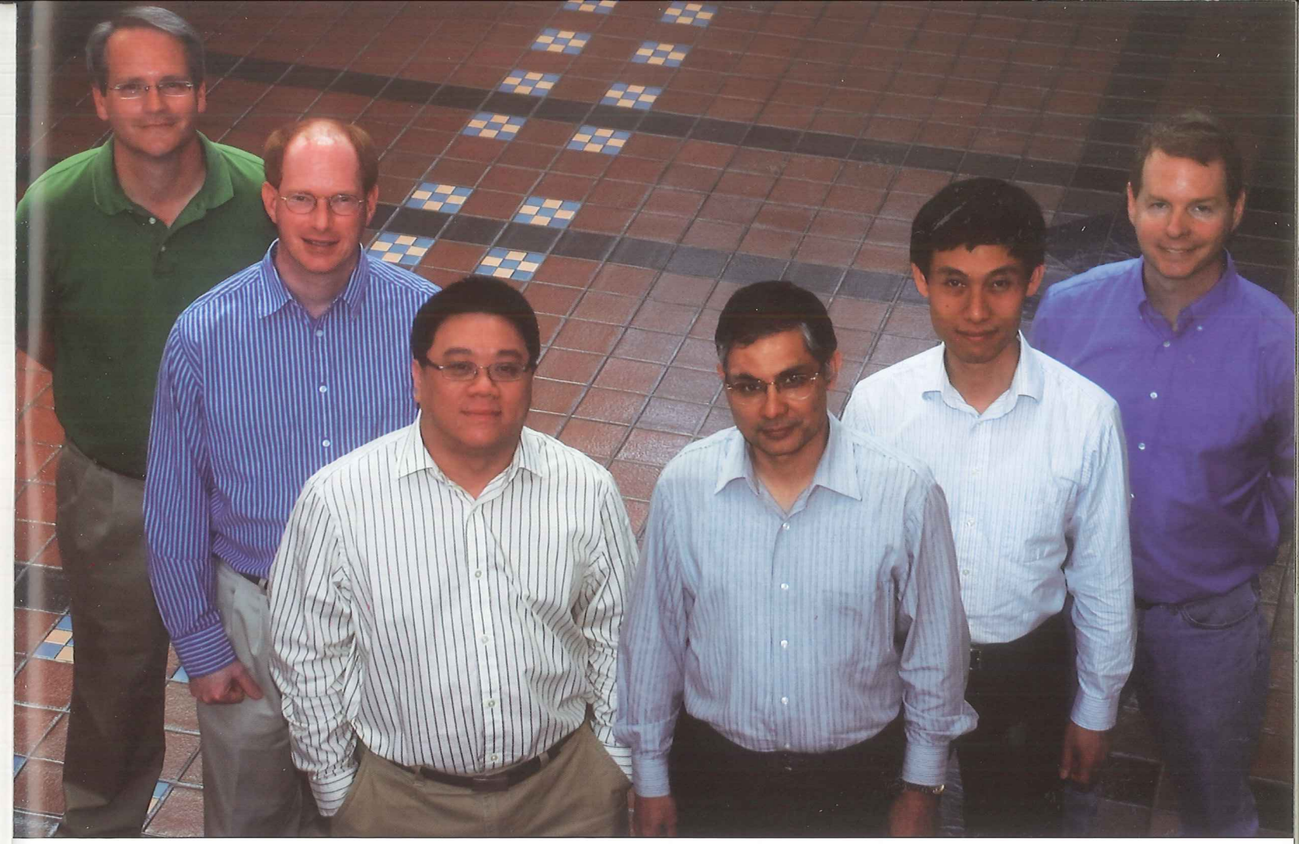
It is called the "empirical approach," where instead of starting from theories, Argus and its industrial collaborators decided to let empirical experiments guide the theory development process. They start by studying how cyber defenders in the trench handle security incidents, and try to extract the essence of such reasoning processes in a semi-formal way. This provides a spiral theory development process, where reasoning models are developed that to some degree simulate human thinking. Then the researchers apply prototype tools to fresh new data from production systems and see how they fare. The experiments will reveal gaps and deficiencies in the empirically developed model, and will provide crucial hints on what theories will be most effective in addressing the limitations, leading to the next round of theory development, and the process goes on. Ou hopes that eventually this constant empirical evaluation of research models will lead to a well-formed theoretical foundation which is also firmly grounded in reality.

"A key enabler of this research methodology is the strong local support we get in setting up the in-house data-collection facility," said Ou. "The CIS department and the university IT security officer provide important resources and access so that we can collect a range of data from the CIS departmental network."

This live data stream has helped the Argus team obtain a number of key insights into the current research model they are working on. They hope eventually their research prototype will also prove useful to system administrators who have been helping the research efforts all along.

Recently, this empirical research methodology got a boost from the National Science Foundation, in the form of a nearly $430K CAREER Award to Dr. Ou in support of this effort titled "Reasoning under Uncertainty in Cybersecurity." While acknowledging this is a high-risk research, the academic peers who evaluated the proposal believed that this methodology is promising and perhaps the best approach we have today.

"I believe it works and I can show it," said Ou.



Scott Deloach
Autonomous Reorganization of Cooperative Robotic Teams for Robustness
Multiagent Systems
4/1/04-3/31/10

John Hatcliff
Partial Evaluation Tool Set for Automatically Customizing Adaptable Software
Software Engineering and Program Specialization
8/1/98-6/30/02

Robby
Formal, Integrated Analysis Framework for Contract-Based Reasoning of Strong Properties of Open Systems
Formal Methods
4/15/07-3/31/10

Daniel Andresen
DESPOT: Enhanced Dynamic Process Management for Beowulf Clusters on the Grid
Distributed Systems / High Performance Computing
9/15/01-8/31/07

Xinming (Simon)Ou
Reasoning about Uncertainty in Cybersecurity
Security
3/1/10-2/28/15

Gurdip Singh
Modular Design of Protocols
Distributed Computing
5/1/95-4/30/99

Not Pictured:
Anindya Banerjee
Type Systems and Program Analyses for Secure and Reliable Interactive Web Services
Language -based Security/Program Analysis
9/1/01-8/31/07

Matthew Dwyer
Engineering High-Quality Concurrent Software
Program Verification
5/1/97-5/31/02

Eight CIS CAREER Awardees

FACULTY

Faculty

Gurdip Singh

Ph. D., Computer Science, State University of New York at Stony Brook, 1991
M. S., Computer Science, State University of New York at Stony Brook, 1989
B. Tech, Computer Science and Engineering, Indian Institute of Technology, 1986

Research: Distributed algorithms, middleware services, sensor networks, optimization, modular design.

Teaching: Distributed computing, network protocols, operating systems, embedded systems.

Torben Amtoft

Ph.D., Computer Science, University of Aarhus, 1993
M.Sc., Computer Science, University of Copenhagen, 1989
B.Sc., Mathematics and Computer Science, University of Copenhagen, 1985

Research: Program analysis, language-based security, program slicing, information-flow analysis, dependency analysis.

Teaching: Databases, algorithms, logic and verification, formal language theory, programming languages.

Daniel Andresen

Ph.D., Computer Science, University of California, Santa Barbara, 1997
M.S., Computer Science, California Polytechnic State University, SLO, 1992
B.S., Computer Science and Mathematics, Westmont College, 1990

Research: Parallel and distributed computing, scheduling and run-time systems, high-performance scientific computing, distributed-sensor networks, telemedicine.

Teaching: Operating systems, distributed systems, computer architecture, WWW technology.

Anindya Banerjee

Ph.D., Computing and Information Sciences, Kansas State University,1995
M.S., Computer and Information Sciences, University of Delaware, 1989
B.C.S.E., Computer Science and Engineering, Jadavpur University, 1987

Research: Logic-based program analysis and verification, programming language-based computer security, modular reasoning and checking of programs, abstract interpretation, concurrency, program transformation, type systems.

Teaching: Programming languages, program analysis, language-based security, logical foundations of computer science.

Doina Caragea

Postdoctoral, Computer Science, Iowa State University, 2004-2006
Ph.D., Computer Science, Iowa State University, 2004
M.S., Computer Science, University of Bucharest, Romania, 1997
B.S., Computer Science, University of Bucharest, Romania, 1996

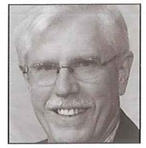
Research and teaching: Bioinformatics, artificial intelligence, machine learning, data mining and knowledge discovery, visual data mining, ontologies and information integration, information retrieval and semantic web.

Scott A. DeLoach

Ph.D., Computer Engineering, Air Force Institute of Technology, 1996
M.S., Computer Engineering, Air Force Institute of Technology, 1987
B.S., Computer Engineering, Iowa State University, 1982

Research: Applying software engineering methods, techniques, and models to design and development of intelligent, complex, adaptive, and autonomous multiagent systems; building tools and techniques necessary to design and build cooperative robotic systems; building and developing hybrid intelligent systems that include humans, software agents, and mobile hardware agents.

Teaching: Agent-oriented software engineering, software engineering, software management.



David A. Gustafson

Ph.D., Computer Science, University of Wisconsin, 1979
M.S., Computer Science, University of Wisconsin, 1973
B.S., Meteorology, University of Utah, 1969
B.S., Mathematics, University of Minnesota, 1967

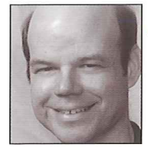
Research and teaching: Software engineering, software metrics, software testing, design analysis, robotics, vision, face recognition, emotion recognition, biometrics, healthcare applications of robots.

John Hatcliff

Ph.D., Computer Science, Kansas State University, 1994
M.Sc., Computer Science, Queen's University, Kingston, Ontario, Canada, 1991
B.A., Computer Science/Mathematics, Mount Vernon Nazarene College, 1988

Research: Formal methods in software engineering, software verification, security analysis and certification, model checking, static analyses of programs, concurrent and distributed systems, middleware, model-integrated computing, semantics of programming languages, compiler construction, logics and type theory.

Teaching: Foundations of programming languages, software specification and verification, logic and set theory, construction of concurrent systems, compiler construction, formal language theory, software engineering, functional programming, logic programming.



Rodney Howell

Ph.D., Computer Science, The University of Texas at Austin, 1988
B.S., Computer Science, Wichita State University, 1984

Research: Real-time scheduling, algorithm analysis, self-stabilizing systems.

Teaching: Analysis of algorithms, data structures, formal language theory, symbolic logic, real-time scheduling theory.

William Hsu

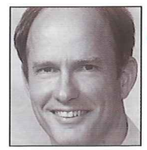
Ph.D., Computer Science, University of Illinois at Urbana-Champaign, 1998
M.S., Computer Science, Johns Hopkins University, 1993
B.S., Computer Science and Mathematical Sciences, Johns Hopkins University, 1993

Research: Laboratory for Knowledge Discovery in Databases (KDD)—research group emphasizing machine learning and intelligent systems.

Masaaki Mizuno

Ph.D., Computer Science, Iowa State University, 1987
M.S., Computer Science, Pennsylvania State University, 1982
M.S., Electrical Engineering, Keio University, Japan, 1980
B.S., Electrical Engineering, Keio University, Japan, 1978

Research and teaching: Operating systems, distributed systems, real-time embedded systems, object-oriented systems.

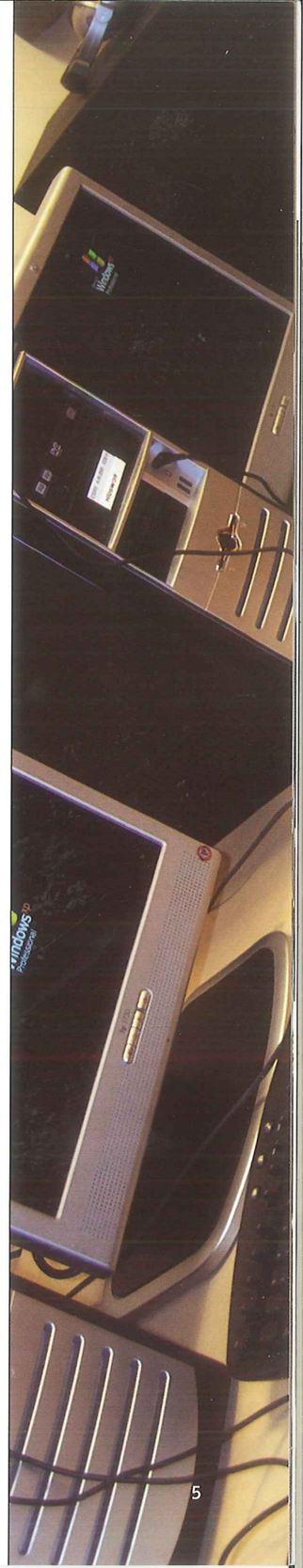


Mitch Neilsen

Ph. D., Kansas State University, Computer Science, 1992
M.S., Kansas State University, Computer Science, 1989
M.S., Kansas State University, Mathematics, 1987
B.S., University of Nebraska-Kearney, Mathematics, 1982

Research: Distributed computing systems, real-time embedded systems, computational engineering, natural resources.

Teaching: Computer architecture, operating systems, networking, real-time systems.



Faculty

Faculty

Xinming (Simon) Ou

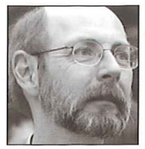
Ph.D., Computer Science, Princeton University, 2005
M.E., Computer Science, Tsinghua University, 2000
B.E., Computer Science, Tsinghua University, 1998

Research and teaching: Computer security, enterprise network defense, intrusion detection and analysis, security metrics, programming languages, High assurance systems.

Robby

Ph.D., Computer Science, Kansas State University, 2004
M.S., Computer Science, Kansas State University, 2000
B.S., Computer Science, Oklahoma State University, 2000

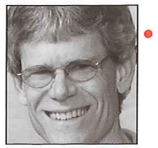
Research: Software verification, specification, analysis, transformation, specialization, testing, software engineering, model-driven software development.
Teaching: Specification and verification of software, programming languages, compiler design and implementation.



David A. Schmidt

Ph.D., Computer Science, Kansas State University, 1981
M.S., Computer Science, Kansas State University, 1977
B.A., Mathematics, Fort Hays State University, 1975

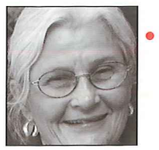
Research: Abstract interpretation, static program analysis, denotational semantics.
Teaching: Programming methodology, program validation, software architecture.



Alley Stoughton

Ph.D., Computer Science, University of Edinburgh, 1987
M.S., Computer Science, University of California, Los Angeles, 1981
B.S., Mathematics/Computer Science, University of California, Los Angeles, 1979

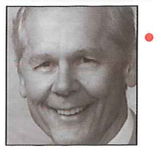
Research: Functional programming and programming languages, pedagogical approaches to and software tool support for formal language theory, programming language semantics.
Teaching: Formal language theory, functional programming, programming language semantics.



Beth Unger

B.S., Mechanical Engineering, Michigan State University, 1961
M.S., Mathematics, Michigan State University, 1963
Ph.D., Computer Science, The University of Kansas, 1978

Research: Database and knowledge system design, data security, information techonology for learning, university of the future
Teaching: Databases, data security.



Virgil Wallentine

Ph.D., Computer Science, Iowa State University, 1972
M.S., Computer Science, Iowa State University, 1970
B.S., Mathematics, Iowa State University, 1965

Research: Parallel scientific simulations, verification of concurrent software, health IT systems.
Teaching: Parallel and distributed systems, impact of computing on society.

Research

Research

Machine Learning and Bioinformatics

Bioinformatics is the field of science in which information and computer sciences are used together to manage and analyze large amounts of molecular biology data such as genomics and proteomics data. Next-generation sequencing technologies have suddenly sped up sequence data generation by orders of magnitude. Entire genomes can be sequenced and assembled within days (for microbes), weeks (for mid-size genomes), or months (for larger genomes), resulting in vast amounts of potentially useful sequence data. The significance of sequencing many diverse genomes cannot be overstated. However, without sophisticated and efficient computational approaches to data management and analysis, the scientific community will simply be unable to take advantage of the great opportunities offered by the next-generation sequencing technologies. Bioinformatics plays an essential role in this "arena" and has the potential to contribute to critical advances in life sciences. Such advances will have direct applications in biotechnology, accelerating the design of cost-effective biofuels, biomaterials, disease-resistant crops, and new therapies.

The machine-learning and bioinformatics (MLB) group at K-State has been involved in several interdisciplinary projects that focus on machine-learning approaches to bioinformatics problems including identification of protein-coding genes and regulatory elements, prediction of alternative splicing events, and discovery of protein localizations and functions. Several genome annotation projects, partially funded through grants from NSF, Ecological Genomics Institute, and Arthropod Genomics Center at K-State, are described below:

- Identification of regulatory elements is important for understanding gene regulation. To address this problem, the MLB group has cast the transcription problem as a machine learning prediction problem using a motif-based feature representation of the data. Motifs that are highly predictive for transcription are identified as regulatory elements.

- Alternative pre-mRNA splicing is an important means for increasing proteome diversity. Alternative splicing is believed to be regulated by splicing factors that bind to regulatory elements, calledsplicing motifs or enhancers/silencers. The MLB group has studied the predictive power of a large set of gene features that have been experimentally shown to have effects on alternative splicing. Their results emphasize the importance of motif features for accurately predicting alternative splicing.

- The MLB group is also researching statistical and machine-learning approaches for constructing gene regulatory networks using gene expression data together with sequence data. The ultimate goal of this project is to use the resulting networks to predict how variation in genes affects the overall pathways and, consequently, responses to deterrent conditions or environments.

The approaches used in the projects described above rely on supervised learning techniques, which assume that labeled data is readily available. However, supervised learning techniques will not meet the challenges that the bioinformatics and biology communities are now faced with in the form of massive amounts of data accumulating every day. A promising solution explored by the MLB group relies on semi-supervised and domain-adaptation algorithms. Semi-supervised algorithms can learn from large amounts of unlabeled data along with small amounts of labeled. Furthermore, domain-adaptation algorithms can transfer knowledge from a well-labeled source domain to a related (although not identical) scarcely labeled (if at all) target domain. Bioinformatics is one area that could greatly benefit from semi-supervised and domain- adaptation algorithms while, at the same time, it can contribute to a better understanding of such algorithms.

The computational methodologies and tools developed by the MLB group and their collaborators are relevant not only in genomics, but also to a number of data-intensive applications in other areas that are rich in "next-generation-type" data such as proteomics, lipidomics, metabolomics, and possibly even media data (e.g., blog data). Biological findings are driven by and shared with the Bioinformatics Center, Ecological Genomics Institute (EGI), Arthropod Genomics Center (AGC), and Kansas Lipidomics Research Center (KLRC) at Kansas State University.

RESEARCH

Research

Argus Group—Cyber Security Research

http://people.cis.ksu.edu/~xou/argus/

CISA—Center for Information and Systems Assurance

http://www.cisa.ksu.edu

The Argus group carries out cyber security research under the direction of Dr. Simon Ou. Argus' focus is on the defense aspect of cyber warfare, and our philosophy is that successful cyber defense can only be achieved through automated coordination of various observation and action points in an enterprise environment. Traditional solutions like firewalls and IDS systems are limited in effectiveness since they only look at one aspect of the system and lack the capability of "connecting the dots" among various information sources to gain a global picture of a system's security status. Our research aims at providing enabling technologies for such automated correlation and analysis with solid theoretical foundation and empirical study.

Argus is part of the Center for Information and Systems Assurance (CISA) at Kansas State University, an umbrella organization established in 2009 for all cybersecurity and information assurance research in the university. Faculty at CISA conduct research in computer and network security, high-assurance software systems, language-based security, security in health IT systems, and security in distributed sensor systems. CISA has extensive collaboration with a number of external industry and government partners such as Rockwell Collins, HP Labs, DRDC-Ottawa, National Institute of Standards and Technology, Idaho National Laboratory, IAI Inc., and Telcordia Technologies. Research in CISA is funded by the National Science Foundation, Department of Defense, and a number of industry partners.

Machine Learning and Bioinformatics (MLB) Group

http://people.cis.ksu.edu/~dcaragea/mlb

The MLB group aims to design algorithms and develop tools for analyzing large amounts of data, in particular, molecular sequence and gene-expression data. Main projects focus on the following:

- ontology engineering and classifier learning from semantically heterogeneous data sources
- EST data analysis, alternative splicing discovery and gene prediction
- gene regulatory network discovery from gene-expression data and sequence information

The MLB group is collaborating with the artificial intelligence and machine learning group at Iowa State University to produce an open-source system for knowledge acquisition and information integration from semantically heterogeneous data sources (NSF funding), and with the Bioinformatics Center at Kansas State University to produce bioinformatics and genomics tools (funding from K-State EcoGen and Targeted Excellence Program).

Collaborative Work on Computational Engineering – M. Neilsen

www.damsafety.info

The U.S. Department of Agriculture (USDA) and U.S. Army Corps of Engineers (USACE) are partnering with Kansas State University to incorporate research and field experience into computational tools for use in design and analysis of water-control structures. These tools provide the basis for optimal use of natural materials such as vegetation to protect embankments and spillways. Tools developed or under development through this cooperative work were highlighted in a booth at the Association of State Dam Safety Officials' (ASDSO) Annual Conference in 2009. Current work involves developing tools to analyze breach failures and tools to perform risk assessment across the United States. Other computational engineering research uses finite-element analysis (FEA) to develop a turbo solder interconnect preditor (Sandia TurboSIP) tool to evaluate Pb-free solder joints in electronic control packaging for satellite systems, etc.

Distributed Systems Lab

http://www.cis.ksu.edu/beocat

The Distributed Systems Lab supports a wide range of interdisciplinary research around a core interest in efficient, effective distributed systems. Key projects include the K-State research computing cluster, BeoCat, the largest academic cluster in Kansas with 1,000 cores; enhancing the efficiency of SOAP/XML communications; medical informatics; ecological modeling; and veterinary telemedicine. Our work is frequently cross-disciplinary and common collaborators go beyond engineering, ranging from agricultural economics to veterinary medicine. Since 1998, the Distributed Systems Lab has received funding from agencies such as the National Science Foundation, U.S. Food and Drug Administration, U.S. Department of Agriculture and NSF EPSCoR.

KDD Lab

http://www.kdd.cis.ksu.edu

The laboratory for Knowledge Discovery in Databases (KDD lab) aims at developing technologies for building models of events and processes from data, and then using these models to help make decisions. Research in the KDD lab focuses on developing algorithms and techniques for the following:

- data mining, machine learning, and probabilistic reasoning over large data sets and text collections
- human language technologies: computational linguistics and information extraction
- visualizing, learning, and reasoning about events and event streams
- analysis of spatial data: georeferencing, spatial outlier detection, deduplication, etc.
- modeling cognitive processes to better understand how humans reason about causality,
- especially with spatial and temporal data.

Applications of these algorithms include software tools for bioinformatics, epidemiology,health informatics, computational physics, sensor network optimization and computer security.

Tools developed by the lab have been used by the Department of Defense, Office of NavalResearch (ONR), Army Research Lab (ARL), National Agricultural Biosecurity Center (NABC) and Kansas Department of Transportation (KDOT). Federal and corporate sponsors of the KDD lab since 1999 include the NSF, DHS, ONR, ARL, Raytheon and American Diagnostic Medicine.

The KDD lab maintains a research collaboration with the University of Illinois at Urbana-Champaign, including the National Center for Supercomputing Applications (NCSA).

The MultiAgent and Cooperative Robotics Laboratory

http://macr.cis.ksu.edu

(MACR) focuses on applying software engineering methods, techniques, and models to the design and development of intelligent, complex, adaptive, and autonomous multiagent systems. Current research focuses on building the tools and techniques necessary to design and build cooperative robotic systems, where the robots work autonomously, but cooperate as part of a team. This research also includes building and developing hybrid intelligent systems that include humans, software agents and mobile hardware agents. Key elements of this work are—

- a set of methods and techniques for analyzing and designing complex, adaptive systems.
- a set of organization-based models upon which the system analysis, design, and implementation are based.
- a set of generic technologies that implement organization-based models.
- a set of multiagent and cooperative robotic systems used to demonstrate our approaches.

The lab has produced the organization-based multiagent systems engineering methodology (OMaSE) and its associated agentTool development environment. The MACR Lab is collaborating with the Human-Machine Teaming Laboratory at Vanderbilt University to integrate humans as teammates into cooperative robotics teams. Since 2002, the MACR Lab has received more than $3.8 million in funding from the National Science Foundation, the Air Force Office of Scientific Research, United States Marine Corps, M2 Technologies, and Stanfield Systems Inc.

SAnToS Laboratory

http://santos.cis.ksu.edu

The Sensor Networks Laboratory is conducting research to develop tools and methodologies for development of sensor applications, and supports multidisciplinary research that draws on faculty expertise from several disciplines. The lab has the following goals:

- Develop model-driven tools for designing and deploying
- large-scale sensor networks.
- Provide the infrastructure support necessary to enable K-State researchers to perform multidisciplinary research and address challenges posed by the next generation of sensor systems.
- Provide laboratory support in various courses to educate and train students for networking and distributed computing research.

The lab has been supported by the K-State's Targeted Excellence Program to promote multidisciplinary research, and instrumentation grants from NSF and DoD. Multidisciplinary projects in the areas of veterinary telemedicine, hydrology, grain science, agronomy, agricultural engineering, and environmental monitoring are being pursued in collaboration with researchers from several departments in engineering, veterinary medicine, agronomy, and agriculture.

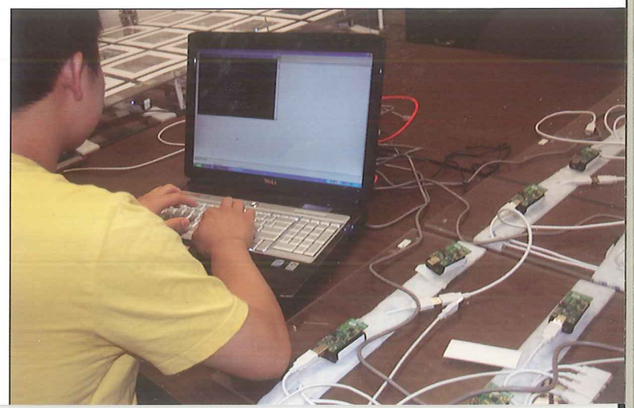
The Sensor Networks laboratory

http://persnl.cis.ksu.edu

The Sensor Networks Laboratory is conducting research to develop tools and methodologies for development of sensor applications, and supports multidisciplinary research that draws on faculty expertise from several disciplines. The lab has the following goals:

- Develop model-driven tools for designing and deploying large-scale sensor networks.
- Provide the infrastructure support necessary to enable K-State researchers to perform multidisciplinary research and address challenges posed by the next generation of sensor systems.
- Provide laboratory support in various courses to educate and train students for networking and distributed computing research.

The lab is currently supported by the K-State's Targeted Excellence Program to promote multidisciplinary research. With additional instrumentation support grants from NSF and DoD, an experimentation test bed has been established to rapidly prototype large-scale sensor applications and to evaluate developed technologies. Multidisciplinary projects in the areas of veterinary telemedicine, hydrology, grain science, agronomy, agricultural engineering and environmental monitoring are being pursued in collaboration with researchers from several departments in engineering, veterinary medicine, agronomy and agriculture.



PUBLICATIONS

- Alanazi, M., and Gustafson, D. "Detecting Inconsistencies in Multiple UML Diagrams." In: MASAUM Journal of Basic and Applied Sciences (MJBAS) Volume 1, Issue 3, October 2009.
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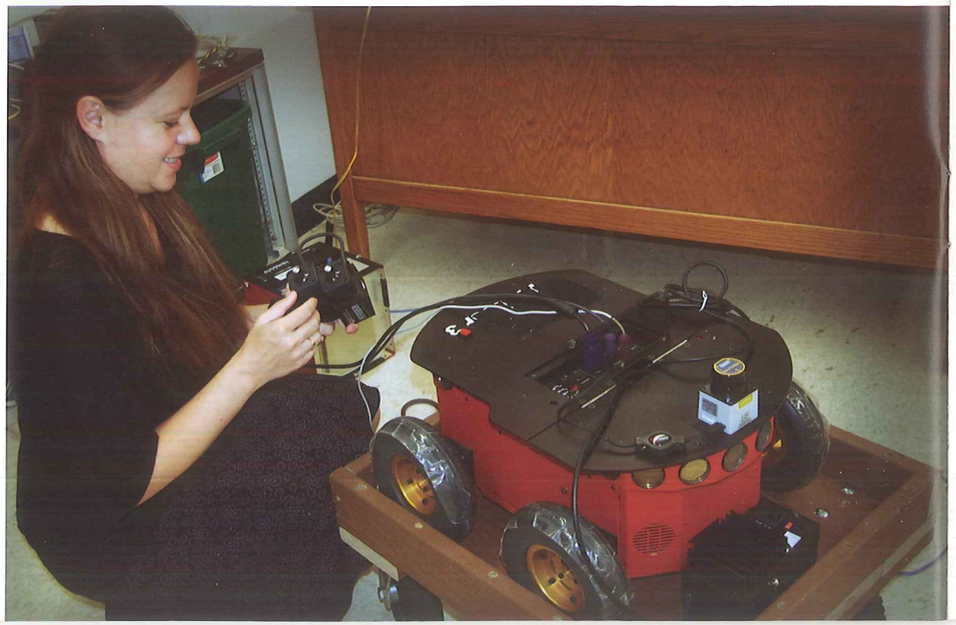


GRANTS

Amtoft

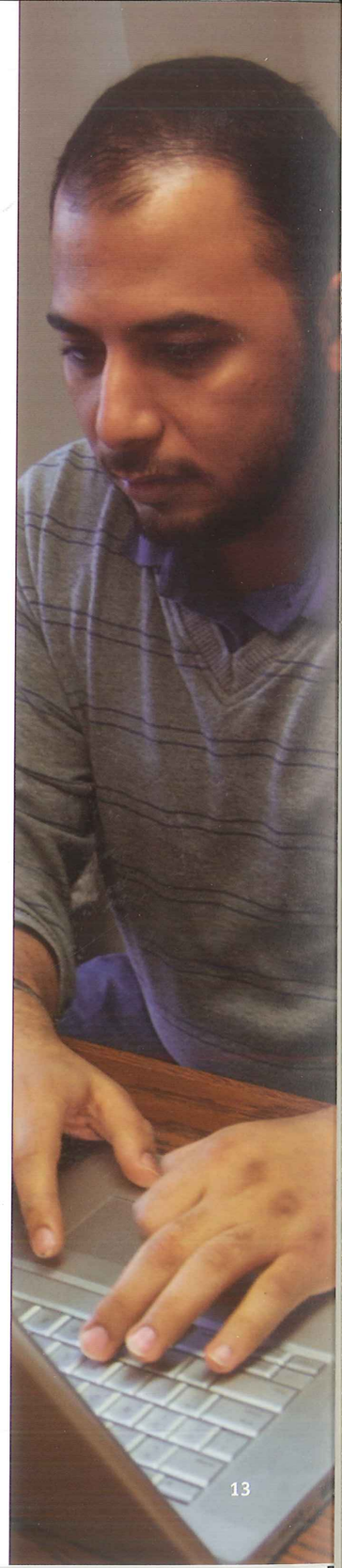
- PI, National Science Foundation, Cyber Trust Program, "Collaborative Research: Access Control and Downgrading in Information-Flow Assurance," $200,000, Sept. 2006 – Aug. 2009.
- Co-PI (PI John Hatcliff, co-PIs Xinming Ou, Robby, Andrew Appel (Princeton)), Air Force Office of Scientific Research, "Evidence-based Trust in Large-scale MLS Systems", $3,000,000, May 2009 -- August 2014.
- Co-PI (PI John Hatcliff, co-PIs Xinming Ou and Robby), Rockwell Collins Advanced Technology Center, "A Domain Specific Language for Defining High-Assurance Secure-Network Guards", $170,000, October 2008 -- August 2010.

Andresen

- Co-PI, NSF CPS (Award no. 0932289), "CPS:Medium:Collaborative Research:Infrastructure and Technology Innovations for Medical Device Coordination," $839,548 September, 2009.
- Senior personnel, NSF CNH (Award no. 0909515), "Hyper-extractive Economies and Sustainability: Policy Scenarios for Sustainable Water Use in the High Plains Aquifer," $1.5M September, 2009.
- Co-PI, (with PI Walter Dodds et al.), NSF EPSCoR RII Track II (Award no. 0919443), "Oklahoma and Kansas: A cyberCommons for Ecological Forecasting," $3M ($1.5M to K-State, $6M between KS and OK) September 2009 – August 2012.
- Senior personnel (with Henry Neeman, OU, et al.), NSF CI-TEAM, "CI-TEAM Demonstration Project: Cyberinfrastructure Education for Bioinformatics and Beyond," $249,974, December 2006 – 2009.
- Senior personnel (with Dave Steward, Steve Welch, Eric Bernard, Jeffrey Peterson), NSF EPSCOR, NSF EPSCOR, "Ecoforecasting Kansas," $6,750,000, April 2006–2010.
- Co-PI, KSU Targeted Excellence Award (with Gurdip Singh et al.), "Center for Sensors and Sensor Systems," up to $1M, summers 2005–2009.
- PI, NSF REU, "Veterinary Telemedicine: Proactive Herd Health Management for Disease Prevention from Farm to Market," $12,000, May 2005–2009.
- PI, NSF REU, "Veterinary Telemedicine: Proactive Herd Health Management for Disease Prevention from Farm to Market," $12,000, May 2004–2009.
- PI, NSF ITR, "Veterinary Telemedicine: Proactive Herd Health Management for Disease Prevention from Farm to Market," $899,996, September 2003–2009.
- Co-PI (PI John Hatcliff and Co-PIs Simon Ou and Robby), Rockwell Collins Advanced Technology Center, "A Domain-Specific Language for Defining High-Assurance Secure-Network Guards," $85,000, September 2008–August 2009.

Caragea

- Co-PI (with Steve Welch PI and Sanjoy Das co-PI), NSF, Cyberinfrastructure Implementation for Genotype to Phenotype Research. Award amount: $103,250, 2009- 2010.
- Senior personnel, (with PI Walter Dodds, co-PI Daniel Andresen et al.), NSF, Collaborative Research: EPSCoR RII Track 2 Oklahoma and Kansas: "A cyberCommons for ecological forecasting," $3M ($1.5M to K-State, $6M between KS and OK) September 2009 – August 2012.
- PI (with PI Vasant Honavar , ISU), NSF, Collaborative Research, "Learning Classifiers from Autonomous, Semantically Heterogeneous, Distributed Data," $145,504, July 2007–June 2010.
- Co-PI (PI Haiyan Wang, co-PI Susan J. Brown), Research Grant, Computational Methods to Characterize Regulatory Networks Involved in Plant Response to Abiotic Stresses. KSU Ecological Genomics Seed Grant (2008–2009). $35,589.
- Co-Principal investigators: Eduard Akhunov, Bikram Gill, Frank White,



GRANTS

Grants

Karen Garrett, James Nelson, Susan Brown, Loretta Johnson, Michael Herman, Jianming Yu, Sanjeev Narayanan, Ludek Zurek, and Doina Caragea. Advanced Genomics at K-State: Ultra-High Throughput DNA Sequencing. KSU Targeted Excellence Program, 2008–2011, $850,000.

Deloach

- PI, (with co-PI Adams, J.), Human-robot teams informed by human performance moderator functions. Air Force Office of Scientific Research (AFOSR/NM). June 2009 – May 2012, $604,480.
- PI (with Co-PIs, Gustafson, D., Adams, J.), Controlling Robot Teams in Urban Environments (Single-Platform Multi-Sensor Control System). US Marine Corp/M2 Technologies/K-State Urban Operations Lab. 2007–2010, $465,000.
- Co-PI (with Singh, G., Natarajan, B., Warren, S., Andresen, D.), CRI: An Experimentation Platform for Developing Customized, Large-Scale Sensor Systems (NSF). 2006–2009. $200,000.
- Co-PI (with Singh, G., McGregor, D., Edgar, J., et al.), KSU Targeted Excellence Award, Center for Sensors and Sensor Systems, 2006–2010, $1,500,000.

Gustafson

- Co-PI (with Co-PIs, Gustafson, D., Adams, J.), Controlling Robot Teams in Urban Environments (Single-Platform Multi-Sensor Control System). US Marine Corp/M2 Technologies/K-State Urban Operations Lab. 2007–2010, $465,000.

Hatcliff

- Co-PI (with PI Gregg Rothermel, co-PIs Matthew Dwyer, Sebastian Elbaum, Greg Rothermel), NSF CNS, "CRI: Collaborative Research: A Community Resource to Support Controlled Experimentation with Program Analysis and Software Testing Techniques," $1,106,576, August 2005 – July 2009.
- PI (with co-PIs Daniel Andresen, Robby, Steve Warren). Infrastructure and Technology Innovations for Medical Device Coordination. (US National Science Foundation -- CNS 0932289). NSF Collaborative Grant with the University of Pennsylvania. Total Amount: $1,500,000, KSU Portion: $839,548. Duration: September 2009 -- August 2012.
- PI (with co-PIs Torben Amtoft, Simon Ou, Robby, Andrew Appel (Princeton University)). Evidence-based Trust in Large-scale MLS Systems (US Air Force Office of Scientific Research -- Contract Number FA9550-09-1- 0138). $3,000,000. Duration: May 2009 -- August 2014.
- PI (with co-PIs Dan Andresen, Robby, Steve Warren), National Science Foundation, "Development of an Open Test Bed for Application of Formal Methods to Plug-and-Play Medical Device," $55,000, September 2007 – August 2008.
- PI, Automatic Analysis Techniques for Discovering Information Flow Properties of Cryptographic Controllers, Rockwell Collins Advanced Technology Center, $110,000, October 2008–August 2009.
- PI (with Co-PIs Torben Amtoft, Simon Ou, and Robby), Rockwell Collins Advanced Technology Center, A Domain-Specific Language for Defining High-Assurance Secure-Network Guards," $170,000, September 2008–August 2009.

Hsu

- Co-PI (with PI Marty Vanier), Simulative Models for Prediction of Epidemics, Department of Defense, $50000, Apr 2009 - Mar 2010
- Co-PI (with PI Marty Vanier), Multimodal Information Extraction: The Predictive Epidemiology Domain, Department of Defense, $150000, 01 Apr 2009 - 31 Mar 2010
- Co-PI (with PI Johanna Schmitt, co-PIs Stephen M. Welch, KSU; Richard Amasino, University of Wisconsin-Madison; Michael Purugganan), National Science Foundation, "Frontiers in Integrative Biological Research (FIBR)," September 2004 – August 2009.
- Co-PI (with PI Marty Vanier), Department of Defense, "Information Extraction for Focused Crawling and Search: The Predictive Epidemiology Domain," $250,000, May 2008–June 30, 2009.

Neilsen

- PI, USDA/ARS: Software Tools for Watershed Dam Design and Analysis. $106,900, 4/18/2005 – 4/17/2010 (completed in 2009).
- PI, USDA/NRCS: Integration of Spillway Erosion Technology and WinTR-20 with WinDAM. $25,000, 8/1/2007 – 5/17/2009. This project is funded by USDA/NRCS through USDA/ARS.
- PI, USDA/ARS: Development of Software Tools for Predicting Embankment Erosion of Earthen Dams. $40,000, 9/1/2007 – 9/30/2011.
- PI, Sandia National Laboratories: Sandia-TurboSIP: Sandia Turbo Solder Interconnect Predictor Tool. $40,000, 3/1/2008 – 9/31/2009.

Ou

- PI, National Science Foundation, "CT-ISG Model-Based, Automatic Network Security Management," $258,500, August 2007 – July 2010.
- Co-PI, A Domain-Specific Language for Defining High-Assurance Secure-Network Guards. Rockwell Collins, Inc. $170,000, 9/22/2008–8/31/2009.
- Co-PI (with co-PIs Torben Amtoft, Simon Ou, Robby, Andrew Appel (Princeton University)). Evidence-based Trust in Large-scale MLS Systems (US Air Force Office of Scientific Research -- Contract Number FA9550-09-1- 0138). $3,000,000. Duration: May 2009 -- August 2014.

Robby

- PI, National Science Foundation (NSF) Faculty Early Career Development (CAREER), "CAREER: A Formal, Integrated Analysis Framework for Contract-Based Reasoning of Strong Properties of Open Systems," $400,000, April 2007 – March 2012.
- Co-PI (with PI Gary Leavens, University of Central Florida; co-PIs Samik Basu, Iowa State University; Yoonsik Cheon, University of Texas at El Paso; Curtis Clifton, Rose-Hulman Institute; Cormac Flanagan, University of California at Santa Cruz; David Naumann, Stevens Insitute of Technology; Hridesh Rajan, Iowa State University), National Science Foundation (NSF) Computing Research Infrastructure (CRI), "Collaborative Research: CRI: CRD: A JML Community Infrastructure–Revitalizing Tools and Documentation to Aid Formal Methods Research," $895,000, K-State's portion: $220,000, July 2007–June 2010.
- Co-PI (with PI John Hatcliff and Co-PIs Torben Amtoft and Xinming Ou), Rockwell Collins Advanced Technology Center, "A Domain-Specific Language for Defining High-Assurance Secure-Network Guards," $170,000, September 2008–August 2009.
- Co-PI (with PI John Hatcliff, and co-PIs Torben Amtoft and Xinming Ou at K-State; Andrew Appel at Princeton University) on Evidence-based Trust in Large-scale MLS Systems, Air Force Office of Scientific Research (AFOSR), project total: $3,000,000, K-State's portion: $2,012,500, March 2009 - November 2014.
- Co-PI (with PI John Hatcliff, and co-PIs Daniel Andresen, Steven Warren at K-State; Insup Lee, and Oleg Sokolsky at University of Pennsylvania) on CPS:Medium:Collaborative Research: Infra structure and Technology Innovations for Medical Device Coordination, National Science Foundation (NSF) CNS-0932289, project total: $1,500,000, K-State's portion: $840,000, September 2009 - August 2012.

Schmidt

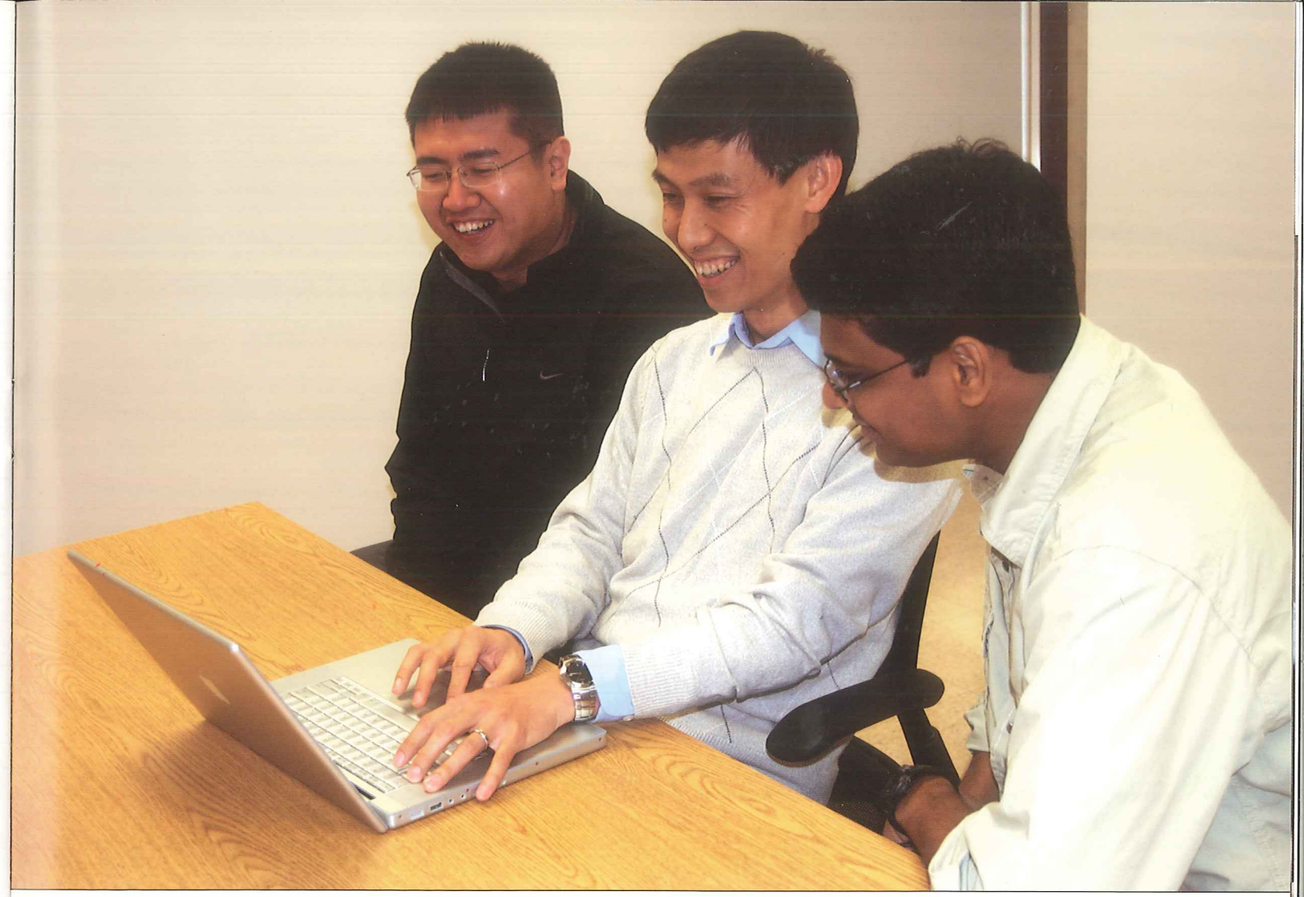
- PI, NSF CNS-0939431, Abstract Parsing: Static analysis of dynamically generated string output, August 2009--July 2011, $299,327.
- PI, Subcontract NSF ITR-0326577, Language-based software security, October 2003- September 2009, $135,000 (award total $900,000).

Singh

- PI, NSF CSR, "Methodologies for Customization of Distributed Algorithms and Middleware," $305,000, July 2006 – June 2010.
- PI, NSF, "Research Experience for Undergraduates Supplement," $12,000, July 2007 – June 2010.
- PI (with co-PIs Dan Andresen, Steve Warren, Scott A. DeLoach, Bala Natarajan), NSF CRI, "Experimentation Platform for Developing Customized, Large-Scale Sensor Systems," $200,000, March 2006 – March 2010.
- PI (with co-PIs Douglas McGregor, Jim Edgar and senior personnel, Scott A. DeLoach), "Center for Sensors and Sensor Systems," Targeted Excellence Program, KSU, $1,500,000, July 2006 – June 2010.
- Co-PI (with PI Scott A. Deloach, David Gustafson, John Hatcliff), Defense University Research Instrumentation Program, "Experimentation Test Bed for Large-Scale Intelligent Mobile Sensor Systems," $219,140, April 2007–March 2008.

Wallentine

- PI, K-State Targeted Excellence Program, "Bioinformatics at K-State," $925,000, 2006–2010.
- PI, Cerner CareAware Software and Hardware, Cerner Corporation, $160,000 , 2009



PROFESSIONAL
service/recognition

Professional

Amtoft
- Program committee member, 18th European Symposium on Programming (ESOP'09), 25-27 March 2009, York, United Kingdom.
- Reviewer, Studia Logica
- Reviewer, Higher-Order and Symbolic Computation

Andersen
- Reviewer, IEEE International Conference on Computational Science and Engineering (CSE'09)
- Reviewer, IEEE Engineering in Medicine and Biology Society (EMBC'09)
- NSF grant review panel member (twice)
- Review Board, Intl. Journal of Next-Generation Computing
- Program committee member, GPN Annual Meeting, Kansas City, MO, May 28-29, 2009
- Program committee member, IEEE International Conference on Computational Science and Engineering (CSE-09), Vancouver, BC, August 29-31, 2009.
- Session organizer and co-chair, ACM Local Chapter Enhancement & Organization, OU Supercomputing Symposium, Norman, OK, October 6-7, 2009
- Kansas State Collegian, quoted in article "Google introduces new operating system," by Aaron
- Weiser, Manhattan, KS, July 15, 2009
- Kansas State Collegian, quoted in article "Professors: total internet control by Obama impossible," by Karen Ingram, Manhattan, KS, September 2, 2009

Banerjee
- Program committee chair, 11th Workshop on Formal Techniques for Java-like Programs (FTfJP), a satellite workshop of ECOOP 2009
- Program committee member, 19th European Symposium on Programming (ESOP'10), March 2010, Paphos, Cyprus

Caragea
- Reviewer, IEEE Transactions on Knowledge and Data Engineering (TKDE), Elsevier, Data and Knowledge Engineering (DKE), IEEE/ACM Transactions on Computational Biology and Bioinformatics (TCBB), Multimedia Tools and Applications (MTAP)
- Program committee member, First ACM International Conference on Bioinformatics and Computational Biology (ACM-BCB), 2010
- Program committee member, The 13th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD), 2009
- Program committee member, International Joint Conferences on Bioinformatics, Systems biology and computational intelligent (IJCBS), 2009
- Program committee member, The 20th Midwest Artificial Intelligence and Cognitive Science Conference (MAICS), 2009
- Program committee member, IEEE International Conference on Bioinformatics and Biomedicine (BIBM), 2009
- Program committee member, The 21st IEEE International Conference on Tools with Artificial Intelligence (ICTAI), 2009
- Reviewer and panelist, NSF, CISE Directorate, IIS Division, 2009
- Honored with two WESP Making a Difference Awards, 2009
- Invited panelist, Spring 2009 ADVANCE Distinguished Lecture Series Luncheon

Deloach
- Panel member, NSF Robust Intelligence
- Proposal review, Air Force Office Scientific Research (AFOSR/NM)
- Editorial board, International Journal of Agent-Oriented Software Engineering
- Reviewer, The Computer Journal, 2009
- Program committee member, Intl Workshop on Agent-Oriented Software Engineering (AOSE) 2009.

- Program committee member, ACM SAC –special track on AOse Methodologies, Infrastructures, and Processes, 2009
- Program committee member, 5th IEEE Workshop on Situation Management (SIMA) 2009
- Program committee member, International Conference on Agents and Artificial Intelligence (ICAART) 2009
- Reviewer, International Conference on Autonomous Agents and Multiagent Systems (AAMAS) 2009
- Reviewer, The 2009 IEEE/RSJ International Conference on Intelligent RObots and Systems (IROS) 2009

Gustafson
- Organizing committee member, Semantic Robotic Vision Challenge, 2009.

Hatcliff
- Editorial board: International Journal for Software Tools for Technology Transfer
- Program committee member, 7th International Conference on Integrated Formal Methods (iFM 2009), Duesseldorf, Germany

Hsu
- Editorial board, Intelligent Data Analysis
- Co-Editor with S. Das, D. Caragea, and S. Welch, Computational Models of Gene Regulatory Networks

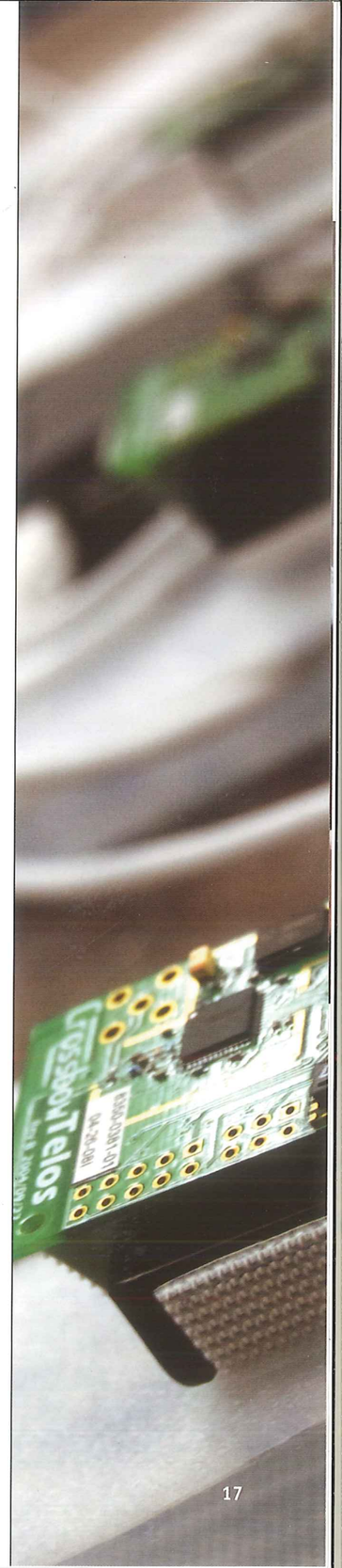
Ou
- Poster and demo co-chair, ACM Conference on Computer and Communications Security (CCS), 2009
- TPC member, Workshop on Assurable & Usable Security Configuration (SafeConfig 2009)
- Tutorial speaker, Security risk analysis of enterprise networks: techniques and challenges, ACM CCS 2009
- Reviewer for numerous journals, conferences, and funding agencies

Robby
- Research program committee member, 2009 ACM SIGPLAN International Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA).
- Co-organizer, 2009 Dagstuhl Seminar on The Java Modeling Language

Schmidt
- Program committee member, International Andrei Ershov Memorial Conference: Perspectives of System Informatics, Novosibirisk, Russia, June 2009, Springer LNCS (http://psi.iis.nsk.su/psi09/)
- Program committee member, Conference on Verification, Abstract Interpretation, and Model Checking. Madrid, Spain, January 2010, Springer LNCS (http://software.imdea.org/events/vmcai10/)
- Steering committee member, conference series on Static Analysis (SAS); conference series on Verification, Abstract Interpretation, and Model Checking (VMCAI)
- Advisory board member, Journal of Higher Order and Symbolic Computation (http://www.brics.dk/~hosc/)

Singh
- Panel member, NSF Expeditions in Computing program
- Panel member, NSF Cyber-Physical Systems program

Wallentine
- Member, Senator Roberts' Information Technology Advisory Committee
- Member, Board of Directors for the Software and Information Technology Assoc. of Kansas (SITAKS)
- Member, Kansas State Olathe Innovation Campus (KOIC) Advisory Board



Undergraduate Studies

The CIS department offers two B.S. degrees: one in information systems (IS) and one in computer science (CS). The CS degree program now has two options:

- a traditional computer science track, which focuses on foundational and scientific issues, including courses on operating systems and databases; and
- a software engineering track, which focuses on software development, including enterprise information systems, project management, software security, parallel programming and software development in a team environment.

Both degree programs allow students flexibility in their programs of study. Students are encouraged to pursue a minor or to study interdisciplinary subjects while still completing their degrees within four years.

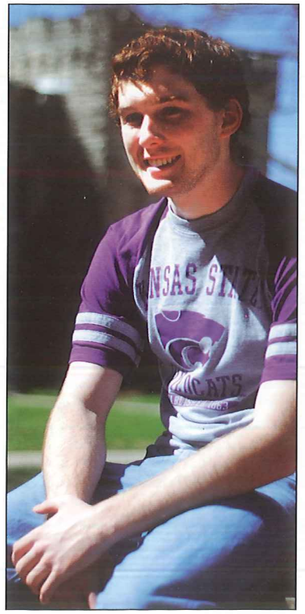
Computer science requirements for each of the three options have a core consisting of 16 credit hours and an option-specific set of 17 hours of advanced courses. The 16 credit-hour core also serves as the minor in computer science.

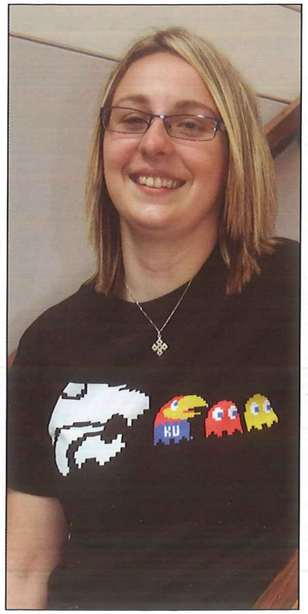
ACM Student Chapter

The local ACM chapter is a professional organization for CIS majors. Average attendance at monthly meetings is 30-40 students. Typically more than a dozen attend the ACM regional programming contest for a chance to interact with their peers and develop professional skills.

AAAI Robotics Competition

The joint undergraduate and graduate robotics team prepares to participate in robotics events at the annual convention of the Association for the Advancement of Artificial Intelligence. The team has competed each of the last five years in this event, a popular project for both undergraduate and graduate students.





Graduate Studies

The department of computing and information sciences is committed to excellence in scholarly activities in research and graduate teaching. We offer courses and a rich variety of projects in the areas of programming languages, high-assurance software, distributed computing, networking, software engineering, bio-informatics, computer security and data mining. In addition to basic research, our curriculum emphasizes collaborative and interdisciplinary research, collaboration with industrial partners, and development and distribution of software tools. We offer two master-level degrees, the master of science (M.S.) and master of software engineering (M.S.E.), and the doctor of philosophy degree in computer science. We offer the M.S.E. degree via distance learning, and a graduate certificate program in real-time embedded systems in collaboration with other engineering departments.

Admission requirements

Applicants for our graduate degrees must possess a bachelor's degree, with at least a 3.0 grade point average or equivalent, from an accredited institution. Students not possessing a degree in computer science must have background that includes the equivalent of core undergraduate computer science courses.

Areas of concentration

Programming language, high-assurance software, distributed computing, networking, software engineering, bio-informatics, computer security and data-mining.

Certificate program

Graduate certificate in real-time embedded systems.

Resources for current and prospective graduate students

- CIS admissions: *http://cis.ksu.edu/programs/grad/admissions*
- CIS research projects: *http://cis.ksu.edu/research*
- CIS profile on Peterson's Online guide: *http://graduate-schools.petersons.com*

How to apply

For a graduate applicaion and other information, contact:

Graduate Studies
Department of Computing and Information Sciences
234 Nichols Hall
Kansas State University
Manhattan, KS 66506 USA
Phone:785-532-6350; Fax: 785-532-7353;
email: cis-gradapps@ksu.edu

Advisory Board

The CIS advisory board is composed of leaders in the development and deployment of software in industry. Because software is pervasive throughout our society, these advisors are technical, management and executive leaders in a broad spectrum of industrial sectors – software development, e-commerce, health IT, transportation, manufacturing, retail, communications, wealth management, military and academe. This industrial leadership help us in three ways:

- Through industrial and university affiliations, it connects us to our alumni, practicing professionals, industry leaders, government leaders and academic researchers. These connections enable us to build collaborative relationships between academe and industry.
- It provides advice on the "state of the practice" in the software industry. This perspective helps us better prepare students for the software development profession, and better integrate our research results into real products and industrial processes.
- Advisory board members provide financial support from both personal and industry sources.

William Cary
President and CEO
Innovision Corporation

Susan Chambers
Senior Vice President, Benefits/Insurance Admin.
Wal-Mart

Katherine (Kacy) Clark
Vice President
Wellington Management Company

Terry Ecklund
Partner
Accenture

Lynn Frick
Database Administrator
Kansas State University Foundation

Dominic Gelinas
Programmer
Texas Instruments

Dr. Mary Lou Hines
Vice Provost
UMKC (Board Chair)

Connie Jaynes
Retired
Shell Oil

Martin Malley
Vice President of Information Technology
Union Pacific

Don Mounday
President
Falcon Technology Group

Shane Runquist
Software Engineer
Garmin

Mark Schonhoff
Vice President
Cerner Corp.

Ken Switzer
President
Pegasus Programming Solutions

Norman Tsiguloff
President
MileHigh Sir Speedy

Neil Tucker
Retired
PeopleSoft

Dr. Ray Vaughn
Professor and Department Head
Computer Science and Engineering
Director, Center for Computer Security Research
Mississippi State University

Dr. Tieren Zhou
Founder and President
Techexcel Corp.

Emeritus Members

Jerry Havemann
Vice President, Retired
Cargill

Jacqualine Trombly
Operations Director, Retired
Lucent Inc.

Dennis Yeo
Founder
Multigen/Paradigm

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Caragea, Doina	Assistant Professor	(785) 532-7908	Nichols 227C	dcaragea@ksu.edu
DeLoach, Scott	Associate Professor	(785) 532-7951	Nichols 324E	sdeloach@ksu.edu
Gustafson, David A.	Professor	(785) 532-7923	Nichols 227A	dag@ksu.edu
Hatcliff, John	Professor	(785) 532-7950	Nichols 324D	hatcliff@ksu.edu
Howell, Rodney R.	Associate Professor	(785) 532-7735	Nichols 227D	rhowell@ksu.edu
Hsu, William	Associate Professor	(785) 532-7905	Nichols 324C	bhsu@ksu.edu
Mizuno, Masaaki	Professor	(785) 532-7928	Nichols 227B	masaaki@ksu.edu
Neilsen, Mitchell L.	Associate Professor	(785) 532-7918	Nichols 219D	neilsen@ksu.edu
Ou, Xinming (Simon)	Assistant Professor	(785) 532-7941	Nichols 316B	xou@ksu.edu
Robby	Associate Professor	(785) 532-7904	Nichols 324B	robby@ksu.edu
Schmidt, David A.	Professor	(785) 532-7912	Nichols 219A	das@ksu.edu
Stoughton, Alley	Associate Professor	(785) 532-7906	Nichols 214	stough@ksu.edu
Unger, Elizabeth A.	Professor	(785) 532-6521	Hale 218A	beth@ksu.edu
Wallentine, Virgil	Professor	(785) 532-7365	Nichols 316C	virg@ksu.edu

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