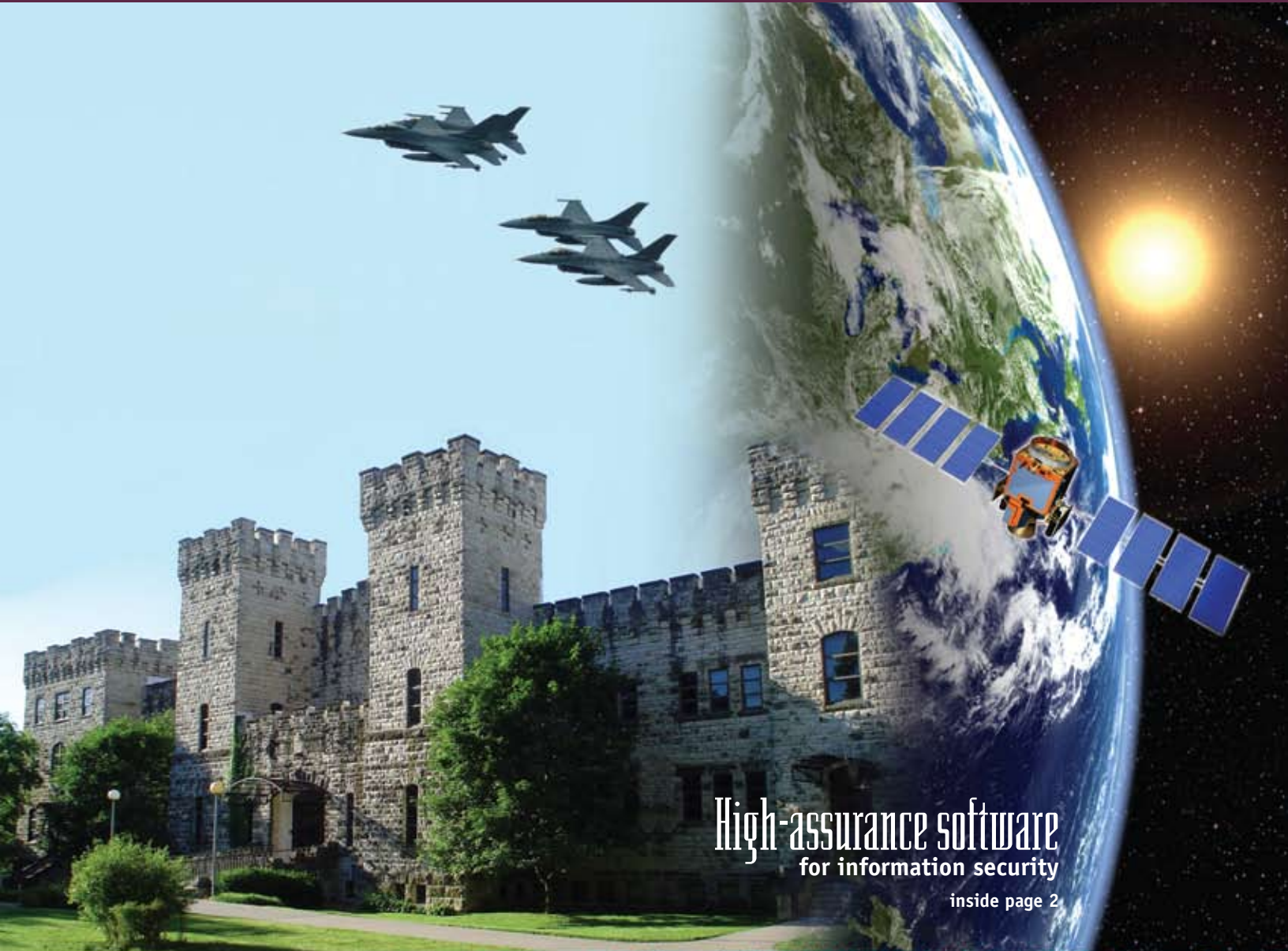


# Computing and Information Sciences

Annual Report 2007



High-assurance software  
for information security

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K-STATE  
ENGINEERING



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# MESSAGE FROM THE DEPARTMENT HEAD

The Kansas State University Department of Computing and Information Sciences has been in existence for 37 years. From my perspective as department head for the past 27 years, I believe the CIS department is the strongest it has ever been. Our faculty are very productive; our students are in high demand; our outreach programs are strong; and our interdisciplinary teaching and research programs enable a broad spectrum of disciplines.

In research, all tenured or tenure-track faculty have extramural funding (<http://www.cis.ksu.edu/research/projects>) and contribute to the body of knowledge in computing through publication of their research results. Dr. Robby was awarded an NSF Career Award to support his work, "A Formal, Integrated Analysis Framework for Contract-Based Reasoning of Strong Properties in Open Systems." We have initiated two new research programs in bioinformatics, under the direction of Dr. Caragea, and computer security, under the direction of Dr. Ou. To further our international collaborative research with industry, Dr. Mizuno took a sabbatical with Hitachi in Japan, and Dr. Banerjee

took a sabbatical with IBM and Microsoft. Finally, CIS faculty are involved in more than 20 interdisciplinary projects.

Our undergraduate program has been restructured to provide more opportunities and specialization for B.S. candidates. Tracks in computer science, software engineering, and information systems permit specialization in a wide variety of targeted areas such as entertainment software, cybersecurity, database systems, enterprise systems, embedded systems, distributed and parallel systems, data mining, sensor networks, and a wide variety of interdisciplinary areas such as biomedical informatics and health IT.

Our outreach programs now target elementary, middle school, high school, and community college programs. Our industrial outreach programs affect a wide variety of state and national industries in areas such as health IT and avionics.

This 2007 report cannot cover all of the accomplishments of CIS for the year, but our Website at <http://www.cis.ksu.edu> will give you a more complete picture of our activities.



Virgil E. Wallentine, Ph.D.  
Department Head  
Computing and Information Sciences  
Kansas State University





# High Assurance

## High-assurance software systems

National and international critical infrastructures, as well as commercial services, increasingly rely on complex distributed systems that share information with “multiple levels of security” (MLS). These systems often seek to coalesce information with mixed security levels into information streams targeted to particular clients.

Examples of this include in a national emergency response system, some data will be privileged, e.g., information regarding availability of military assets and deployment orders for those assets, and some data will be public, e.g., weather and mapping information. Similarly, military frameworks such as the Global Information Grid and the Joint Battlespace Infosphere emphasize flexible access to information with multiple levels

of security to war fighters across all levels of command and across forces. In the healthcare domain, envisioned integrated health informatics systems go beyond providing caregivers with information on a current patient to include statistical data on treatments and outcomes for patients with similar clinical profiles and treatment regimes.

In these systems, a huge tension exists between providing aggressive information flow to gain operational and strategic advantage, while preventing leakage to unauthorized parties. Specifying and validating information-flow security policies in this context is challenging. When such systems need to be certified for high levels of assurance, providing formal representations of policies and correctness arguments is exceedingly difficult.

Researchers in the K-State CIS Laboratory for Static Analysis and Transformation of Software (SAnToS) are developing innovative static analysis techniques and program logics for attacking such challenges.

- SAnToS static analysis techniques automatically scan system source-code programs to generate a conceptual “road map” of how information is flowing through a system implementation. This information is presented to system designers and programmers in integrated development environments that allow them to easily visualize and navigate information flows to guide system design and

to facilitate debugging in situations where information flow violates high-level system security policies.

- To aid in the formal capture and verification of information-flow policies, SAnToS researchers have developed a novel program logic for specifying policies that describe how information is expected to flow between the inputs and outputs of program components.

Proofs in the logic provide guarantees that the system implementation satisfies a specified information-flow policy.

These static analysis methodologies are applied to automatically construct a vast majority of required information-flow proofs.



These can be viewed as “certificates” that provide hard evidence of satisfaction of security policies—evidence that can be independently audited by automatic certificate-checking programs.

“One of the things that makes our work unique is that we focus not only on providing hard-core verification and proofs of conformance to stated information-flow policies, we also provide a variety of forms of integrated development and analysis support to help developers manage and automate checking of security policy conformance,” said John Hatcliff, professor and leader of the SAnToS Lab.

“We spend a lot of time of thinking about how developers carry out the process of designing and developing a system and how our techniques can be integrated in a non-intrusive manner into the workflows of industrial engineers,” he said. “It’s our practical approach to providing high-assurance solutions that makes our work attractive to industry groups and government regulators working in the area of security-critical systems that must be built to provide the highest levels of confidence.”

Rockwell Collins, a communications and electronics provider headquartered in Cedar Rapids, Iowa, is one of the industrial partners with which SAnTOS has formed a long-term relationship. The research division of Rockwell Collins, the Advanced Technology Center (ATC), is funding SAnToS to develop compositional contract-based



SAnToS Research Group, CIS Department, KSU

approaches for certifying secure information-flow requirements in military information assurance products.

Rockwell Collins ATC engineers, led by Matthew Wilding, have established themselves as industry leaders in the area of certification of systems built according to the “multiple independent levels of security” (MILS) architecture. The MILS program, primarily supported through various U.S. Department of Defense funding agencies, proposes to make development, accreditation, and deployment of MILS-capable systems more practical and affordable by providing a certified infrastructure foundation for systems that require assured information sharing.

MILS systems are developed on top of a separation kernel that isolates and controls communication between application components deployed in different partitions of the kernel. MILS middleware provides various services such as a partitioning communication system which extends the single-node, security-policy enforcement provided by the separation kernel to a distributed environment, and high-assurance network guards that validate that data passing between MILS components is authorized. The MILS program aims to establish a commercial market for high-assurance, standards-based COTS components that can be assembled to produce accredited systems.

“SAnToS researchers have a great reputation for developing powerful formal methods tools that can be applied to real-world problems,” Wilding said. “Rockwell Collins ATC has sought out and funded Kansas State as a research partner based on Kansas State’s expertise in static analysis that we believe can be applied to automate and scale-up portions of our verification processes.”

Rockwell Collins ATC engineer David Greve has played a key role in developing RC ATC’s security verification infrastructure. “We’re very happy with the early results we are getting with the Kansas State team,” said Greve. “What we are finding is that many elements of our verification framework can be automated using SAnToS technology. Over the long term, we believe these techniques are going to lead to a dramatic reduction in effort, decreased time required to certify, and a greater ability to handle more complex systems that are needed in emerging and future applications.”

“This is exactly the type of relationship that CIS seeks to foster with companies across our region,” said Virgil Wallentine, CIS department head at K-State. “We have several CIS graduates working at Rockwell Collins now, and those alumni have helped facilitate this research partnership and internships that provide experience in exciting and relevant application areas for our graduate students.

“The ongoing research partnership is providing not only financial support for world-class research in our department, it’s also infusing our research context with challenging problems and an understanding of what it takes to build real systems with cutting-edge technology. The formal methods and security verification group at Rockwell Collins ATC are truly industry leaders in their area, and we are happy to be working with them.”

For more information about the SAnToS work on information assurance, see <http://santos.cis.ksu.edu>.

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“Rockwell Collins ATC has sought out and funded Kansas State as a research partner based on [its] expertise in static analysis . . .”

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# FACULTY

# Faculty



### 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.



### 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.



### 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**

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

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 Neilson**

- • • • • 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



## 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, logical techniques in security, programming languages.



## 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.



## 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.



## 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 technology for learning, university of the future
- Teaching: Databases, data security.

## 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](http://www.damsafety.info)

The United States Department of Agriculture (USDA) and its partners are actively involved in providing the tools and technology for maintaining safe dams. Through the programs of the USDA, Natural Resources Conservation Service (NRCS), USDA has assisted in the construction of more than 11,000 dams in 47 states since 1948. These dams provide flood control as well as water supply and recreation opportunities. The USDA, Agricultural Research Service (ARS), works closely with the NRCS to develop the technology needed for the economical design and rehabilitation of these dams. Kansas State University is partnering with the USDA to incorporate the results of research and field experience into computational tools for use in design and analysis of dams. 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 include Sites 2005.1.3— used to evaluate vegetated-earth (both rock and soil) emergency spillways at the watershed scale, (b) WinTR-20— used to route hydrographs through various types of streams and diversions, (c) SSEA+LHS— used to develop probabilistic flow and erosion models for risk management, (d) waterway design tool (WDT) to design vegetated channels in grassed waterways, and (e) WinDAM— modules for erosion and breach analysis.

In addition, ongoing collaborative work with

the U.S. Army Corps of Engineers in Vicksburg, Miss., develops risk-assessment tools for water-control structures (e.g., Tuttle Creek Spillway, 1993 flood), and with Sandia National Laboratories, develops solder interconnect predictor (SIP) tools to evaluate Pb-free solder joints in electronic control packages for satellites, etc.

## Distributed Systems Lab

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; 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 aims at developing technologies for building models of events and processes from data, and then using these models to help make decisions. Technical aspects of this research emphasize the following:

- development of data mining, machine learning, and probabilistic reasoning algorithms that scale up to large data sets
- application of algorithms in software tools for analyzing data from domains such as bioinformatics, epidemiology, medical informatics, computational physics, and sensors
- models of cognitive processes that lead to a better understanding of how to automate learning and reasoning about causality, especially with spatial and temporal data

The lab has produced the Bayesian Network in Java (BNJ) suite of tools for learning, reasoning with, displaying, and converting among graphical models, spatial classification, and prediction tools for the Kansas Department of Transportation (KDOT), and intelligent search applications for several federal agencies. KDD lab researchers are currently focusing on applications in predictive epidemiology, multimodal information extraction, social networks, visualization of swarm intelligence and multiagent systems, computational genomics (particularly graphical models of gene regulatory dynamics), and proteomics (especially identifying protein-protein interactions). A cur-

rent research program funded by the Defense Intelligence Agency and Department of Homeland Security aims toward sifting through online information sources to summarize references to significant entities and current events. Other federal and corporate sponsors of the KDD lab since 1999 include the National Science Foundation, Office of Naval Research, Army Research Lab, Raytheon, and American Medical Diagnostics. The KDD lab maintains a research collaboration with the University of Illinois at Urbana-Champaign, including the National Center for Supercomputing Applications, and with the University of Texas, San Antonio.

### **Collaborative Learning Through Real-Time Embedded System Design: NSF RET-SITE (0227709)**

PI: M.L. Neilsen, M. Mizuno, G. Singh, D. Lenhert, N. Zhang

Rapid advances in embedded systems present significant opportunities for fundamental change in education at all levels, with a greater focus on active, collaborative learning. These advances can be exploited by integrating them into the elementary and middle school curriculums, and by having students work in teams to develop innovative new solutions to embedded design problems.

This project strives to attract an even more diverse pool of students into education and engineering to design and implement all types of engineered systems. In order to attract such students, we believe that it is important to engage them in the engineering process at an early age. Consequently, this project recruits 30 upper elementary and middle school teachers to work with researchers on campus at Kansas State University during the summer. In the following academic year, teachers receive ongoing support within their own classrooms. To provide an entry level that is attractive to both upper elementary and middle school teachers, the group is started with the Lego Mindstorms™ Robotics Invention System, simple object-oriented programming, and simple embedded sensors and actuators. Designing both simple and complex embedded systems naturally motivates both teachers and students to acquire a much deeper understanding of the underlying mathematics and science. Teachers gain practical new skills that can be directly integrated into their own classroom activities. For example, they can use their embedded controllers for data acquisition and analysis in a biology experiment which is both highly motivational and age appropriate for elementary school students. This project involves participation of teachers from both rural and urban areas in Kansas.

### **The MultiAgent and Cooperative Robotics Laboratory**

<http://macr.cis.ksu.edu>

The MultiAgent and Cooperative Robotics (MACR) Laboratory 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 the 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 (O-MaSE) and its associated agentTool development environment. O-MaSE and agentTool support building complex, adaptive systems based on the organizational model for adaptive, complex systems (OMACS) using dynamic models of the problems being solved, which are captured via the goal model for dynamic systems (GMoDS). Research currently focuses on using metrics to predict system performance based on design artifacts. In addition, 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 \$1.6 million in funding from the National Science Foundation, the Air Force Office of Scientific Research, and Stanfield Systems Inc.

### **Real-Time Embedded Systems Laboratory**

<http://www.cis.ksu.edu/~external/chert/home.html>

The Laboratory for research on Embedded Real-Time systems (CHERT) aims to develop technologies and tools for distributed, fault-tolerant, real-time embedded systems. The focus is on both formal and informal methods for embedded-system development. Our initial target for development was on event-triggered controller area networks used extensively for networking controls and actuators on board machinery and in vehicles. More recent work focuses on time-



triggered protocols such as FlexRay™. The group currently works on areas related to hard real-time systems whose operation depends not only on the correctness of the results, but also on their timeliness. Areas of interest include networking and operating system support for hard real-time embedded systems, specification and design languages for developing real-time embedded applications, and simulation and verification tools for ensuring their correctness. Since 2000, the chERT Laboratory has received more than \$1 million in funding through agencies and companies such as the National Science Foundation, USDA, U.S. Navy Tasking and Trimble Navigation. This lab supports the Center for Sensors and Sensor Systems by applying the methodologies developed by CHERT researchers in designing real-time sensor systems.

### **SAnToS Laboratory**

<http://santos.cis.ksu.edu>

The Laboratory for Specification, Analysis, and Transformation of Software (SanToS) aims to develop technologies and tools for effective construction of high-confidence software systems. Work in the lab emphasizes—

- use of rigorous analysis techniques with solid mathematical underpinnings,
- a variety of forms of code and model-integrated software specifications to capture crucial system correctness properties, and
- use of software models as a key mechanism for capturing essential software structure leading to system analysis and verification.

The lab has produced tools including the Bandera and Bogor software model-checking frameworks, the Cadena modeling frameworks for component-based systems, and the Indus static and analysis and slicing frameworks that are widely recognized within the academic software engineering and verification communities. SAnToS researchers are currently focusing on ap-

plications in security, software product lines, integrated medical devices, and sensor networks. Since 1998, SAnToS Laboratory has received more than \$8.5 million in funding through agencies and companies such as the National Science Foundation, Army Research Office, Air Force Office of Scientific Research, Defense Department Advanced Projects Agency (DARPA), NASA, Lockheed Martin, Rockwell Collins, IBM, Honeywell, and Intel.

### **The Sensor Networks laboratory**

<http://people.cis.ksu.edu/~singh/csss/csss.htm>

The Sensor Networks Laboratory is conducting research to develop tools and methodologies for the 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.

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- PI (with co-PI Robby), Air Force Office of Scientific Research (AFOSR/NM), "Organization-Based, Model-Driven Development of High-Assurance Multiagent Systems," \$481,816, December 2005 – November 2008.
- PI, Stanfield Systems, Inc. (from AFRL), Information Management Staff Toolkit – Information System (IMTK-IS), \$78,735, 2005 – 2007.

#### Hatcliff

- Co-PI (with Matthew Dwyer, Gregg Rothermel, Sebastian Elbaum), NSF CCF, "Collaborative Research: Program Analysis Techniques to Support Dependable RTSJ Applications," \$60,000, September 2006 – August 2007.
- 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 Torben Amtoft, Anindya, Banerjee), Air Force Office of Scientific Research, "An Integrated Specification and Verification Environment for Component-Based Architectures of Large-Scale Distributed Systems," \$450,000, February 2006 – November 2008.
- PI, Lockheed Martin, Software Technology Initiative, \$60,000, March 2007 – December 2007.
- 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 (with co-PI Torben Amtoft), Rockwell Collins Advanced Technology Center, "Flow Modeling Analysis (Formalization and Supporting Tools for Secure Information Flow Certification of Industrial Applications)," \$50,000, January 2007 – August 2007.

#### Hsu

- Co-PI (with Kevin Chang, David Forsyth, Jiawei Han, Chengxiang Zhai, University of Illinois at Urbana-Champaign; Anhai Doan, University of Wisconsin-Madison; Qi Tian, University of Texas-San Antonio), Department of Homeland Security (DHS), "MIAS: Multimodal Information Access and Synthesis," \$30,000, May 2007 – July 2007.
- PI, AIdentity Matrix Medical, Inc., "Web Interface for Intelligent Human-Computer Interactive Systems," \$30,000, December 2006 – August 2007.
- Co-PI (with PI Talat Rahman, co-PIs Jacques Amar, Abdelkader Kara, Virgil Wallentine), National Science Foundation, "Information Technology Research (ITR) for National Priorities," October 2004 – September 2007.
- 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.

- PI, AIdentity Matrix Medical, Inc., "Web Interface for Intelligent Human-Computer Interactive Systems," \$30,000, September 2007 – March 2008.
- Co-PI (with PI Marty Vanier), Defense Intelligence Agency, "A Multimodal Information Extraction Research Activity," \$50,000, December 2007 – August 2008.

#### Neilson

- PI (co-PIs Masaaki Mizuno, Gurdip Singh) NSF-RET-Site: Collaborative Learning Through Real-Time Embedded System Design, (NSF #0227709), \$449,254,
- PI, Sandia National Laboratories: Sandia-SIP: Solder Interconnect Predictor Tool. \$40,000, 8/1/2006 – 10/31/2007.
- PI, USDA/ARS: Software Tools for Watershed Dam Design and Analysis. \$106,900, 4/18/2005 – 4/17/2010.
- 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. \$20,000, 9/1/2007 – 6/30/2010.
- Senior Investigator (PI Gurdip Singh, et. al)KSU Targeted Excellence: Infrastructure Development for Sensor Networks, 2005-2007.

#### Ou

- PI, U.S. Department of Energy, "Automatic Control-Network Security Management Using Attack Graphs," \$35,000, March 2007 – August 2007.
- PI, National Science Foundation, "CT-ISG Model-Based, Automatic Network Security Management," \$245,000, August 2007 – July 2009.

#### 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 Institute of Technology; Hridayesh 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.

- PI, Lockheed Martin Advanced Technology Laboratories, “Analysis and Verification of Large-Scale .Net Application Models,” \$60,000, May 2007 – December 2007.

#### **Schmidt**

- Subcontract PI (with Alex Aiken, Thomas Henzinger, George Necula, Ras Bodik, David Wagner, Univ. California, Berkeley; Anindya Banerjee, KSU), NSF ITR, “Language-Based Software Security,” \$135,000, October 2003 – August 2008.

#### **Singh**

- PI, NSF CSR, “Methodologies for Customization of Distributed Algorithms and Middleware,” \$305,000, July 2006 – June 2009.
- PI, NSF, “Research Experience for Undergraduates Supplement,” \$12,000, July 2007 – June 2009.
- 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 2009.

- 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 2009.
- 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,” \$219,000.

#### **Unger**

- Campus EAI: KSU Campus EAI Oracle Portal, 2003-2008, \$949,750.
- Co-PI (with PI R. Dyer, co-PI’s T. King, B. Montelone, S. White) National Science Foundation: ADVANCE Institutional Transformation Award: Institutional Transformation at Kansas State University, 2003-2008, \$3,500,000.

#### **Wallentine**

- PI, K-State Targeted Excellence Program, “Bioinformatics at K-State,” \$925,000, 2006-2010.
- Co-PI (with Rahman, Amar, Hsu), NSF ITR, “Parallel Kinetic Monte Carlo Simulations,” \$1,074,807, 2004-2007.

#### **Andresen**

- Program committee member, IASTED International Conference on Parallel and Distributed Computing and Networks (PDCN 2007), Innsbruck, Austria, Feb. 13-15, 2007.
- International program committee member, 2007 International Conference on Internet Computing (ICOMP'07), Las Vegas, Nev., June 25-28, 2007.
- Program committee member, IASTED International Conference on Parallel and Distributed Computing and Networks (PDCN 2008), Innsbruck, Austria, Feb. 12-14, 2008.
- International program committee member, 2008 International Conference on Grid Computing and Applications (GCA'08) Las Vegas, Nev., July 14-17, 2008.
- International program committee member, 2008 International Conference on Semantic Web and Web Services (SWWS'08) Las Vegas, Nev., July 14-17, 2008.
- International program committee member, 2008 International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA'08), Las Vegas, Nev., July 14-17, 2008.
- International program committee member, 2008 International Conference on Internet Computing (ICOMP'08), Las Vegas, Nev., July 14-17, 2008.

#### **Banerjee**

- Program committee member for Joint Workshop on Foundations of Computer Security and Automated Reasoning for Security Protocol Analysis (FCS-ARSPA), affiliated to LICS 2007 and ICALP 2007, Wroclaw, Poland, 2007.

#### **Caragea**

- Organizing committee member, IJCAI 2007 Workshop on Semantic Web for Collaborative Knowledge Acquisition (SWeCKa 2007), in conjunction with Twentieth International Joint Conference on Artificial Intelligence, Hyderabad, India, January 2007.
- Program committee member, 2007 AAAI Doctoral Consortium Program (DC-07), in conjunction with Twenty-First National Conference on Artificial Intelligence (AAAI 2007), July 2007, Vancouver, B.C., Canada.
- Program committee member, Second International Conference on Computing in the Global Information Technology (ICCGI'07), March 4-9, 2007, Guadeloupe, French Caribbean.
- Program committee member, Midwest Artificial Intelligence and Cognitive Science Conference (MAICS'07), DePaul University, April 2007, Chicago, Ill.
- Program committee member, Third International Conference on Autonomic and Autonomous Systems (ICAS 2007), June 19-25, 2007, Athens, Greece.
- Program committee member, 2007 IEEE International Conference on Bioinformatics and Biomedicine (BIBM), Nov. 2-4, 2007, San Jose, Calif.
- Program committee member, 2007 Workshop on Cyberinfrastructure for e-Science (CyIneS 2007) held in conjunction with 2007 IEEE/WIC/ACM Conference on Web Intelligence, November 2007, Fremont, Calif.
- Program committee member, First International Conference on Advances in Semantic Processing (SEMAPRO 2007), Nov. 4-9, 2007, Papeete, French Polynesia (Tahiti).
- Program committee member, 2008 SIAM Conference on Data Mining (SDM 2008), April 24-26, 2008, Atlanta, Ga.
- Program committee member, 4th International Symposium on Bioinformatics Research and Applications (ISBRA), Atlanta, Ga., May 6-8, 2008.
- Program committee member, 2008 Workshop on Collaborative Distributed Knowledge Discovery (CDKD'08) in conjunction with 2008 International Symposium on Collaborative Technologies and Systems (CTS 2008), May 19-23, 2008, Irvine, Calif.
- Program committee member, 2008 International Conference on BioMedical Engineering and Informatics (BMEI 2008), Sanya, Hainan, China, May 28-30, 2008.
- Program committee member and special area chair (Bio-Ontologies), International Conference on Biocomputation, Bioinformatics, and Biomedical Technologies (BIOTECHNO 2008), June 29 - July 5, 2008, Bucharest, Romania.
- Program committee member, 2008 AAAI Doctoral Consortium Program (DC-08) in conjunction with Twenty-Second National Conference on Artificial Intelligence (AAAI 2008), July 2008, Chicago, Ill.
- Program committee member, Third International Conference on Computing in the Global Information Technology (ICCGI'08), July 27 - Aug. 1, 2008, Athens, Greece.
- Program committee member, Second International Conference on Advanced Engineering Computing and Applications in Sciences (ADVCOMP 2008), Valencia, Spain, Sept. 29 - Oct. 4, 2008.

### DeLoach

- Editorial board, International Journal of Agent-Oriented Software Engineering.
- Panel member, NSF Robust Intelligence.
- Program committee member, IEEE Systems, Man & Cybernetics Conference, October 7-10, 2007, Montreal Canada.
- Program committee member, Agent-Oriented Information Systems (AOIS) Workshop, June 11-15, Trondheim, Norway.
- Program committee member, Intl Workshop on Agent-Oriented Software Engineering (AOSE), May 14-18, 2007, Honolulu, Hawaii.
- Program committee member, Intl Conference on Self-Organization and Autonomic Systems in Computing and Comm. (SOAS), 24-27 September 2007, Leipzig, Germany.

### Hatcliff

- Program committee member, 2007 ACM Symposium on Principles of Programming Languages (POPL 2007).
- Program committee member, 2007 Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'2007); 2008 ACM Workshop on Partial Evaluation and Program Manipulation (PEPM).
- Editorial board member, Journal of Software Tools for Technology Transfer

### Hsu

- Editorial board member, Intelligent Data Analysis (IDA) Conference Program Committees.
- Program committee member, International Conference of the Association for the Advancement of Artificial Intelligence, March 2007.
- AAAI 2007: student abstract program committee, January 2007.

### Neilson

- NSF CPATH Review Panel, Feb. 2007.
- PDCS 2007 Reviewer and Session Chair.
- EMS 2007 Session Chair.

### Ou

- Journal of Network and Systems Management (JNSM)—special issue on security configuration, Journal of Computer Security.

### Robby

- Program committee member, Static Analysis Summit II (SASII, 2007).
- Program committee member, Generative Programming and Component Engineering (GPCE 2007).
- Program committee member, 2007 Testing: Academic and Industrial Conference— Practice and Research Techniques (TAIC PART 2007).
- Program committee member, 1st International Workshop on Verification and Analysis of Multi-Threaded Java-Like Programs (VAMP 2007).
- Program committee member, 10th International Conference on Fundamental Approaches to Software Engineering (FASE 2007).

### Schmidt

- Co-general organizer, "Tribute Workshop for Neil D. Jones," Aug. 25-26, Copenhagen (<http://www.diku.dk/forskning/topps/neilfest/index.html>).
- Co-general chair, "Thirty Years of Abstract Interpretation" workshop, Jan. 9, San Francisco, Calif. (<http://30yai.di.univr.it/>).
- Program committee member, 16th International Symposium on Fundamentals of Computation Theory, Aug. 27-30, 2007, Budapest, Hungary (<http://www.conferences.hu/fct2007/>).
- Program committee member, 14th International Static Analysis Symposium, Kongens Lyngby, Denmark, Aug. 22-24, 2007 (<http://www2.imm.dtu.dk/sas2007/>).
- Steering committee member, Static Analysis Symposia, Conferences on Verification, Model Checking, and Abstract Interpretation.
- Advisory board member, Journal of Higher-Order and Symbolic Computation.

### Singh

- Program committee member, IEEE International Conference on Computer Communications and Networks, 2007.
- Program committee member, International Conference on Embedded Software and Systems, 2007.
- Program committee member, International Conference on Parallel and Distributed Computing and Systems, 2007.

### Wallentine

- Member, U.S. Senator Pat Roberts Committee on Information Technology.
- Board of directors member, Software and Information Technology Association of Kansas (SITAK).



# UNDERGRADUATE STUDIES

# Undergraduate

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

# GRADUATE

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's-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://cis.ksu.edu/AnnualReport>

## How to apply

For a graduate application 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](mailto:cis-gradapps@ksu.edu)



# ADVISORY BOARD

# ADVISORY

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.

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**Norman Tsiguloff**

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Founder  
Multigen/Paradigm

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[www.cis.ksu.edu](http://www.cis.ksu.edu)



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