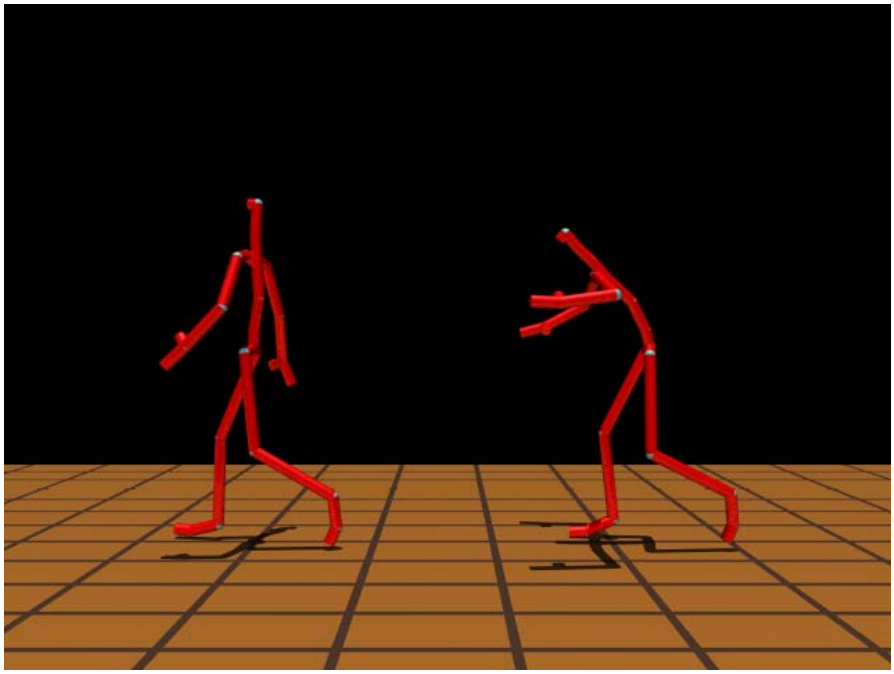
Henry Samueli School of Engineering & Applied Science



Learning the style of recorded motions (MAGIX Lab research program)

COMPUTER SCIENCE DEPARTMENT

University of California, Los Angeles

Fall 2005

Henry Samueli School of Engineering and Applied Science

Computer Science Department

4732 Boelter Hall
University of California, Los Angeles
Los Angeles, CA 90095-1596

Telephone: +1.310.825.3886
Fax: +1.310.825.2273
Email: chair@cs.ucla.edu
URL: www.cs.ucla.edu

Computer Science Department Statistics

- Faculty (40)
- Graduate Enrollment (280)
- M.S. Degrees Awarded (105)
- Engineering Degree Awarded (1)
- Ph.D. Degrees Awarded (28)
- Undergraduate Enrollment (539)
- Undergraduate Degrees Awarded (164)

The Computer Science Department was formally established during UCLA's 1968-69 academic year—more than 36 years ago. UCLA is one of the nation's largest and most prestigious graduate education centers in computer and information technology. The dedicated efforts of our prominent faculty and exceptional students have coalesced to rank us among the top computer science departments in the world. The UCLA Computer Science Department is well known for its research in the design and analysis of complex computer systems and networks, and for its key role in the creation of the ARPANET—the precursor to today's Internet. Internationally recognized research has been carried out in such diverse computer science areas as embedded systems, artificial intelligence, mobile computing, architecture, simulation, graphics, data mining, CAD and reconfigurable systems, biomedical systems, programming languages and compilers.

The Computer Science Department has continued to excel in both research and education during the 2003 to 2005 academic years (the period covered in this report). We made significant progress in many areas, including faculty recruiting, expansion of research programs, production of high-quality and exciting results in both basic and applied research, success in securing significant funding, further refinement of undergraduate and graduate programs, placement of graduates, and faculty and student awards and recognitions. These areas of progress are highlighted in this report.

During the past two years, the department added two new faculty members: Amit Sahai (theory of computation, security and cryptography) as an associate professor, and Demetri Terzopoulos (graphics and computer vision) as Chancellor's professor. Both are highly sought-after leaders in their fields, and both bring a great amount of visibility and energy to the department. Their profiles are highlighted later in this report. The department now has thirty-six ladder faculty and six adjunct faculty.

The department has more than thirty labs and research groups, and three major research centers: CENS (Center for Embedded Networked Systems), CAINS (Center for Intelligent Autonomous Systems), and CICS (Center for Information and Computation Security). These centers, described in detail later in this issue, involve faculty from other departments and universities, and partners from industry and the community. Furthermore, given the rapid expansion of computer science and information technology and the tight interaction of various disciplines within computer science and engineering, we have organized the department's research activities into four interdisciplinary research clusters: Internet Technologies, Embedded Systems, Intelligent Systems and Interfaces, and Software Systems. These clusters, highlighted later, cut across the boundaries of the traditional computer science core areas and promote a wider collaboration among faculty and students. We expect these clusters to be adaptive, evolving over time and reflecting leading research trends in computer science, engineering and related disciplines—as well as reflecting the strengths of our faculty and research programs.

The quality and significance of our research programs are partially reflected in the research funding and faculty recognition received over the past two years. From 2003 to 2005, the department received 26 new research contracts and grants (a subset is listed on pages 29 and 30), for a total close to $19 million. Our faculty received over thirty diverse prizes, honors and recognitions, best paper awards, and patent awards. In particular, our adjunct faculty member, Dr. Alan Kay, received the 2003 Turing Award and the 2004 Kyoto Prize.

We continue our excellence in both undergraduate and graduate education. Our undergraduate program, with degrees in computer science and computer science and engineering, has approximately 539 students. During 2004 to 2005, 164 B.S. degrees were awarded. The interest in computer science and engineering remains high, and our two undergraduate majors are among the most popular in the Henry Samueli School of Engineering and Applied Science. Our graduate program has 280 students, most of them in the Ph.D. program. During 2004 to 2005, 105 M.S. and 28 Ph.D. degrees were awarded. Our graduate program is very dynamic, with areas of specialization ranging from Internet computing, Web technologies, data mining, and sensor networks to VLSI CAD, embedded/reconfigurable systems, computer vision, and graphics. Our graduate students are highly sought after. Many of our Ph.D. graduates in the past two years have embarked on their new careers at major research universities such as Northwestern, UC Davis, UCI, UC Merced, and UIUC; or at leading research laboratories or centers such AT&T Research, GE Research, HP Laboratories, IBM Research, and JPL; and also at many Fortune 500 companies such as Google, Intel, Microsoft, and Rockwell. Additionally, many of our graduates have received numerous honors and earned international recognition. For example, our renowned alumnus, Dr. Vinton Cerf (Ph.D. 1972), has received the 2005 Turing Award, an award that is often recognized as the "Nobel Prize of computing."

Finally. I want to take this opportunity to thank our outgoing chair, Professor Milos Ercegovac, for his leadership during his five-year term that began in 2000. The Computer Science Department grew significantly under his direction — especially with the addition of fourteen ladder faculty members who brought a much-needed new level of energy and excitement to the department. As the incoming chair, I will capitalize on this energy and excitement, working closely with the faculty to greatly extend our current strength, to build new centers of excellence, to reach out to other areas of the campus to explore emerging multidisciplinary areas—and by doing this, to bring the department to a new level of success.

Jason (Jingsheng) Cong
Chair, Computer Science Department
November 2005

New Faculty

Amit Sahai

Computer Science Theory

Amit Sahai joined UCLA's Computer Science Department as an associate professor in the fall of 2004. Prior to that, he was an assistant professor of computer science at Princeton University (2000-2004), and also worked as a researcher at IBM's Almaden Research Center.

Professor Sahai received his Ph.D. in computer science from MIT in 2000 while a member of the Theory of Computation Group at the Laboratory for Computer Science. His research concerns theoretical computer science broadly, with a primary focus on the foundations of cryptography and computer security, learning theory, computational complexity theory, and fault tolerant computing.

Professor Sahai is the recipient of many awards and honors, including the National Science Foundation's ITR and Cybertrust awards, and an Alfred P. Sloan Foundation Research Fellowship. He has authored over 40 technical research papers, served on several technical program committees including the ACM Symposium on the Theory of Computing (STOC), and chaired two technical program committees. Professor Sahai has published in and refereed several international journals, including the *Journal of the ACM (JACM)*. He recently graduated two Ph.D. students working under his supervision, one of whom is now a computer science faculty member at the University of Illinois at Urbana-Champaign (UIUC).

At UCLA, Professor Sahai is associate director of the new Center for Information and Computation Security. Together with Professor Rafail Ostrovsky, he leads several research efforts, including projects on zero-knowledge proofs, broadcast encryption, metric embeddings, and biometric information (see http://www.cs.ucla.edu/~sahai/).

New Faculty

Demetri Terzopoulos

Computer Graphics & Vision

Demetri Terzopoulos is the Chancellor's Professor of Computer Science. He earned his Ph.D. in EECS from MIT in 1984 for his research in computer vision, which was carried out at MIT's Artificial Intelligence Lab where he remained as a research scientist through 1985. Professor Terzopoulos joined UCLA in 2005 from New York University, where he held an endowed chair in science and served as a professor of computer science and mathematics in NYU's Courant Institute of Mathematical Sciences. Previously, he was a professor of computer science and electrical & computer engineering at the University of Toronto, with which he remains affiliated in an adjunct capacity. Before he became an academic in 1989, he was a program leader at Schlumberger corporate research centers in California and Texas. Over the years, he has been a visiting professor at Schlumberger, Digital, Intel, and IBM.

A Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and a member of the European Academy of Sciences, Professor Terzopoulos is one of the most highly cited computer scientists and electrical engineers. His published work comprises approximately 300 technical papers, primarily in computer graphics and vision as well as in medical imaging, computer-aided design, and artificial intelligence/life. He has delivered hundreds of invited talks around the world on these topics, including numerous distinguished lectures and keynote addresses.

Professor Terzopoulos has been a Killam Research Fellow of the Canada Council for the Arts, an E.W.R. Steacie Memorial Fellow of the Natural Sciences and Engineering Research Council of Canada, and an AI/Robotics Fellow of the Canadian Institute for Advanced Research. He is the recipient of an award from the American Association for Artificial Intelligence (AAAI) for his work on deformable models in computer vision, an award from the IEEE for his work on active contours ("snakes"), two distinctions from the International Medical Informatics Association for his work on model-based medical image analysis, an award from the Japanese computer graphics society, NICOGRAPH, for his work on human facial modeling and animation, awards from the International Digital Media Foundation and from Ars Electronica, the premier competition for creative work with digital media, for his work on the artificial life simulation of animals, and six University of Toronto Arts and Science Excellence Awards. The Canadian Image Processing and Pattern Recognition Society has cited him for his "outstanding contributions to research and education in image understanding." The many Ph.D. theses that he has supervised include the winner of the 1996 ACM Doctoral Dissertation Award.

Professor Terzopoulos has served on DARPA, NIH, and NSF advisory committees. He has been an organizer and/or program committee member of the major conferences in graphics, vision, medical imaging, artificial intelligence, etc. He was a program chair for the 1998 IEEE Computer Vision and Pattern Recognition Conference and the 2004 Pacific Graphics conference, and conference chair for the 2005 SIGGRAPH/EG Symposium on Computer Animation. He is a founding member of the editorial boards of journals spanning the fields of computer vision, computer graphics, and medical imaging. Professor Terzopoulos has been a consultant to several major American, Canadian, and Japanese corporations.

Center for Autonomous Intelligent Networked Systems (CAINS)

http://www.cains.cs.ucla.edu

Lead Sponsors

Office of Naval Research (ONR)
National Science Fouundation (NSF)

The *Center for Autonomous Intelligent Networks and Systems (CAINS)* was established in 2001, with six laboratories in the Computer Science and Electrical Engineering departments of UCLA's Henry Samueli School of Engineering and Applied Science.

The Center's mission is to serve as a forum for *intelligent agent* researchers and visionaries from academia, industry, and government, with an interdisciplinary focus on such fields as engineering, medicine, biology and the social sciences. Information and technology will be exchanged through symposia, seminars, short courses, and through collaboration in joint research projects sponsored by the government and industry.

Many research projects are underway, including one that involves the development of technologies enabling unmanned autonomous vehicles (UAVs) to communicate and behave in an intelligent, coordinated fashion without direct human interaction. Current laboratory research includes work in the following areas:

Video compression
Video network transport
Vision-based localization
Ad hoc multi-hop networking
Vehicular networks
Dynamic unmanned backbone
Mobile sensor platforms
Systolic OFDM radios
Adaptive transceivers

UCLA Director: Mario Gerla

Scientific Board:
Rajive Bagrodia, Babak Daneshrad, Leonard Kleinrock, Izhak Rubin, Mani Srivastava, John Villasenor, Clifford Anderson (ONR)

Partnerships:
Center of Automated Control for Large Complex Systems, Bologna, Italy

Collaborations:

- Biology-inspired systems (USC, Caltech)
- UAV navigation systems (UCB, MIT, ACR)
- Learning systems (SRI)
- Mobile sensor platforms (Istituto Boella, Torino)
- Autonomous agent-based systems (University of Trento, Italy)

Center for Embedded Networked Sensing (CENS)

http://research.cens.ucla.edu
Lead sponsor: National Science Foundation (NSF)

Director: Deborah Estrin, 3531H Boelter Hall, UCLA—destrin@cs.ucla.edu
Associate Director: Gregory Pottie, 56-147G Engineering IV, UCLA— pottie@ee.ucla.edu
CAO: Bernie Dempsey, 3563 Boelter Hall, UCLA—bdempsey@cens.ucla.edu

The Center for Embedded Networked Sensing (CENS) is an NSF science and technology center established in 2002 to develop *embedded networked sensing systems* and to apply this technology to critical scientific and social applications. Like the Internet, these large-scale distributed systems, composed of smart sensors and actuators embedded in the physical world, will eventually infuse the entire world, but at a physical level instead of the virtual level.

Embedded networked sensing systems will form a critical infrastructure resource for society. They will monitor and collect information on such diverse subjects as plankton colonies, endangered species, soil and air contaminants, medical patients, and buildings, bridges and other man-made structures. Across this wide range of applications, these sensing systems promise to reveal previously unobservable phenomena.

CENS has the following mission:

- **Address scientific issues of national and global priority through pioneering research and education in embedded networked sensing technology.**
- **Develop and demonstrate architectural principles and methodologies for deeply embedded, massively distributed, sensor-rich distributed systems.**
- **Apply and disseminate these systems in support of scientific research critical to social and environmental concerns.**
- **Create and disseminate meaningful inquiry-based science instruction using embedded networked sensing technology for a diverse grade 7 to 12 population.**

Current CENS activities include multi-disciplinary research spanning information technology, science applications, education, and legal/social implications. CENS academic partner institutions include UC Riverside, UC Merced, USC, Caltech, James Reserve, New Roads School, Berkeley School, CSU Los Angeles, and JPL.

Technologies
Network autonomy
Programming and storage
Tools, platforms, and testbeds
Actuation
Sensor information processing
Micro/nano sensor technology
NIMS—Networked info-mechanical systems

Applications
Contaminant assessment and management
Aquatic microbial observing systems
Terrestial ecology observing systems
Seismic monitoring and structural response

Science Education, Diversity, and Ethical/Legal Issues
Pre-college/grades 7-12 science education
New graduate and undergraduate curriculum/programs
Research internships and summer courses for undergraduates
Education research
Ethical, legal, and social implications

Center for Information & Computation Security (CICS)

http://www.cs.ucla.edu/security

Director: Rafail Ostrovsky (rafail@cs.ucla.edu)
Associate Director: Amit Sahai (sahai@cs.ucla.edu)

The *Center for Information & Computation Security (CICS)* was founded in UCLA's Henry Samueli School of Engineering and Applied Science in the fall of 2003 under the directorship of Professor Rafail Ostrovsky. In 2004 Professor Amit Sahai joined the leadership team to serve as associate director. Headquartered within the Computer Science Department, the Center's mission is to promote all aspects of research and education in cryptography and computer security.

The Center explores novel techniques for securing both national and private-sector information infrastructures across various network-based and wireless platforms, as well as wide-area networks. The inherent challenge in this work is to provide guarantees of privacy and survivability under malicious and coordinated attacks. Meeting this challenge is especially complex because solutions must achieve several conflicting goals: while making applications more accessible, ubiquitous, and wide-spread, any solution must also be resilient against a wide range of both internal and external coordinated attacks, simultaneously providing strong privacy and security guarantees to both individuals and organizations. The Center's research directions include the following:

- **Developing state-of-the-art cryptographic algorithms, definitions, and proofs of security.**
- **Developing novel cryptographic applications, such as new electronic voting protocols, identification schemes, encryption schemes, data-rights management schemes, privacy-preserving data mining, searching on encrypted data, and searching with privacy.**
- **Developing the security mechanisms underlying a "clean-slate" design for a next-generation secure Internet.**
- **Developing novel biometric-based models and tools, such as encryption and identification schemes based on fingerprint scans.**
- **Exploring the interplay of cryptography and security with other fields, including algorithms, complexity theory, networks, communication complexity, machine learning, compiler and language design, operating systems, hardware design, and distributed computing.**

The Center promotes both long-term foundational work and short-term applied research to support the development of cryptographic foundations and critical security tools and techniques. It has a cross-disciplinary nature and an active research program.

THE FACULTY

Rajive Bagrodia, Professor, Ph.D. (Texas, Austin) 1987: wireless networks, mobile computing and communications, network simulation and analysis, parallel and distributed computing.

Alfonso Cardenas, Professor, Ph.D. (UCLA) 1969: Database management, distributed heterogeneous and multimedia (text, image/ picture, voice) systems, information systems planning and development methodologies, medical informatics, legal and intellectual property issues, and software engineering.

Junghoo (John) Cho, Assistant Professor, Ph.D. (Stanford) 2002: Internet search engines, database systems, information management systems, and digital libraries. Development of new algorithms and techniques to manage large-scale data on the Internet.

Wesley Chu, Professor, Ph.D. (Stanford) 1966: Distributed processing and distributed database systems, and intelligent information systems.

Jason (Jingsheng) Cong, Professor and Chair, Ph.D. (Illinois, Urbana) 1990: Computer-aided design of VLSI circuits, fault-tolerant designs of VLSI systems, design and analysis of algorithms.

Adnan Darwiche, Associate Professor, Ph.D. (Stanford) 1993: Probabilistic and logical reasoning and its applications, including diagnosis, planning, and system design and analysis.

Joseph DiStefano, III, Professor (also Professor of Medicine), Ph.D. (UCLA) 1966: Biomodeling, identification and simulation, expert systems in life science research, optimal kinetic experiment design and endocrine system physiology and control.

Michael Dyer, Professor, Ph.D. (Yale) 1982: Processing and acquisition of natural language through symbolic, connectionist and genetic algorithm techniques.

Paul Eggert, SOE Lecturer, Ph.D. (UCLA) 1980: Software design and engineering, programming language design and implementation, and software internationalization.

Milos Ercegovac, Professor, Ph.D. (Illinois, Urbana) 1975: Computer arithmetic and hardware-oriented algorithms, design of digital and reconfigurable systems.

Deborah Estrin, Professor, Ph.D. (MIT) 1985: Network interconnection and security, design of network and routing protocols for global networks, development of protocols and systems architectures for rapidly deployable and robustly operating networks of many thousands of physically embedded devices. Particularly interested in applications to environmental monitoring.

Petros Faloutsos, Assistant Professor, Ph.D. (Toronto, Canada) 2002: Computer graphics, physics-based animation, robotics, and biomechanics.

Eliezer Gafni, Associate Professor, Ph.D. (MIT) 1982: Distributed algorithms, mathematical programming with application to distributed routing and control of data networks, and computer science theory.

Mario Gerla, Professor, Ph.D. (UCLA) 1973: Performance evaluation, design and control of distributed computer communication systems, and high-speed computer networks (B-ISDN and optical).

Sheila Greibach, Professor, Ph.D. (Harvard) 1963: Algorithms and computational complexity, program schemes and semantics, formal languages and automata theory and computability.

Richard Muntz, Professor, Ph.D. (Princeton) 1969: Distributed and parallel database systems, temporal data models and query processing, knowledge discovery in database systems, and computer performance evaluation.

Eddie Kohler, Assistant Professor, Ph.D. (MIT) 2001: Operating systems, software architecture, network measurement, network protocol design, and programming language techniques for improving systems software.

Rafail Ostrovsky, Professor, Ph.D. (MIT) 1992: All aspects of theory of computation, especially cryptography and security, distributed algorithms, high-dimensional search, and routing and flow control in communication networks.

Richard Korf, Professor, Ph.D. (Carnegie-Mellon) 1983: Problem-solving, heuristic search, planning and parallel processing in artificial intelligence.

Jens Palsberg, Professor, Ph.D. (University of Aarhus, Denmark) 1992: Compilers, embedded systems, programming languages, software engineering, and information security.

Songwu Lu, Associate Professor, Ph.D. (Illinois, Urbana-Champaign) 1999: Wireless networking, mobile computing, network security, sensor networks, network middleware.

D. Stott Parker, Professor, Ph.D. (Illinois, Urbana) 1978: Knowledge-based modeling and databases, stream processing, logic programming, rewriting, and systems for constraint processing.

Rupak Majumdar, Assistant Professor, Ph.D. (Berkeley) 2003: Formal verification and control of reactive, real-time, hybrid, and probabilistic systems. Software verification and programming languages. Game theoretic problems in verification. Logic and automata theory.

Miodrag Potkonjak, Professor, Ph.D. (UC Berkeley) 1991: Complex distributed systems, including embedded systems, communication designs, computer-aided design, ad hoc sensor networks, computational security, electronic commerce, and intellectual property protection.

Adam Meyerson, Assistant Professor, Ph.D. (Stanford) 2002: Approximation algorithms, randomized algorithms, online algorithms, theoretical problems in networks and databases.

Glenn Reinman, Assistant Professor, Ph.D. (UC San Diego) 2001: Processor architecture design and optimization, speculative execution, profile-guided optimizations, techniques to find and exploit instruction-level parallelism.

Todd Millstein, Assistant Professor, Ph.D. (University of Washington), 2003: Programming languages and language design, compilation, software model checking, formal methods, and database systems.

David A. Rennels, Associate Professor, Ph.D. (UCLA) 1973: Computer systems architecture, fault-tolerant computing and modular architectures for VLSI implementation.

Amit Sahai, Associate Professor, Ph.D. (MIT) 2000: Theoretical computer science, primarily foundations of cryptography and computer security.

Demetri Terzopoulos, Chancellor's Professor, Ph.D. (MIT) 1984: Computer graphics, computer vision, medical image analysis, computer-aided design, artificial intelligence/ life.

Majid Sarrafzadeh, Professor, Ph.D. (Illinois, Urbana-Champaign) 1987: Embedded and reconfigurable computing, VLSI CAD, and design and analysis of algorithms.

Carlo Zaniolo, Professor, Ph.D. (UCLA) 1976: Knowledge-based systems, database systems, non-monotonic reasoning, spatio/temporal reasoning, and scientific databases.

David Smallberg, SOE Lecturer, M.S. (UCLA) 1978: Computer science education, programming languages, generic programming, student software analysis.

Lixia Zhang, Professor, Ph.D. (MIT) 1989: Network traffic dynamics, support for integrated services and reliable multicast protocols, adaptive web caching (AWC), support for differentiated services, Internet distance map service (IDMAPs), extremely large-scale sensor networking, and fault tolerance in large-scale distributed systems.

Stefano Soatto, Professor, Ph.D. (California Institute of Technology) 1996: Computer vision and nonlinear estimation and control theory.

Song-Chun Zhu, Associate Professor, Ph.D. (Harvard University) 1996: Computer vision, statistical modeling and computing, machine learning. (Joint appointment with UCLA Department of Statistics)

Yuval Tamir, Associate Professor, Ph.D. (UC Berkeley) 1985: Computer systems, parallel and distributed systems, computer architecture, software systems, dependable systems, cluster computing, reliable network services, interconnection networks and switches, CPU and memory system architecture, reconfigurable systems.

Adjunct Faculty

- Leon Alkalai (flight computing, fault tolerant systems)
- Alan Kay (programming languages, computer human interfaces)
- Boris Kogan (math, modeling & computer simulation of physical, engineering & bio-medical systems)
- Gerald Popek (security, distributed systems, mobility)
- Peter Reiher (distributed systems, security)
- M. Y. Sanadidi (computer networks)

Emeriti Faculty

- Algirdas Avizienis (dependable & fault-tolerant computing)
- Bertram Bussell (computer architecture)
- Jack Carlyle (communications systems & modeling)
- Gerald Estrin (design methods)
- Thelma Estrin (biomedical)
- Leonard Kleinrock (computer connectivity, mobility, security)
- Allen Klinger (biological & social patterns, mathematical models)
- Michel Melkanoff (linguistics: human & computer languages)
- Judea Pearl (artificial intelligence, philosophy of science, and causal reasoning)
- Jacques Vidal (soft computing: neural networks, genetic optimization)

FACULTY AREAS OF EXPERTISE

Artificial Intelligence	Graphics & Vision
Darwiche—Automated Reasoning	**Faloutsos**—Computer Graphics
Dyer—Natural Language Processing	**Soatto**—Computer Vision
Korf—Heuristic Search	**Terzopoulos**—Computer Graphics & Vision
Pearl—Automated Reasoning, Causality, Philosophy of Science	**Zhu**—Computer Vision
Terzopoulos—Artificial Life	**Information & Data Management**
Computer Networks	**Cardenas**—Database Management, BioXX-informatics
Bagrodia—Network Simulation, Wireless Networks	**Cho**—Internet Information Systems
Estrin—Embedded Network Systems	**Chu**—Intelligent Info Systems, Data Mining, Medical Informatics
Gerla—Wireless Computing	**Muntz**—Database Management, Data Mining
Kleinrock—Nomadic Computing	**Ostrovsky**—Analysis & Search of High Dimensional Spaces
Lu—Wireless Mobile Computers	**Parker**—Data Mining, Bioinformatics
Ostrovsky—Routing Protocols, Network Security	**Sahai**—Privacy-Preserving Data Mining
Sahai—Network Security	**Zaniolo**—Database Management
Zhang—Internet Computing	**Scientific Computing**
Computer Science Theory	**DiStefano**—Biomedical Systems
Gafni—Distributed Algorithms	**Kogan**—Biomedical Systems
Greibach—Algorithms, Complexity	**Software Systems**
Meyerson—Randomized Algorithms	**Bagrodia**—Parallel Computing
Ostrovsky—Cryptography, Geometric Algorithms, Randomized Algorithms, Complexity	**Eggert**—Software Design & Engineering
Sahai—Algorithms, Complexity, Cryptography	**Kohler**—Operating Systems, Internet Systems
Computer System Architecture & CAD	**Majumdar**—Formal Verification
Cong—Computer-Aided Design & Reconfigurable Systems	**Millstein**—Programming Languages
Ercegovac—Computer Arithmetic, Reconfigurable Systems	**Palsberg**—Compilers
Potkonjak—Computer-Aided Design	**Parker**—Models & Paradigms
Reinman—Processor Design and Optimization	**Sahai**—Software Security
Rennels—Fault Tolerance, High-Performance Computing	**Smallberg**—Programming Paradigms
Sarrafzadeh—Embedded & Reconfigurable Systems	**Tamir**—Distributed Systems, Network Services
Tamir—Parallel & Distributed Systems, Fault Tolerance	

Internet Technologies Cluster

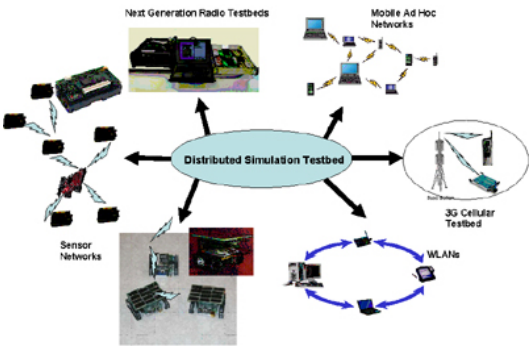
The concept of packet networking was successfully demonstrated for the first time in 1969 at UCLA (the first node in the ARPANET), sowing the seeds for the creation of today's modern Internet. Thirty-six years later, the term "networking" means much more than switching packets on wires. Networking and the Internet have become an essential fabric of our society and the support of vital applications ranging from electronic mail, distributed databases, multimedia streaming, file sharing, command and control systems, homeland security and distributed computing. Since the early ARPANET days, UCLA has maintained a position of prominence and is now one of the most active centers of Internet research in the nation. The key to the success of the Internet Technologies Cluster at UCLA is the excellence, multidisciplinary expertise and collaboration history of its faculty. The cluster hosts the key technologies that will shape the future of the Internet. These technologies include:

- *Internet protocols* (e.g., routing, DNS, overlays, peer-to-peer, etc.), targeting better quality-of-service guarantees along with scalability and robustness.
- *Advanced modular processor (software and hardware) designs* aimed at scalability, fault tolerance and low energy consumption.
- *Wireless protocols* coupled with programmable radios/antennas and adaptive modulation and encoding techniques to enable the interconnection of wireless networks and mobile customers with the wired Internet.
- *Distributed applications* (e.g., multimedia, sensor fields, databases, peer-to-peer, etc.) that can efficiently utilize network and computing resources.
- *Network security strategies* for the protection of resources from attacks and for the enforcement of privacy.
- *Analytic models and methods* for the optimal design and systematic evaluation of protocols and algorithms.
- *Simulation models and tools* for performance evaluation/prediction that are essential for the design/implementation cycle.

Our research skills are distributed over multiple departments (CS, EE, and MANE) within the Henry Samueli School of Engineering and Applied Sciences (HSSEAS). They are brought together by collaborative projects to implement integrated networked system designs and distributed applications in school-wide centers and testbeds such as: *CENS* (embedded networked systems), *CAINS* (intelligent autonomous systems), *CICS* (information and computation security), and *WHYNET* (wireless hybrid network testbed). These resources are not only an asset for research and education in HSSEAS, but are shared with other schools and industry, thus providing a bridge with external research communities and an opportunity for expanded collaboration.

RESEARCH HIGHLIGHT — WHYNET: Scalable Testbed for Next-Generation Mobile Wireless Networking Technologies (http://pcl.cs.ucla.edu/projects/whynet/)

Supported by a $5.5M multi-year grant from NSF, WHYNET is a multi-university (UCLA, UCSD, UCSB, UCD, UCR, USC, Univ. of Delaware) project to develop a Wireless HYbrid NETworking (WHYNET) testbed to study the impact of next-generation wireless communication technologies on application-level performance. The UCLA team includes Professors Bagrodia, Gerla, Srivastava, Daneshrad, and Fitz, and Drs. Takai and Marina.



WHYNET researchers are exploring effective techniques for building robust, heterogeneous wireless networks with tens of thousands of communicating elements. The testbed infrastructure includes diverse sets of physical testbeds, including 802.11-based networks (wireless LAN, mesh, MANET), sensor networks, novel SDR and MIMO radio platforms, as well as ultra-wideband devices; it supports seamless inter-working of simulated, emulated and physical components for scalable and realistic evaluation of heterogeneous wireless networking scenarios. WHYNET has been used to evaluate streaming video, audio, and data applications on heterogeneous networks that include cellular, sensor, and mobile ad hoc communication devices.

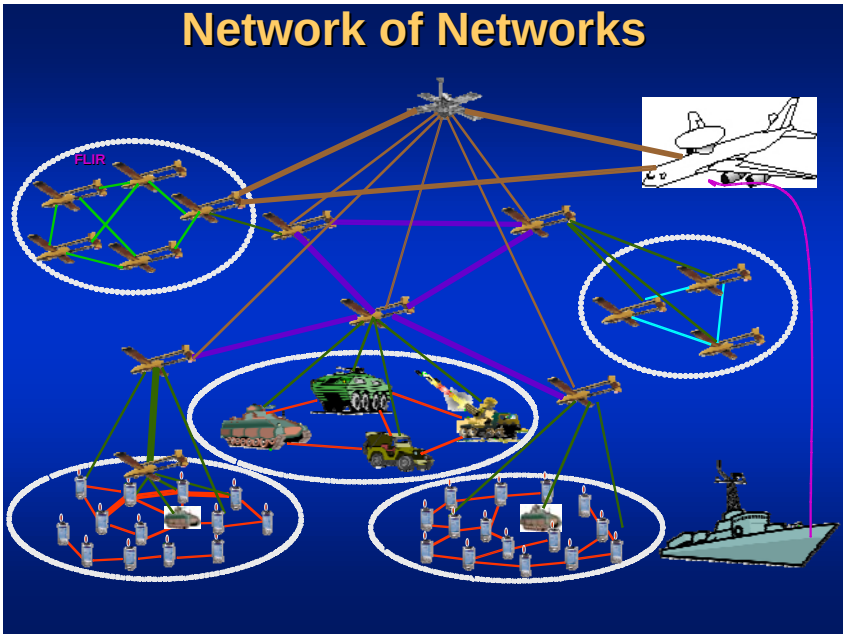
Internet Technologies Cluster

RESEARCH HIGHLIGHT — **Minuteman. "A War of Robots, All Chattering on the Western Front" (portions extracted from the 11 July 2002 NY Times article of same title. Full article may be viewed at http://www.nytimes.com/2002/07/11/technology/circuits/11NEXT.html)**

Since the United States military campaign began in Afghanistan, the unmanned spy plane has gone from a bit player to a starring role in Pentagon planning. Commanders are envisioning wars involving vast robotic fleets on the ground, in the air and on the seas — swarms of drones that will not just find their foes, but will fight them, too. But such forces will need an entirely new kind of network in which to function, a wireless Internet in the sky that will let thousands of drones communicate quickly while zooming around a battle zone at speeds of up to 300 miles an hour.

At UCLA, an association of nearly fifty scientists and engineers spread across seven project teams and coordinated by the Office of Naval Research has engaged in a five-year, $11 million effort to build such a system. The project is called Multimedia Intelligent Network of Unattended Mobile Agents, or *Minuteman*. The most important aspect is the network's structure, developed by Mario Gerla, a professor of computer science at the University of California, Los Angeles. The network will deploy high flying UAVs which, soaring above the battlefield at 50,000 feet or higher, will communicate with headquarters, transmitting data and receiving commands. The commands will be passed along to a team of lower-flying UAVs that will relay them in turn to single drones serving as liaisons for squadrons of UAVs.

"Besides serving as routers, the drones also have to do reconnaissance and carry weapons," Dr. Gerla said. "There is no central control — as soon as you do that you are vulnerable." As a graduate student nearly 30 years ago, Dr. Gerla did work for the federal government on the ARPANET, the military precursor to the Internet. This flexible "network of networks" structure not only allows communications to stay up when individual drones go down, but also enables the network to reconfigure itself to maximize bandwidth and to meet goals on the battlefield. Robot planes would constantly shift position to communicate with one another.



Embedded Systems Cluster

An embedded system is a computer-based system that interacts with its environment. Embedded systems range from cell phones to radars and sonars, from biomedical and automotive devices to nuclear plants and missile controllers. More than 99 percent of all computer systems are embedded.

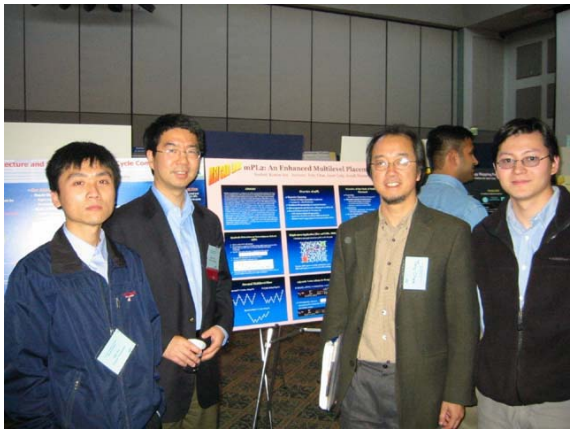
The embedded systems field is on the verge of a revolution due to the convergence of computation, communication, sensing, actuating, and embedded power production technologies. This poses numerous challenges to self-recovering systems, security and privacy, location-award computing, low-cost and low-power design, and many other areas of research.

At UCLA the embedded systems research emphasis is on sensor networks, computer-aided design of embedded systems, reconfigurable/programmable embedded systems, design of low-power systems, architectural and compiler techniques for embedded systems, and Internet-based embedded systems. Several large research groups here at UCLA emphasize embedded systems research. One of these groups, the *Center for Embedded Networked Sensing (CENS)*, is an important focal point for embedded computing research in Southern California.

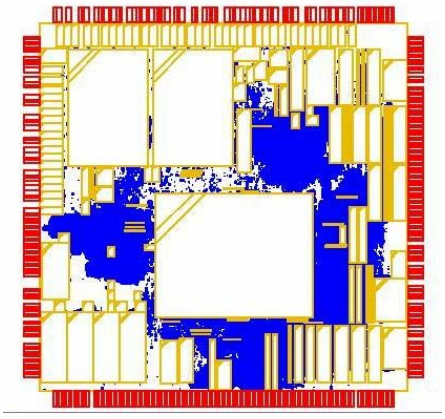
RESEARCH HIGHLIGHT— mPL5, A High-Quality Placement Tool

Very-Large Scale Integrated (VLSI) circuit placement—spatially arranging the interconnected components of an integrated circuit in a nonoverlapping configuration on a chip—is a crucial step in today's VLSI physical design flow. Placement determines the basic structure of the interconnect, and interconnect delay is the bottleneck of nanoscale VLSI system performance. Placement is challenging, not only because of the enormous number of objects (in millions or tens of millions) to be placed, but also because of many complex constraints, such as signal delay, wireability, thermal temperature, and manufacturability.

A high-quality placement tool, *mPL5*, was recently developed by a UCLA research group led by professors Jason Cong of the Computer Science Department and Tony Chan of the Mathematics Department. *mPL5* builds on a highly scalable, multilevel nonconvex nonlinear programming framework. It makes use of accurate and smooth approximations of the wirelength objective function and fast numerical methods for computing the generalized bin-based density constraints. It also naturally integrates discrete optimization and legalization operations in the multilevel framework. *mPL5* has been tested on all the publicly available benchmarks. It demonstrated the best performance among all the academic placers, and received a Best Paper Award at the 2005 International Symposium on Physical Design.



From left to right: Min Xie, Jason Cong, Tony Chan, and Kenton Sze (not pictured: Joe Shinnerl)



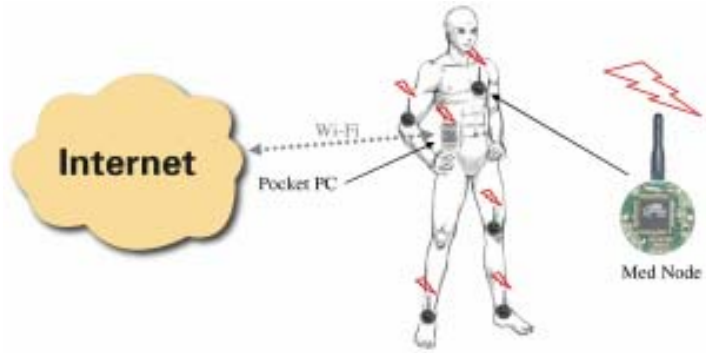
mPL placement on a design with 255023 cells and 159 macros

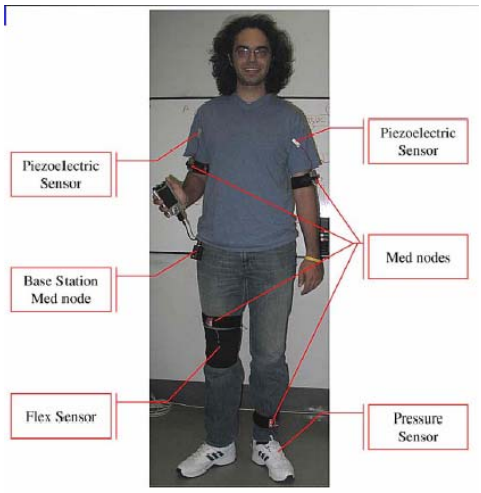
Embedded Systems Cluster

RESEARCH HIGHLIGHT— **CustoMed**

CustoMed

The Embedded and Reconfigurable Systems Lab is working on a new and flexible architecture aimed at reducing the customization and reconfiguration time for reconfigurable embedded systems, specifically for medical applications. The system is composed of "med nodes," which are stand-alone components consisting of a processing unit, a battery, and various types of physiological sensors. They support a variety of analog and digital sensors such as flex sensors, piezoelectric sensors, pressure sensors, etc. Also, they are software programmable, so that they can be customized for various applications and types of sensors, and have on-chip memory blocks for data storage. The system allows for flexible and fast reconfiguration, which in turn allows for the customization of a large system of med nodes very quickly.





Intelligent Systems & Interfaces Cluster

UCLA has a long tradition of research in intelligent systems, having pioneered developments in some of the most influential areas, including commonsense reasoning and heuristic search. For example, the foundations of probabilistic commonsense reasoning were established at UCLA, leading to probabilistic graphical models that currently underlie a significant portion of the research on intelligent systems. Moreover, some of the most influential methods in heuristic search were developed at UCLA and are currently in common daily use in a variety of optimization problems. Recently, the Intelligence Systems and Interfaces Cluster experienced major growth in several new dimensions. First, significant thrusts were created in the area of visual sciences, which includes computer graphics, computer vision, medical image analysis, and artificial life. Second, the classical strength in probabilistic reasoning has been augmented by a major thrust in the area of symbolic and logical reasoning.

Research efforts in this cluster are spread over a wide spectrum, from the very theoretical to the very practical. There are efforts concerned with mathematical formalizations of various aspects of living systems and intelligence, including belief revision, causality, multi-agent coordination, biomechanics and motor control, behavior simulation, expressive facial animation and visual speech, and human simulation.

Furthermore, there are on-going efforts that develop algorithms for implementing these formalizations effectively, and include work on searching very large problem spaces (over 10 trillion nodes), embedded reasoning, and any-space algorithms. Finally, there are efforts that focus on building systems for experimental and real-world use in a variety of application areas, including intelligent interfaces, interactive game technologies, motion picture special effects, verification, diagnosis, 3D reconstruction, visual recognition, and visual motion estimation.

RESEARCH HIGHLIGHT— **DARPA Grand Challenge**

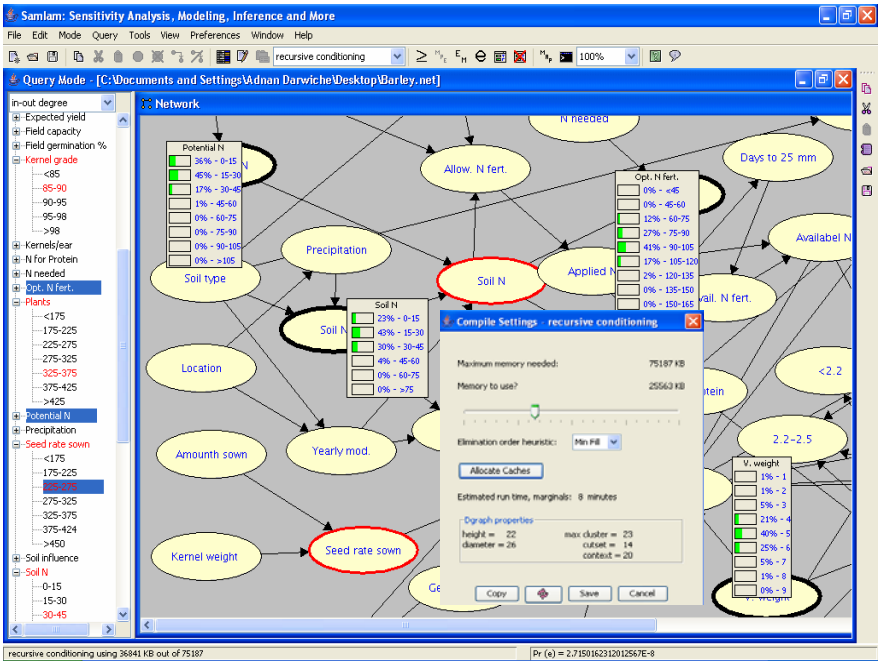
The UCLA Vision Lab was actively engaged in this year's DARPA Grand Challenge (www.grandchallenge.org). Of the over-200 teams that first registered, 193 were selected for site visits where they demonstrated autonomous driving and obstacle avoidance. Forty-three were selected for the semifinals where they had to compete on a challenging course that included obstacles, tunnels, walls and traps. Of these, 20 teams were selected for the final competition, which took place in Primm, Nevada, on October 8, 2005. Golem 2, UCLA's entry in the Grand Challenge, successfully passed all qualifying stages to compete in the final event.

UCLA's entry in the DARPA Grand Challenge was developed by a group of students and faculty led by Professor Stefano Soatto of the Computer Science Department.

Intelligent Systems & Interfaces Cluster

RESEARCH HIGHLIGHT— Expanding the Reach of Automated Reasoning

One of Adnan Darwiche's primary goals as a researcher in artificial intelligence is to enable the routine use of automated reasoning systems when solving complex real-world problems, such as verifying properties of system designs, isolating and recovering from faults in manufacturing processes, and determining distances between genes on a chromosome for early disease detection (a process known as genetic linkage analysis). Historically, a key barrier for the use of automated reasoning systems has been their scalability, as the body of relevant knowledge, say in a genetic linkage analysis problem, may well overwhelm the most sophisticated automated reasoning systems. Another key barrier is the potential footprint of these systems, which may sometimes prohibit their cost-effective embeddability in consumer products, such as cars and toys. Professor Darwiche has pinpointed some fundamental limitations in traditional approaches to automated reasoning that inflate these barriers, and proposed alternative theoretical approaches that are detailed in a sequence of papers in the *Journal of the ACM*. For example, he has proposed a new class of algorithms for reasoning with probabilistic graphical models, which is not only sensitive to the topology of these models (as is traditionally the case), but also adaptive to their specific parameterization. He also proposed a fundamental approach that compiles the complex process of automated reasoning to the simple task of circuit evaluation. Over the last few years, the Automated Reasoning group at UCLA, directed by Professor Darwiche, has embarked on realizations of these theoretical results, producing a new generation of automated reasoning tools that can handle problems of scale never attained, or even perceived possible before. These tools are available for public download at *reasoning.cs.ucla.edu*, and include SamIam (a comprehensive system for modeling and reasoning with probabilistic graphical models), Ace (a system for embedded reasoning), and RC Link (a system for genetic linkage analysis) which surpasses, by orders of magnitude, classical systems that have been under development by computer scientists and geneticists for over three decades.



SamIam: A system for probabilistic reasoning with a time-space tradeoff engine.

Software Systems Cluster

The Software Systems Cluster is a wonderful mix of faculty and students whose research goal is to develop the software of the future. UCLA has long had strength in databases and in parallel and distributed systems. In the past few years that strength has been complemented with additional faculty whose focus is on software engineering, operating systems, programming languages, compilers, and verification. As result, UCLA is now a major player in the software research community.

This is an exciting time to be a software researcher at UCLA. We have critical mass for large-scale collaboration, and we have strong ties to other research areas within the Computer Science Department and to the Center for Embedded Networked Sensing. The software development of today and tomorrow is facing many challenges. One approach to meeting those challenges is to provide better languages, analysis tools, and compilers for the working programmer. For example, consider event-driven software, which is everywhere in today's society. Next-generation language and tool support should lead to increased confidence in a wide variety of event-driven systems, including Web servers, sensor networks, medical implants, engine control, and fly-by-wire/drive-by-wire systems. The UCLA Software Systems Cluster is well positioned to meet such challenges.

RESEARCH HIGHLIGHT— **Event-Driven Programming**

Event-driven programming has found pervasive acceptance, from high-performance servers to embedded systems, as an efficient method for interacting with a complex world. Unfortunately, the loose coupling of components that comprise an event-driven program obscures the program's control flow and makes dependencies hard to express and detect. As a result, event-driven software is difficult to debug, maintain, and understand.

Professors Eddie Kohler, Rupak Majumdar, Todd Millstein, and Jens Palsberg have teamed up to build the next generation of language and tool support for event-driven programming. Their NSF-funded Event-Driven Software Quality project leverages the diverse strengths of the four professors, ranging from systems software to programming languages to compilers to computer-aided verification. A talented group of graduate students is driving the current research, which includes language constructs to make the event-driven style more modular, a library for event-driven software that makes the dependencies among components explicit, and compiler technologies for ensuring adherence to resource constraints that arise in embedded event-driven systems.

(Standing, from left) Shane Markstrum, Todd Millstein, Brian Chin, Ben Titzer, Jens Palsberg, Rupak Majumdar, Jeff Fischer, Alex Warth, Manav Mital and Krishna Nandivada. (Sitting, from left) Eddie Kohler, Mike Emmi and Lih Chen.

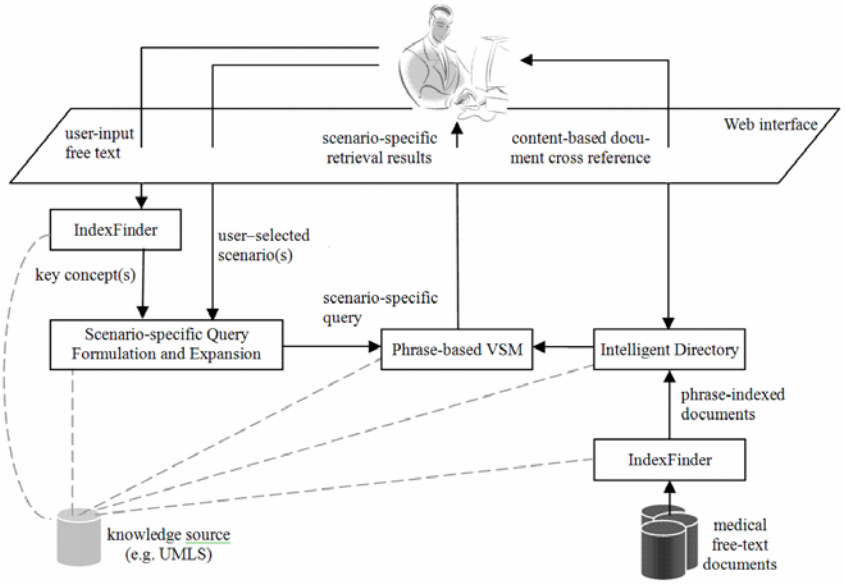
Software Systems Cluster

RESEARCH HIGHLIGHT— A Medical Digital Library for Scenario-Specific Retrieval

Patient medical records, such as clinical and laboratory reports, are now commonly stored on computers to improve accessibility for health care providers However, information retrieval is limited on an individual patient basis (i.e., using patient ID as a key). Therefore, it would be highly beneficial to be able to transform this sea of data into a general medical information source. In doing so, we would then be able to provide users with valuable scenario-specific information for patient care, medical research and education. For example, a patient could search for relevant literature and specialists regarding the treatment of his/her specific disease. Health care providers would be able to identify other individuals in the system with a demography and disease similar to their patients, and could thereby discover the success rates and side effects of treatment methods used. Medical researchers would be able to study the characteristics of new diseases and the effectiveness of treatment methods for those diseases. Motivated by this potential, Professor Wesley Chu, teamed with professors H. Kangarloo and D. Aberle of the UCLA School of Medicine, received a five-year grant from the National Institute of Health. One of their tasks was to develop such a medical digital library. More specifically, their goal is to research innovative methodologies for organizing and identifying specific information sources, supporting users with scenario-specific query answering, and providing content-based cross-referencing.

Since most documents in the medical domain are written in semi-structural or free-text forms, several new challenges need to be investigated: extracting key features from free text to represent document content, clustering similar key features into topics and organizing them into hierarchies for content-based cross reference, developing knowledge-based scenario-specific query expansion techniques to resolve any mismatch between key terms used in the query and those used in documents, and similarity ranking matrices with considerations of query semantics. The unique aspect of this research is in the integration of the medical knowledge base (e.g., ULMS) as an integral part of the methodology.

Three computer science Ph.D. students developed their research topics based on this project. A test bed was implemented using the above-developed methodologies for scenario-specific information retrieval. Experimental results showed that our proposed techniques (feature extractions, knowledge base query expansion and phrase-based vector space model) significantly improved the performance and effectiveness of document retrieval. Our system was demonstrated at the 2003 Radiology Society of America (RSNA) annual meeting and received a certificate of merit award. In January 2005, the UCLA Intellectual Property Office filed a patent application on this work entitled *"Content Correlation and Indexing of Clinical Texts and Documents."*



SELECTED PUBLICATIONS*

J. Zhou, Z. Ji, M. Takai, and **R. Bagrodia**, "MAYA: Integrating Hybrid Network Modeling to the Physical World," *ACM Transactions on Modeling and Computer Simulation*, V. 14 N. 2, pp. 49-169, April 2004.

G. Yeung, M. Takai, **R. Bagrodia**, A. Mehrnia, and B. Daneshrad, "Detailed OFDM Modeling in Network Simulation of Mobile Ad Hoc Networks," Proceedings *of Parallel and Distributed Simulation (PADS 2004)*, May 16-19, 2004. (**Best Paper Award**)

T. Phan, G. Zorpas, and **R. Bagrodia**, "Middleware Support for Reconciling Client Updates and Data Transcoding," *Proceedings of the ACM International Conference on Mobile Systems, Applications, and Services (MobiSys 2004)*, June 6-9, 2004.

Z. Ji, Y. Yang, J. Zhou, M. Takai, and **R. Bagrodia**, "Exploiting Medium Access Diversity in Rate Adaptive Wireless LANs," *Proceedings of ACM MOBICOM 2004*, Philadelphia, September 26 - October 1, 2004.

M. Varshney and **R. Bagrodia**, "Detailed Models for Sensor Network Simulations and Their Impact on Network Performance," *Proceedings of ACM MSWIM 2004*, Venice, Italy, October 4-6, 2004.

A. F. Cárdenas, R. K. Pon, P. A. Michael, and J. T. Hsiao, "Image Stack Viewing and Access," *Journal of Visual Languages and Computing*, Vol. 14, Academic Press Ltd., pp. 421-441, 2003.

M. S. Brown, S. K. Shah, R. C. Pais, Y. Lee, M. F. McNitt-Gray, J. G. Goldin, **A. F. Cárdenas**, and D. R. Aberle, "Database Design and Implementation for Quantitative Image Analysis Research," *IEEE Transactions on Information Technology and Biomedicine*, Vol. 9, No. 1, pp. 99-108, March 2005.

R. K. Pon and **A. F. Cárdenas**, "Data Quality Inference," *Second International ACM SIGMOD Workshop on Information Quality in Information Systems (IQIS 2005),* Baltimore, MD, June 17, 2005.

A. F. Cárdenas, R. K. Pon, R. B. Cameron, and M. A. Coyle, "The Mobile Patient and Mobile Physician Data Access and Transmission," *The 2005 International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences (METMBS '05),* Las Vegas, Nevada, June 20-25, 2005.

A. F. Cardenas, R. K. Pon, and B. S. Islam, "The Image Stack Stream Model, Querying and Architecture," *2005 Distributed Multimedia Systems Conference*, Banff, Canada, September 5-7, 2005.

J. Cho and S. Roy, "Impact of Web Search Engines on Page Popularity," *Proceedings of the World-Wide Web Conference (WWW),* May 2004.

P. G. Ipeirotis, A. Ntoulas**, J. Cho**, and L. Gravano, "Modeling and Managing Content Changes in Text Databases," *Proceedings of the International Conference on Data Engineering (ICDE),* March 2005. (**Best Paper Award**)

U. Lee, Z. Liu, and **J. Cho**, "Automatic Identification of User Goals in Web Search," *Proceedings of the World-Wide Web Conference (WWW),* May 2005.

J. Cho, S. Roy, and R. E. Adams, "Page Quality: In Search of an Unbiased Web Ranking," *Proceedings of 2005 ACM International Conference on Management of Data (SIGMOD),* June 2005.

S. Pandey, S. Roy, C. Olston, **J. Cho**, and S. Chakrabarti, "Shuffling a Stacked Deck: The Case for Partially Randomized Ranking of Search Engine Results," *Proceedings of 31st International Conference on Very Large Databases (VLDB),* September 2005.

S. Liu, Q. Zou, and **W. W. Chu,** "Configurable Indexing and Ranking for XML Information Retrieval," *ACM Proceedings of Special Interest Group on Information Retrieval (SIGIR),* 2004.

D. Lee, W. Mao, H. Chiu, and **W. W. Chu,** "Designing Triggers with Trigger-By-Example," *Knowledge and Information Systems*, Springer, 2004.

W. W. Chu, Z. Liu, W. Mao, and Q. Zou, "A Knowledge-Based Approach for Retrieving Scenario-Specific Medical Text Documents," *Control Engineering Practice*, Special Issue on Modeling and Control of Biomedical Systems, 13(9), pp. 1105-1121, 2005.

Q. Zou, Y. Chen, **W. W. Chu**, and X. Lu, "Mining Association Rules from Tabular Data Guided by Maximal Frequent Itemsets," book chapter, in *Foundations and Advances in Data Mining*, ed. Wesley W. Chu and T. Y. Ling, Springer, 2005.

*Publications list has been limited to five per faculty.

Z. Liu and **W. W. Chu**, "Knowledge-Based Query Expansion to Support Scenario-Specific Retrieval of Medical Free Text," *Proceedings of the 20th ACM Symposium on Applied Computing (SAC 2005)*, Special Track on Information Access and Retrieval, Santa Fe, NM, March 2005.

J. Cong and Y. Zhang, "Thermal Via Planning for 3-D ICs," *Proceedings of the 2005 IEEE/ACM Int'l Conference on Computer Aided Design*, 2005.

J. Cong, Y. Fan, G. Han Y. Lin, J. Xu, Z. Zhang, and X. Cheng, "Bitwidth-Aware Scheduling and Binding in High-Level Synthesis," *Proceedings of the Asia South Pacific Design Conference,* January 2005.

J. Cong, H. Huang, and X. Yuan, "Technology Mapping and Architecture Evaluation for k/m-Macrocell-Based FPGAs," *ACM Transactions on Design Automation of Electronic Systems*, vol. 10, no. 1, pp.3-23, January 2005. **(Best Paper Award)**

J. Cong, Y. Fan, G. Han, A. Jagannathan, G. Reinman, and Z. Zhang, "Instruction Set Extension with Shadow Registers for Configurable Processors," *Proceedings of the ACM/SIGDA Int'l Symposium on Field Programmable Gate Arrays*, Monterey, CA, February 2005.

T. Chan, **J. Cong**, and K. Sze, "Multilevel Generalized Force-Directed Method for Circuit Placement," *Proceedings of the Int'l Symposium on Physical Design*, San Francisco, CA, April 2005. **(Best Paper Award)**

J. Huang and **A. Darwiche**, "DPLL with a Trace: From SAT to Knowledge Compilation," *Proceedings of the 19th International Joint Conference on Artificial Intelligence (IJCAI)*, pp. 156-162, 2005.

A. Darwiche, H. Palacios, B. Bonet, and H. Geffner, "Pruning Conformant Plans by Counting Models on Compiled d-DNNF Representations," *Proceedings of the 15th International Conference on Planning and Scheduling (ICAPS),* pp. 141-150, 2005.

J. Huang and **A. Darwiche**, "On Compiling System Models for Faster and More Scalable Diagnosis," *Proceedings of the 20th National Conference on Artificial Intelligence (AAAI)*, pp. 300-306, 2005.

M. Chavira and **A. Darwiche**, "Compiling Bayesian Networks with Local Structure," *Proceedings of the 19th International Joint Conference on Artificial Intelligence (IJCAI)*, pp. 1306-1312, 2005.

A. Choi, H. Chan, and **A. Darwiche**, "On Bayesian Network Approximation by Edge Deletion," *Proceedings of the 21st Conference on Uncertainty in Artificial Intelligence (UAI)*, pp. 128-135, 2005.

D. MacKenzie, A. Demaille, **P. Eggert**, J. Meyering, A. Oliva, and T. Tromey, software program: GNU Autoconf 2.59, December 2003. http://www.gnu.org/software/autoconf/.

D. MacKenzie, J. Meyering, **P. Eggert**, et al., software program: GNU Core Utilities 5.2.1, March 2004. http://www.gnu.org/software/coreutils/.

P. Eggert and A. D. Olson, software program: Sources for Time Zone and Daylight Saving Time Data, September 2005. http://www.twinsun.com/tz/tz-link.htm.

P. R. Eggert and D.S. Parker, "Perturbing and Evaluating Numerical Programs Without Recompilation–the Wonglediff Way," *Software—Practice and Experience*, Vol. 35, No. 4, pp. 313-322, April 2005.

R. Corbett, R. Stallman, A. Demaille, **P. Eggert**, and W. Hansen, software program: GNU Bison 2.1, September 2005. http://www.gnu.org/software/coreutils/.

M. D. Ercegovac, and J.-M. Muller, "Complex Square Root with Operand Prescaling," *IEEE International Conference on Application-Specific Systems, Architectures and Processors*, pp. 293-303, 2004. (**Best Paper Award**)

J.-A. Pineiro, **M. D. Ercegovac,** and J. D. Bruguera, "Algorithm and Architecture for Logarithm, Exponential, and Powering Computation," *IEEE Trans. Computers*, 53(9), pp. 1085-1096, 2004.

J.-A. Pineiro, **M. D. Ercegovac** and J. D. Bruguera, "High-Radix Logarithm with Selection by Rounding: Algorithm and Implementation," *Journal of VLSI Signal Processing*, Vol. 40, pp. 109-123, 2005.

Z. Huang and **M. D. Ercegovac**, "High-Performance Low-Power Left-to-Right Array Multiplier Design," *IEEE Trans. Computers*, 54(3), pp. 272-283, 2005.

P. Adharapurapu and **M. D. Ercegovac**, "A Linear-System Operator Based Scheme for Evaluation of Multinomials," *Proceedings of 17th IEEE Symposium on Computer Arithmetic*, pp. 249-256, 2005.

B. Greenstein, E. Kohler, and **D. Estrin**, "A Sensor Network Application Construction Kit (SNACK)," *Proceedings of the Second ACM Conference on Embedded Networked Sensor Systems (SenSys),* 2004.

L. Girod, T. Stathopoulos, N. Ramanathan, J. Elson, **D. Estrin**, E. Osterweil, and T. Schoellhammer, "A System for Simulation, Emulation, and Deployment of Heterogeneous Sensor Networks," *Proceedings of SenSys 2004*, November 2004.

M. Rahimi, M. Hansen, W. J. Kaiser, G. S. Sukhatme, and **D. Estrin**, "Adaptive Sampling for Environmental Field Estimation Using Robotic Sensors," *Proceedings of IEEE/RSJ International Conference on Intelligent Robots and Systems*, Edmonton, Canada, August 2004.

M. Rahimi, R. Baer, O. I. Iroezi, J. C. Garcia, J. Warrior, **D. Estrin**, and M. Srivastava, "Cyclops: In Situ Image Sensing and Interpretation," *Proceedings of the Third ACM Conference on Embedded Networked Sensor Systems (SenSys),* November 2-4, 2005.

N. Ramanathan, K. Chang, R. Kapur, L. Girod, E. Kohler, and **D. Estrin**, "Sympathy for the Sensor Network Debugger," *Proceedings of the Third ACM Conference on Embedded Networked Sensor Systems (SenSys),* November 2-4, 2005.

A. Shapiro, Y. Cao, and **P. Faloutsos**, "Stylistic Motion Decomposition," *ACM SIGGRAPH/Eurographics Symposium on Computer Animation*, extended abstract, Grenoble, France, August 2004.

Y. Cao, **P. Faloutsos**, E. Kohler, and F. Pighin, "Real-time Speech Motion Synthesis from Recorded Motions," *Proceedings of ACM SIGGRAPH/Eurographics Symposium on Computer Animation*, pp. 347-355, 2004.

A. Shapiro, Y. Cao, and **P. Faloutsos**, "Interactive Motion Decomposition," *SIGGRAPH 2004*, technical sketch, Los Angeles, CA, August 2004.

A. Shapiro, **P. Faloutsos**, and V. Ng-Thow-Hing, "Dynamic Animation and Control Environment," *Graphics Interface*, pp. 61-70, 2005.

Y. Yi, **M. Gerla,** and K. Obraczka, "Scalable Team Multicast in Wireless Networks Exploiting Coordinated Motion," *Ad Hoc Networks Journal*, August 2003.

B. Zhou, K. Xu, and **M. Gerla**, "Group and Swarm Mobility Models for Ad Hoc Network Scenarios Using Virtual Tracks," *Proceedings of MilCom '04*, Monterey, California, USA, 2004.

M. Luglio, M. Y. Sanadidi, J. Stepanek, and **M. Gerla**, "On-Board Satellite Split TCP Proxy," *IEEE Journal on Selected Areas in Communications, JSAC*, Special Issue on Broadband IP Networks via Satellites, Vol. 22, n. 2, pp. 362-370, February 2004.

R. Kapoor, L.-J. Chen, L. Lao, **M. Gerla**, and M. Y. Sanadidi, "CapProbe: A Simple and Accurate Capacity Estimation Technique," ACM SIGCOMM 2004, Portland, USA, August 2004.

A. Nandan, S. Das, G. Pau, M. Y. Sanadidi, and **M. Gerla**, "Cooperative Downloading in Vehicular Ad Hoc Networks," *WONS 2005*, St Moritz, Switzerland, January 2005. **(Best Paper Award)**

L. Kleinrock, "The Internet Rules of Engagement: Then and Now," Elsevier Ltd, pp. 193-207, April-August 2004.

S. Tewari and **L. Kleinrock**, "On Fairness, Optimal Download Performance and Proportional Replication in Peer-to-Peer Networks," *Proceedings of IFIP Networking 2005*, Waterloo, Canada, May 2005.

S. Tewari and **L. Kleinrock**, "Analysis of Search and Replication in Unstructured Peer-to-Peer Networks," *Proceedings of ACM SIGMETRICS 2005*, Banff, Canada, June 2005.

R. Huffaker, S. Lamp, J. Weiss, and **B. Kogan**, "Intracellular Calcium Cycling, Early After Depolarizations, and Reentry in Simulated Long QT Syndrome," *Heart Rhythm*, 4, pp. 441-448, 2004.

R. Samade and **B. Kogan**, "The Properties of The Cardiac Cell Mathematical Model with Markovian Representation of Potassium Channel Gating Processes Under High Passing Rate," *Proceedings of the International Conference on Mathematics and Engineering (Techniques in Medicine and Biological Sciences)*, Eds. F. Valafar and H. Valafar, pp. 371-376, CSREA Press, 2004.

S. Katti, D. Katabi, C. Blake, **E. Kohler**, and J. Strauss, "MultiQ: Automated Detection of Multiple Bottleneck Capacities Along a Path," *Proceedings of Internet Measurement Conference (IMC) 2004*, Taormina, Sicily, October 2004.

B. Greenstein, **E. Kohler**, and D. Estrin, "A Sensor Network Application Construction Kit (SNACK)," *Proceedings of 2nd ACM Conference on Embedded Networked Sensor Systems (SenSys '04)*, Baltimore, Maryland, November 2004.

M. Handley, **E. Kohler**, A. Ghosh, O. Hodson, and P. Radoslavov, "Designing Extensible IP Router Software," *Proceedings of 2nd Symposium on Networked Systems Design & Implementation (NSDI '05)*, Boston, Massachusetts, May 2005.

R. Cunningham and **E. Kohler**, "Making Events Less Slippery with Eel," *Proceedings of 10th Hot Topics in Operating Systems Symposium (HotOS-X)*, Santa Fe, New Mexico, June 2005.

C.-C. Han, R. Kumar, R. Shea, **E. Kohler**, and M. Srivastava, "A Dynamic Operating System for Sensor Nodes," *Proceedings of 3rd International Conference on Mobile Systems, Applications, and Services (MobiSys '05)*, Seattle, Washington, June 2005.

R. E. Korf, "Optimal Rectangle Packing: New Results," *International Conference on Automated Planning and Scheduling (ICAPS04)*, Whistler, British Columbia, pp. 142-149, June 2004.

R. E. Korf, "Best-First Frontier Search with Delayed Duplicate Detection," *National Conference on Artificial Intelligence (AAAI-04)*, San Jose, CA, pp. 650-657, July 2004.

A. Felner, **R. E. Korf**, and S. Hanan, "Additive Pattern Database Heuristics," *Journal of Artificial Intelligence Research*, Vol. 22, pp. 279-318, November 2004.

R. E. Korf and P. Schultze, "Large-Scale, Parallel Breadth-First Search," *National Conference on Artificial Intelligence (AAAI-05)*, Pittsburg, PA, pp. 1380-1385, July 2005.

R. E. Korf, W. Zhang, I. Thayer, and H. Hohwald, "Frontier Search," *Journal of the Association for Computing Machinery*, Vol. 52, No. 5, pp. 715-748, September 2005.

H. Luo, J. Cheng, and **S. Lu**, "Self-Coordinating Localized Fair Queueing in Wireless Ad Hoc Networks," *IEEE Transactions on Mobile Computing*, Vol. 3, No. 1, March 2004.

X. Meng, S. Wong, Y. Yuan, and **S. Lu**, "Characterizing Flows in Large Wireless Data Networks," *ACM MOBICOM'04*, pp. 174-186, September 26 - Oct 1, 2004.

V. Pappas, Z. Xu, **S. Lu**, A. Terzes, D. Massey, and L. Zhang, "Impact of Configuration Errors on DNS Robustness," *ACM SIGCOMM'04*, pp. 319-330, August 30 – September 3, 2004.

H. Yang, F. Ye, Y. Yuan, **S. Lu,** and W. Arbaugh, "Toward Resilient Security in Wireless Sensor Networks," *ACM MOBIHOC'05*, 2005, pp. 34-45, May 25-28, 2005.

P. Zerfos, G. Zhong, and **S. Lu**, "A Software Support Infrastructure for Wireless Access Routers," *IEEE Journal on Selected Areas in Communications*, Vol. 23, No. 6, June 2005.

R. Jhala and **R. Majumdar**, "Path Slicing, PLDI 05: Programming Language Design and Implementation," *ACM*, 2005.

L. de Alfaro, M. Faella, **R. Majumdar**, and V. Raman, "Code Aware Resource Management," *MSOFT 05: Embedded Software, ACM*, 2005.

J. Fischer, R. Jhala, and **R. Majumdar**, "Joining Dataflow with Predicates," *FSE 05: Foundations of Software Engineering, ACM*, 2005.

T. A. Henzinger, R. Jhala, and **R. Majumdar**, "Permissive Interfaces," *FSE 05: Foundations of Software Engineering, ACM*, 2005.

K. Chatterjee, T. A. Henzinger, R. Jhala, and **R. Majumdar**, "Counterexample-Guided Planning," *UAI 05: Uncertainty in Artificial Intelligence*, 2005.

K. Andreev, C. Garrod, B. Maggs, and **A. Meyerson**, "Simultaneous Source Location," *International Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX)*, 2004.

N. Bansal, A. Blum, S. Chawla, and **A. Meyerson**, "Approximation Algorithms for Deadline-TSP," *ACM Symposium on Theory of Computing (STOC*), 2004.

A. Meyerson, L. O'Callaghan, and S. Plotkin, "A k-median Algorithm with Running Time Independent of Data Size," *Journal of Machine Learning (MLJ), Special Issue on Theoretical Advances in Data Clustering*, 2004.

A. Meyerson and R. Williams, "On the Complexity of Optimal K-Anonymity," *ACM Symposium on Principles of Database Systems (PODS)*, 2004.

S. Koenig, M. Lagoudakis, V. Markakis, D. Kempe, P. Keskinocak, A. Kleywegt, C. Tovey, **A. Meyerson**, and S. Jain, "Auction-Based Multi-Robot Routing," *Robotics: Science and Systems*, 2005.

T. Millstein, "Practical Predicate Dispatch," *ACM SIGPLAN Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA '04),* pp. 345-364, 2004.

T. Millstein, C. Bleckner, and C. Chambers, "Modular Typechecking for Hierarchically Extensible Datatypes and Functions," *ACM Transactions on Programming Languages and Systems (TOPLAS),* 26(5), pp. 836-889, September 2004.

B. Chin, S. Markstrum, and **T. Millstein**, "Semantic Type Qualifiers," *ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI '05),* pp. 85-95, 2005.

S. Lerner, **T. Millstein**, E. Rice, and C. Chambers, "Automated Soundness Proofs for Dataflow Analyses and Transformations via Local Rules," *ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL '05*), pp. 364-377, 2005.

T. Ball, **T. Millstein**, and S. K. Rajamani, "Polymorphic Predicate Abstraction," *ACM Transactions on Programming Languages and Systems (TOPLAS),* 27(2), pp. 314-343, March 2005.

R. Muntz and Y. Xia, "Mining Frequent Itemsets in Uncertain Datasets," *Proceedings. of IEEE Workshop on Foundations and New Directions in Data Mining*, pp. 133-140, Melbourne, Florida, November 2003.

Y. Chi, Y. Yang, and **R. Muntz**, "Indexing and Mining Free Trees," *The Third IEEE International Conference on Data Mining (ICDM'03),* pp. 509-512, November 2003.

T. A. S. Coelho, P. P. Calado, L. V. Souza, B. Ribeiro-Neto, and **R. Muntz**, "Image Retrieval Using Multiple Evidence Ranking," *IEEE TKDE*, Vol. 16, No. 4, pp. 408-417, April 2004.

Y. Chi, Y. Xia, Y. Yang, and **R. R. Muntz**, "CMTreeMiner: Mining Both Closed and Maximal Frequent Subtrees," *The Eighth Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD'04),* pp. 63-73, May 2004.

Y. Chi, Y. Xia, Y. Yang, and **R. Muntz**, "Mining Closed and Maximal Frequent Subtrees from Databases of Labeled Rooted Trees," *IEEE TKDE*, Vol. 17, No. 2, pp. 190-202, March 2005.

R. Ostrovsky and W. E. Skeith, "Private Searching on Streaming Data," *CRYPTO*, pp. 223-240, 2005.

X. Boyen, Y. Dodis, J. Katz, **R. Ostrovsky**, and A. Smith, "Secure Remote Authentication Using Biometric Data," *EUROCRYPT*, pp. 147-163, 2005.

R. Ostrovsky, Y. Rabani, and L. J. Schulman, "Error-Correcting Codes for Automatic Control," *FOCS*, pp. 309-316, 2005.

R. Ostrovsky and Y. Rabani, "Low Distortion Embeddings for Edit Distance," *STOC*, pp. 218-224, 2005.

Y. Ishai, E. Kushilevitz, and **R. Ostrovsky**, "Sufficient Conditions for Collision-Resistant Hashing," *TCC*, pp. 445-456, 2005.

N. Glew, **J. Palsberg**, and C. Grothoff, "Type-Safe Optimization of Plugin Architectures," *Static Analysis Symposium*, pp. 135-154, 2005.

M. Naik and **J. Palsberg**, "A Type System Equivalent to a Model Checker," *European Symposium on Programming,* pp. 374-388, 2005.

V. K. Nandivada and **J. Palsberg**, "Timing Analysis of TCP Servers for Surviving Denial-of-Service Attacks," *IEEE Real-Time and Embedded Technology and Applications Symposium*, pp. 541-549, 2005.

B. Titzer, D. K. Lee, and **J. Palsberg**, "Avrora: Scalable Sensor Network Simulation with Precise Timing," *International Symposium on Information Processing in Sensor Network*, pp. 477-482, 2005.

J. Palsberg, T. Zhao, and T. Jim, "Automatic Discovery of Covariant Read-only Fields," *ACM Transactions on Programming Languages and Systems*, 27(1), pp. 126-162, 2005.

J. Pearl, "Robustness of Causal Claims," *Proceedings of the 20th Conference on Uncertainty in Artificial Intelligence*, Banff, Canada, pp. 446-453, July 2004.

M. Hopkins and **J. Pearl**, "Causality and Counterfactuals in the Situation Calculus," *Proceedings of the 7th International Symposium on Logical Formalizations of Commonsense Reasoning*, pp. 115-122, 2005.

C. Avin, I. Shpitser, and **J. Pearl**, "Identifiability of Path-Specific Effects," *Proceedings of the International Joint Conference on Artificial Intelligence*, Edinburgh, Scotland, pp. 357-363, 2005.

J. L. Wong, R. Majumdar, and **M. Potkonjak**, "Fair Watermarking Using Combinatorial Isolation Lemmas," *IEEE Transactions on CAD*, Vol. 23 , No. 11, pp. 1566-1574, November 2004.

S. Megerian, F. Koushanfar, **M. Potkonjak**, and M. B. Srivastava, "Worst and Best-Case Coverage in Sensor Networks," *IEEE Transactions on Mobile Computing*, Vol. 4 , No. 1, pp. 84-92, January-February 2005.

A. Cerpa, J. L. Wong, L. Kuang, **M. Potkonjak**, and D. Estrin, "Statistical Model of Lossy Links in Wireless Sensor Networks," *The ACM/IEEE Fourth International Conference on Information Processing in Sensor Networks (IPSN'05),* April 2005.

A. Cerpa, J. L. Wong, **M. Potkonjak**, and D. Estrin, "Temporal Properties of Low Power Wireless Links: Modeling and Implications on Multi-Hop Routing," *MOBIHOC*, pp. 414 - 425, May 2005.

F. Koushanfar, I. Hong, and **M. Potkonjak**, "Behavioral Synthesis Techniques for Intellectual Property Protection, *ACM Transactions on Design Automation of Electronic Systems (TODAES)*, Volume 10, Issue 3, pp. 523-545, July 2005.

Jelena Mirkovic and **Peter Reiher**, "D-WARD: A Source-End Defense Against Flooding Denial-of-Service Attacks," *IEEE Transactions on Dependable and Secure Computing*, Vol. 2, No. 3, September 2005, pp. 216-232.

An-I Andy Wang, Geoff Kuenning, and **Peter Reiher**, "Using Permuted States and Validated Simulation to Analyze Conflict Rates in Optimistic Replication," *2005 International Symposium on Performance Evaluation of Computer and Telecommunications Systems (SPECTS),* July 2005.

Jelena Mirkovic and **Peter Reiher**, "A Taxonomy of DDoS Attacks and DDoS Defense Mechanisms," *Computer Communications Review*, Vol. 34, No. 2, April 2004.

N. Nguyen, A. Wang, G. Kuenning, and **P. Reiher**, "Electric Field Routing: A Reliable Framework for Routing in MANETs," *ACM Mobile Computing and Communications Review (MC2R)*, Vol. 8, No. 2, April 2004, pp. 35-49.
2004.

Jun Li, Gerald Popek, and **Peter Reiher**, "Resilient Self-Organizing Overlay Networks for Security Update Delivery," *IEEE Journal on Selected Areas in Communications*, Special Issue on Service Overlay Networks, Vol. 22, No. 1, January 2004.

Y. Liu, A. Shayesteh, G. Memik, and **G. Reinman**, "Tornado Warning: the Perils of Selective Replay in Multithreaded Processors," *International Conference on Supercomputing*, June 2005.

J. Cong, A. Jagannathan, **G. Reinman**, and Y. Tamir, "Understanding The Energy Efficiency of SMT and CMP with Multi-clustering," *IEEE/ACM International Symposium on Low Power Electronics and Design*, August 2005.

T. Yeh and **G. Reinman**, "Fast and Fair: Data-stream Quality of Service," *International Conference on Compilers, Architecture, and Synthesis for Embedded Systems*, September 2005.

A. Shayesteh, E. Kursun, T. Sherwood, S. Sair, and **G. Reinman**, "Reducing the Latency and Area Cost of Core Swapping through Shared Helper Engines," *IEEE International Conference on Computer Design*, October 2005.

Y. Liu, G. Memik, and **G. Reinman**, "Reducing the Energy of Speculative Instruction Schedulers," *IEEE International Conference on Computer Design,* October 2005.

C. Dwork, M. Naor, and **A. Sahai**, "Concurrent Zero-Knowledge," *Journal of the ACM*, Vol. 51, No. 6, November 2004.

B. Lynn, M. Prabhakaran, and **A. Sahai**, "Positive Results and Techniques for Obfuscation," *Proceedings of EUROCRYPT*, 2004.

Y. Dodis, S. J. Ong, M. Prabhakaran, and **A. Sahai**, "On the (Im)possibility of Cryptography with Imperfect Randomness," *Proceedings of FOCS*, 2004.

A. Sahai and B. Waters, "Fuzzy Identity-Based Encryption," *Proceedings of EUROCRYPT*, 2005.

B. Barak and **A. Sahai**, "How To Play Almost Any Mental Game Over the Net: Concurrent Composition via Super-Polynomial Simulation," *Proceedings of FOCS*, 2005.

R. Kapoor, L.-J. Chen, L. Lao, M. Gerla, and **M. Sanadidi**, "CapProbe: A Simple and Accurate Capacity Estimation Technique," *ACM SIGCOMM 2004*, Portland, USA, 2004.

A. Balk, M. Gerla, D. Maggiorini, and **M. Sanadidi**, "Adaptive Video Streaming: Pre-Encoded MPEG-4 with Bandwidth Scaling," *Computer Networks Journal* (44): pp 415-439, 2004.

L. J. Chen, T. Sun, **M. Y. Sanadidi**, and M. Gerla, "Improving Wireless link throughput via Interleaved FEC," *IEEE Symposium on Computers and Communications (ISCC)*, Alexandria, Egypt, 2004.

A. Nandan, S. Das, G. Pau, **M. Sanadidi**, and M. Gerla, "Cooperative Downloading in Vehicular Ad Hoc Networks," *Proceedings of the 2nd Wireless On-Demand Network Systems and Services [WONS],* 2005, St Moritz, Switzerland. (**Best Paper Award)**

R. Wang, K. Yamada, **M. Sanadidi**, and M. Gerla, "TCP with Sender-Side Intelligence to Handle Dynamic, Large, Leaky Pipes," *IEEE JSAC on "Intelligent Services And Applications in Next Generation Networks*, Vol. 23, No. 2, February 2005.

P. Brisk, A. Kaplan, and **M. Sarrafzadeh**, "Area Efficient Instruction Set Synthesis for Reconfigurable System-on-Chip Designs," *Proceedings of the 41st Design Automation Conference* (DAC), pp. 395-400, June 7-11, 2004.

S. Ghiasi, H. J. Moon, A. Nahapetian, and **M. Sarrafzadeh**, "Collaborative and Reconfigurable Object Tracking," *Kluwer Journal of Supercomputing*, Vol. 30, No 3, pp. 213-238, December 2004.

S. Ghiasi, A. Nahapetian, H. J. Moon, and **M. Sarrafzadeh**, "Reconfiguration in Network of Embedded Systems: Challenges and Adaptive Tracking Case Study," *Journal of Embedded Computing (JEC)*, Vol. 1, No 1, pp. 147-166, 2005.

S. Memik, E. Bozorgzadeh, R. Kastner, and **M. Sarrafzadeh**, "A Scheduling Algorithm for Optimization and Planning in High-level Synthesis," *ACM Transactions on Design Automation of Electronic Systems (TODAES),* Vol. 10, No. 1, January 2005.

S. Memik, A. Srivastava, B. K. Choi, and **M. Sarrafzadeh**, "On Effective Slack Management in Post-Scheduling Phase," *IEEE Transactions on Computer Aided-Design of Integrated Circuits and Systems,* Vol. 24, No. 4, April 2005.

D. Cremers and **S. Soatto**, "Motion Competition: a Variational Approach to Piecewise Parametric Motion Segmentation," *International Journal of Computer Vision*, pp. 249-265, May 2005.

H. Jin, **S. Soatto,** and A. Yezzi, "Multi-View Stereo Reconstruction of Dense Shape and Complex Appearance," *International Journal of Computer Vision*, pp. 175-189, July 2005.

A. Vedaldi and **S. Soatto**, "Features for Recognition: Viewpoint Invariance for Non-planar Scenes," *Proceedings of the International Conference on Computer Vision (ICCV),* October 2005.

A. Vedaldi, H. Jin, P. Favaro, and **S. Soatto**, "KALMANSAC: Causal Inference of Dynamic Processes in the Presence of Outliers," *Proceedings of the International Conference on Computer Vision (ICCV)*, October 2005.

E. Jones and **S. Soatto**, "Layered Active Appearance Models," *Proceedings of the International. Conference on Computer Vision (ICCV)*, October 2005.

M. Li and **Y. Tamir**, "Practical Byzantine Fault Tolerance Using Fewer than 3f+1 Active Replicas," *17th International Conference on Parallel and Distributed Computing Systems*, San Francisco, CA, pp. 241-247, September 2004.

N. Aghdaie and **Y. Tamir**, "Efficient Client-Transparent Fault Tolerance for Video Conferencing," *International Conference on Communication and Computer Networks*, Marina del Rey, CA, October 2005.

J. Haber, **D. Terzopoulos** (eds.), *Facial Modeling and Animation*, ACM SIGGRAPH 2004 Course Notes, Vol. 5, Association for Computing Machinery Press, 2004.

M.A.O. Vasilescu, **D. Terzopoulos**, "TensorTextures: Multilinear Image-Based Rendering," *ACM Transactions on Graphics,* 23(3):336-342, August 2004.

F. Qureshi, **D. Terzopoulos**, and R. Gillett, "Cognitive Vision for Autonomous Satellite Rendezvous and Docking," *Proceedings of the 9th IAPR Conference on Machine Vision Applications (MVA 2005),* Tsukuba Science City, Japan, May 2005.

M. A. O. Vasilescu and **D. Terzopoulos**, "Multilinear Independent Components Analysis," *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR'05*), San Diego, CA, I-547-553, June 2005.

W. Shao and **D. Terzopoulos**, "Autonomous Pedestrians," *Proceedings of SIGGRAPH/EG Symposium on Computer Animation*, Los Angeles, CA, pp. 19-28, July 2005.

Y.-N. Law, H. Wang, and **C. Zaniolo**, "Query Languages and Data Models for Database Sequences and Data Streams," *VLDB*, pp. 492-503, 2004.

R. Sadri, **C. Zaniolo**, A. Zarkesh, and J. Adibi, "Expressing and Optimizing Sequence Queries in Database Systems," *ACM Transactions on Database Systems (TODS)*, Volume 29, Issue 2, June 2004.

F. Wang, **C. Zaniolo**, and X. Zhou, "Temporal XML? SQL Strikes Back!," *TIME2005: 12th International Symposium on Temporal Representation and Reasoning*, pp. 47-55, 2005.

C. Luo, H. Thakkar, H. Wang, and **C. Zaniolo**, "A Native Extension of SQL for Mining Data Streams," *SIGMOD* Conference, pp. 873-875, 2005.

Y.-N. Law and **C. Zaniolo**, "An Adaptive Nearest Neighbor Classification Algorithm for Data Streams," *2005 ECML/PKDD Conference*, Porto, Portugal, October 3-7, 2005.

V. Pappas, Z. Xu, S. Lu, D. Massey, A. Terzis, and **L. Zhang**, "Impact of Configuration Errors on DNS Robustness," *SIGCOMM 2004*, September 2004.

B. Zhang, R. Liu, D. Massey, and **L. Zhang**, "Collecting the Internet AS-level Topology," *ACM Computer Communication Review Special Issue on Internet Vital Statistics*, January 2005.

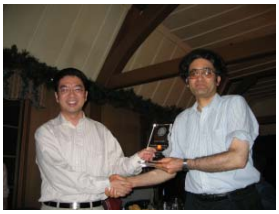
F. Ye, G. Zhong, S. Lu, and **L. Zhang**, "GRAdient Broadcast: A robust Data Delivery Protocol for Large Scale Sensor Networks," *ACM Wireless Networks (WINET) Journal*, Vol. 11, No. 2, March 2005.

F. Ye, H. Luo, S. Lu, and **L. Zhang**, "Statistical En-Route Filtering in Wireless Sensor Networks," *IEEE Jounal on Selected Areas in Communications, Special Issue on Self-organizing Distributed Collaborative Sensor Networks*, Vol. 23, No. 4, pp. 839-850, April 2005.

B. Zhang, D. Pei, D. Massey, **L. Zhang**, "Timer Interaction in Route Flap Damping," *Proceedings of 25th International Conference On Distributed Computing Systems (ICDCS 2005)*, June 2005. **(Best Paper Award)**

Faculty Anniversary Awards

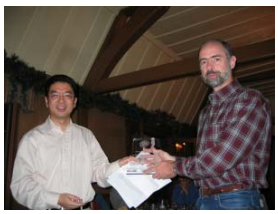
Department chair, Jason Cong, with Miodrag Potkonjak (10 years)



Jason Cong with Yuval Tamir (20 years)

Jason Cong with Lixia Zhang (10 years)

Jason Cong with Milos Ercegovac (30 years)



Jason Cong with Richard Korf (20 years)

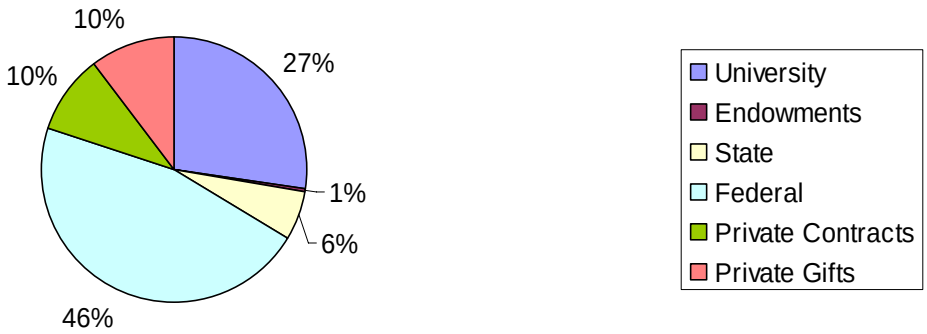
Selected Contracts & Grants Awarded in 2003-2005

AGENCY	TITLE	FACULTY
Abdus Salam Int	E-Grid: Grid Technology Enhancement to Support Financial Modeling and Simulation	Gerla/Pau
AFOSR	Dynamic Vision for Control	Soatto
AFOSR MURI	3D Dynamic Vision	Soatto
Altera/Intel/ Magma/ Xilinx/UC Micro	Synthesis and Optimization for Gigascale Integration	Cong
Altera/ Xilinx/UC Micro	Synthesis and Optimization for FPGA Designs	Cong
DARPA	Monitoring and Analysis of Routing Dynamics and Path Redundancy in the Global Internet	Zhang
Marco GSRC	Collaborative Research in the Design, Verification and Test of Integrated Gigascale Systems: The Gigascale Systems Research Center	Cong
NASA/JPL	Compiled Planner/Executive for Robust Real-Time Control	Darwiche
NIH	Center for Computational Biology	Soatto
NSF	Scalable Testbed For Next-Generation Mobile Wireless Networking Technologies	Bagrodia/Gerla
NSF	Career: Web Archive the History of the Web	Cho
NSF	ITR: Knowledge Based Inference Techniques to Ensure the Security of Database Content	Chu
NSF	CPA: Closing the Gap in VLSI Physical Design	Cong
NSF	Design and Synthesis of Power Efficient Programmable Fabric	Cong/Reinman
NSF	A Community Resource for Heterogeneous Embedded Sensor Network Development	Estrin
NSF	NeTS-NOSS: Tenet: An Architecture for Tiered Embedded Networks	Govindan/Estrin/ Kohler
NSF	Run-Time and Design-Time Exploration of Field-Level Energy, Space, Time and Fidelity Tradeoffs in Distributed Sensor Networks	Srivastava/Estrin
NSF	Speaking with Passion: Real-Time Expressive Visual	Faloutsos
NSF	Transport Protocols for the Wired/Wireless NGI	Gerla/Sanadidi
NSF	Panoply: Enabling Safe Ubiquitous Computing Environments	Kleinrock/Reiher
NSF	NeTS-NOSS: High-Level and Efficient Sensor Network Programs	Kohler
NSF	A Survivable Information Infrastructure for National Civilian Biodefense	Ostrovsky
NSF	Event Driven Software Quallity	Palsberg/Kohler/ Majumdar/ Millstein

Selected Contracts & Grants Awarded in 2003-2005

AGENCY	TITLE	FACULTY
NSF	Conquest-2: Improving Energy Efficiency and Performance Collaborative research with Florida State University	Reiher
NSF	DEFCOM: Distributed Defense Against DDOS Attacks Collaborative research with University of Delaware	Reiher
NSF	Probabilistic Networks for Automated Reasoning	Pearl
NSF	Career: The Evaluation and Design of a Scalable High Performance and Energy Efficient Microprocessor Architecture	Reinman
NSF	New Directions in Software Security	Sahai
NSF	Reconfigurable Fabric	Sarrafzadeh/ Estrin/Reinman
NSF	Automating Early Assessment of Academic Standards for Very Young Native and Non-Native Speakers of American English	Zaniolo
NSF	Beyond BGP: Flexible and Scalable Interdomain Routing	Zhang
NSF	BBGP: Beyond the Border Gateway Protocol	Zhang
ONR	An Integrated Approach to Decision Making Under Uncertainty	Darwiche/Pearl
ONR	Investigations on Dynamic Visual Processes	Soatto
SRC	Design and Evaluation of Power-Efficient High-Performance Processors with Programmable Fabric	Cong/Reinman
STMicro-electronics	Mesh Meets Ad Hoc: The Urban Vehicular Grid	Gerla/Pau
STMicro-electronics/ UC Micro	Enhanced QOS Support in Personal and Mobile Wireless Networks	Gerla/Pau
USAF	Probabilistic Sensitivity Analysis for Situation Awareness	Darwiche

CSD Faculty Funding Sources



Highlights and Awards

Algirdas Avizienis—Honored by IFIP WG 10.4, 18th World Computer Congress, Toulouse, France, 2004.

Rajive Bagrodia— DARPA special commendation "for outstanding achievement in the development of Network Modeling and Simulation Technology, May 2005.

John Cho—IBM Faculty Award for 2005.

Wesley Chu—IEEE Computer Society 2003 Technical Achievements Award "for contribution to intelligent information systems."

Jason Cong—Okawa Foundation Award, 2004 ■ Distinguished Lecturer, IEEE Circuit and Systems Society, 2001-2005.

Joseph DiStefano—Lockheed Martin Excellence in Teaching Award, 2004.

Alan Kay—2004 Kyoto Prize ■ 2003 Turing Award.

Leonard Kleinrock—Honorary Laurea Doctorate in Internet Science, University of Bologna, May 2005 ■ Honorary Laurea Doctorate in Ingegneria Telematica, Turin Polytechnic, October 2005, "for contributions to queuing theory and creation of the ARPANET."

Boris Kogan—Interviewed by IEEE Control Systems Magazine. An account, "Analog Computing in the Soviet Union," is published in the magazine's June 2005 issue.

Richard Korf—Lockheed Martin Excellence in Teaching Award, 2005.

Songwu Lu—Okawa Foundation Award, 2005.

Rafail Ostrovsky—Okawa Foundation Award, 2004.

Glenn Reinman—2004 Northrop Grumman Award for Teaching Excellence.

Amit Sahai—Invited to present the 2004 Distinguished Cryptographer Lecture Series at NTT Labs, Japan ■ Invited keynote speaker, Indocrypt 2004.

Majid Sarrafzadeh—Okawa Foundation Award, 2005.

David Smallberg—Voted Professor of the Year, Engineering Society of the University of California.

Stefano Soatto—Keck Foundation endowment to establish interdisciplinary Laboratory for Vision and Image Science.

Lixia Zhang—Elected to the Internet Architecture Board, March 2005.

Patent and Publication Awards

Rajive Bagrodia—Best Paper Award, "Detailed OFDM Modeling in Network Simulation of Mobile Ad Hoc Networks" (with G. Yeung, M. Takai, A. Mehrnia, and D. Daneshrad), *Proceedings of Parallel and Distributed Simulation (PADS 2004),* May 16-19, 2004.

John Cho—Best Paper Award, "Modeling and Managing Content Changes in Text Databases" (with P. Ipeirotis, A. Ntoulas, and L. Gravano), *Proceedings of the International Conference on Data Engineering (ICDE)*, March 2005.

Jason Cong—Best Paper Award, "Technology Mapping and Architecture Evaluation for k/m-Macrocell-Based FPGAs" (with H. Huang and X Yuan), *ACM Transactions on Design Automation of Electronic Systems (TODAES*), 2005.

Jason Cong—Best Paper Award, "Multilevel Generalized Force-Directed Method for Circuit Placement" (with T. Chan and K. Sze), *International Symposium on Physical Design (ISPD),* 2005.

Milos Ercegovac—Best Paper Award, "Complex Square Root with Operand Prescaling" (with J.-M. Muller), *IEEE 15th International Conference on Application-Specific Systems, Architectures, and Processors*, 2004.

Mario Gerla and **M. Sanadidi**—Best Paper Award, "Cooperative Downloading in Vehicular Ad Hoc Networks" (with A. Nandan, S. Das, and G. Pau), *WONS 2005*.

Amit Sahai—Invited paper, "New Notions of Security: Achieving Universal Composability Without Trusted Setup" (with Manoj Prabhakaran). special issue for selected papers, *ACM Symposium on Theory of Computing (STOC),* 2004.

Lixia Zhang—Best Paper Award, "Timer Interaction in Route Flap Damping" (with B. Zhang, D. Pei, and D. Massy), *Proceedings of 25th International Conference on Distributed Computing Systems*, June 2005.

Majid Sarrafzadeh—Patent 6,851,099 issued February 1, 2005, "Placement Method for Integrated Circuit Design Using Topo-Clustering."

Stefano Soatto—Patent 6,944,327 issued September 13, 2005, "Method and System for Selecting and Designing Eyeglass Frames."

Doctoral Students Placement

Ph.D. Student	Academia/Industry	Title	Year	Advisor
Navid Aghdale	Ask Jeeves	Sr. Software Engineer	2005	Yuval Tamir
Elaheh Bozorgzadeh	UCI	Assistant Professor	2004	Majid Sarrafzadeh
Yu Uny Cao	Cyber Ark International	Sr. Software Engineer	2005	Leonard Kleinrock
Yong Cao	Electronic Arts	Software Engineer	2005	Petros Faloutsos
Alberto Cerpa	UC Merced	Assistant Professor	2005	Deborah Estrin
Deming Chen	UIUC	Assistant Professor	2005	Jason Cong
Ling Jhy Chen	Academia Sinica, Teipei	Research Fellow	2005	Mario Gerla
Michael Gang Chen	Magma Design Automation	Member Technical Staff	2005	Jason Cong
Yun Chi	NEC Laboratories	Member Technical Staff	2005	Richard Muntz
Bo-Kyung Choi	Magma Design Automation	Member Technical Staff	2004	Majid Sarrafzadeh
Fang (Andrea) Chu	Google	Member Technical Staff	2005	Carlo Zaniolo
Shirshanka Das	Paypal, Inc.	Sr. Software Engineer	2005	Mario Gerla
Gianfranco Doretto	GE Global Research	Researcher	2005	Stefano Soatto
Edith Elkind	University of Warwick, UK	Postdoc	2005	Amit Sahai
Jeremy Elson	Microsoft	Member Technical Staff	2004	Deborah Estrin
Scott Friedman	UCLA	Programmer Analyst	2004	Richard Muntz
Zhenghua Fu	Pelco Lab	Member Technical Staff	2004	Songwu Lu
Alex Fukunaga	JPL	Member Technical Staff	2005	Richard Korf
Deepak Ganesan	Univ. Mass. Amherst	Assistant Professor	2004	Deborah Estrin
Soheil Ghiassi	UC Davis	Assistant Professor	2005	Majid Sarrafzadeh
Jinbo Huang	NICTA Research Center, Australia	Researcher	2005	Adnan Darwiche
Ashok Jagannathan	Intel Corporation	Sr. Engineer	2005	Jason Cong
Russell Knight	JPL	Sr. Member Technical Staff	2005	Richard Korf
J. J. Kong	UCLA, CS	Postdoc	2004	Mario Gerla
Fariniza Koushanfar	Rice University	Assistant Professor	2005	Miodrag Potkonjak

Doctoral Students Placement

Ph.D. Student	Academia/Industry	Title	Year	Advisor
C.-J. Lai	FX/PAL	Member Technical Staff	2005	Richard Muntz
Zhenyu (Victor) Liu	Google	Research Staff	2005	Wesley Chu
Haiyun Luo	UIUC	Assistant Professor	2004	Songwu Lu
Seda Memik	Northwestern	Assistant Professor	2004	Majid Sarrafzadeh
Bartlett S. Michel	Aerospace Corp.	Member Technical Staff	2004	Leonard Kleinrock
Alok Nandan	Microsoft	Research Program Manager	2005	Mario Gerla
Dan Pei	ATT Labs-Research	Member Technical Staff	2005	Lixia Zhang
Manoj Prabhakaran	UIUC	Assistant Professor	2005	Amit Sahai
Michail Romesis	Magma Design Automation	Member Technical Staff	2005	Jason Cong
Ming-Feng Tsai	National Central University, Taoyuan	Assistant Professor	2004	Wesley Chu
Yoshio F. Turner	HP Laboratories	Research Scientist	2005	Yuval Tamir
Fusheng Wang	Siemens Corporate Research	Member Technical Staff	2004	Carlo Zaniolo
Lan Wang	University of Memphis	Assistant Professor	2004	Lixia Zhang
Ren Wang	Rockwell	Research Scientist	2004	Mario Gerla
Zhenghao Wang	Microsoft	Member Technical Staff	2004	Richard Muntz
Kaixin Xu	Scalable Network Technologies	Research Scientist	2004	Mario Gerla
Fan Ye	IBM Watson Research Center	Member Technical Staff	2004	Lixia Zhang
Xia Yi	Teradata/NCR	Member Technical Staff	2005	Richard Muntz
Yunjung Yi	Honeywell, Inc.	Research Scientist	2004	Mario Gerla
Petros Zerfos	Research Lab of Deutsche Telekcom	Member Technical Staff	2005	Songwu Lu
Qinghua Zhu	Microsoft	Research Staff	2005	Wesley Chu

Computer Science Department
Advisory Board

Mission Statement: To promote the communication, growth, and shared activities of UCLA Computer Science Department alumni, faculty and students.

The Board is representative of the department's several generations of alumni since its foundation in the fall of 1969, and reflects the major fields of computer science.

The Board will meet on a quarterly basis, and in keeping with its mission, will be involved in a number of activities—including the department's Annual Research Review, the Career Panel and job interview workshop for graduating students, the Rose Bowl pre-game tailgate party for UCLA's homecoming football game, and other activities that are posted on the department's alumni web site *http://www.cs.ucla.edu/csd/people/alumni*.

Alumni Board Members

Mr. Ric Pozo (Alumni Chair)
Director, Space and Airborne Systems Center
Raytheon Company, El Segundo, CA

Braulio Estrada, Analyst
Accenture (formerly Andersen Consulting)
El Segundo, CA

Dr. Don Calhoun
Former Executive Director, Hughes Electronics
Redondo Beach, CA

Dr. Margaret Chock
Member of the Technical Staff
BAE Systems, Santa Monica, CA

Dr. William R. Goodin, Manager
Short Course Program
UCLA Extension, Los Angeles, CA

Maria H. (Lolo) Penedo, Ph.D.
NGMS Technical Fellow
Northrop Grumman, Carson, CA

Mr. John Rosati
Former Sr. Executive, TRW Space & Defense Systems
Los Angeles, CA

Dr. James Winchester, Vice President
Northrop Grumman Commercial Navigation Systems
Beverly Hills, CA

Dr. Behzad Zamanzadeh, Technical Director
Reuters America, Inc.
El Segundo, CA

Faculty Board Members

Dr. Alfonso Cardenas (Faculty Chair)
Computer Science Department

Dr. Leonard Kleinrock
Computer Science Department

Mr. David Smallberg
Computer Science Department

Undergraduate Program

The Computer Science Department offers B.S. degrees both in computer science and in computer science and engineering. The B.S. in computer science and engineering is designed to accommodate those students who desire a strong foundation in computer science but who also have a strong interest in computer system hardware. Both majors are approved by the Accreditation Board for Engineering and Technology (ABET).

Educational Goal
The educational goal of the computer science department is to produce graduates that are well grounded in core computer science knowledge, and have the problem-solving and professional skills that will enable them to become leaders in their chosen computer science careers.

Educational Program Objective
The overall objective of our undergraduate educational program is to graduate students who are:

1. Prepared for entry-level positions as practicing scientists/engineers or acceptance into graduate programs through core scientific and engineering knowledge, laboratory and design experience, and exposure to state-of-the-art areas in computer science.

2. Positioned for sustained career achievement through introduction to critical professional skills, including teamwork, written and oral communications, problem-solving abilities, a commitment to life-long learning, and knowledge of the implications of one's work on society.

3. Prepared for practice in the fertile application areas where computing and other technical fields intersect through in-depth knowledge of at least one related engineering discipline or application area.

The department has an advisory board consisting of representatives from industry, other academic institutions, alumni, and students. The board meets twice a year to review the computer science program and refine the department's goals and program objectives.

Undergraduate Program Advisory Board Members

Shaun Ahmagian, UCLA CS Undergraduate
Leon Alkalai, JPL & UCLA CS Dept
Joseph Bannister, USC, ISI
Peter Blankenship, Northrop Grumman
Philip Brisk, UCLA CS Grad Student
Doug Caldwell, Ecliptic Enterprises
Jon Canon, Windows Microsoft
Paul Eggert, UCLA CS Dept
Ryan Kastner, UCSB
Pekka Kostamma, Teradata
Geoff Kuenning, Harvey Mudd College
Stephen Lui, Raytheon
Ani Nahapetian, UCLA CS Grad Student
Joseph Qu-Yang, IBM
David Rennels, UCLA CS Dept
John Rosati, Trilennia Group LLC
Mike Sievers, Time Logic, Inc.
Akhilesh Singhania, UCLA EE Undergraduate
David Smallberg, UCLA CS Dept
Mike Todd, Google
Behzadeh Zamazadeh, Reuters America
David Zats, UCLA CS Undergraduate

Programs and Annual Events

The Computer Science Department is committed to maintaining strong ties to industry, collaborating on state-of-the-art research, and engaging in a mutually beneficial exchange of information regarding advances in technology. The department's **Industrial Affiliate Program** facilitates these goals while also providing many benefits to its affiliate members. These benefits include such services as attention to member recruiting needs (including student listings, resumes, and on-site interviews), facilitating summer internships, invitations to the department's Annual Research Review and Distinguished Lecturer Series, reprints of relevant in-house technical reports and conference papers, and hosting industrial visitors. For details, see:

http://www.cs.ucla.edu/csd/research/affiliates/list.html

Affiliate Members

Amgen

Magma Design Automation

Northrop Grumman MS-TSD

Northrop Grumman MS-SRD

Raytheon

Sun Microsystems

The Computer Science Department's **Annual Research Review** takes place each year during UCLA's spring academic quarter. This year, the Research Review will be held jointly with other departments within the Henry Samueli School of Engineering and Applied Science. In addition to the many technical presentations and panel discussions by faculty and distinguished guests, a significant portion of each year's review is devoted to a very large and successful poster session that attracts many enthusiastic visitors. Here, our emerging Ph.D. students have an opportunity to describe their research results to faculty and classmates, as well as to industrial guests who just might be scouting for talented researchers looking for positions in industry.

The **Jon Postel Lecturer Series** is dedicated to the memory of Dr. Jon Postel—an alumnus of UCLA's Computer Science Department, a quiet and gentle man, a brilliant and dedicated scientist who made many key contributions to the formative days of the ARPANET. Each year the Computer Science Department hosts a series of lectures by world-renowned scientists in academia and industry, covering a broad range of topics that are timely and relevant to today's high-technology world.

2004-2005 Lecturers

Philip A. Bernstein
Microsoft Research

Andrew W. Appel
Princeton University

Vern Paxson
International CS Institute &
Lawrence Berkeley National Lab

John Paul Shen
Microarchitecture Research

2005-2006 Lecturers

Hector Garcia-Molina
Stanford University

Vinton Cerf
Google, Inc.

Peter Lee
Carnegie Mellon University

Shafi Goldwasser
MIT and Weizmann Institute of Science, Israel

Graduate Student Life

The University of California, Los Angeles, encompasses over 419 acres in the foothills of the Santa Monica mountains, and boasts near-perfect weather all year around. Its architecture, theaters, concert halls, museums, libraries, and sculpture and botanical gardens supply the setting for everything from the ancient to the avant-garde. Since its inception, the University has been dedicated to preserving the past and creating the future.

The Computer Science Department is helping to create that future with internationally recognized research in all areas within the many fields of computer science. Our current achievements and those of the past, such as our key role in the birth of the Internet 36 years ago, attract graduate applicants from every region in the United States, and indeed, from all over the world.

In addition to campus aesthetics and the challenging intellectual climate, there are other challenges for our students to face—such as the highly competitive basketball games between faculty and student teams, and the ever-popular softball games that take place during the Computer Science Department's annual picnic event.