

SCHOOL OF COMPUTING
THE UNIVERSITY OF UTAH



2009 & 2010 **REPORT**

Star-ray TRT graphics museum demo

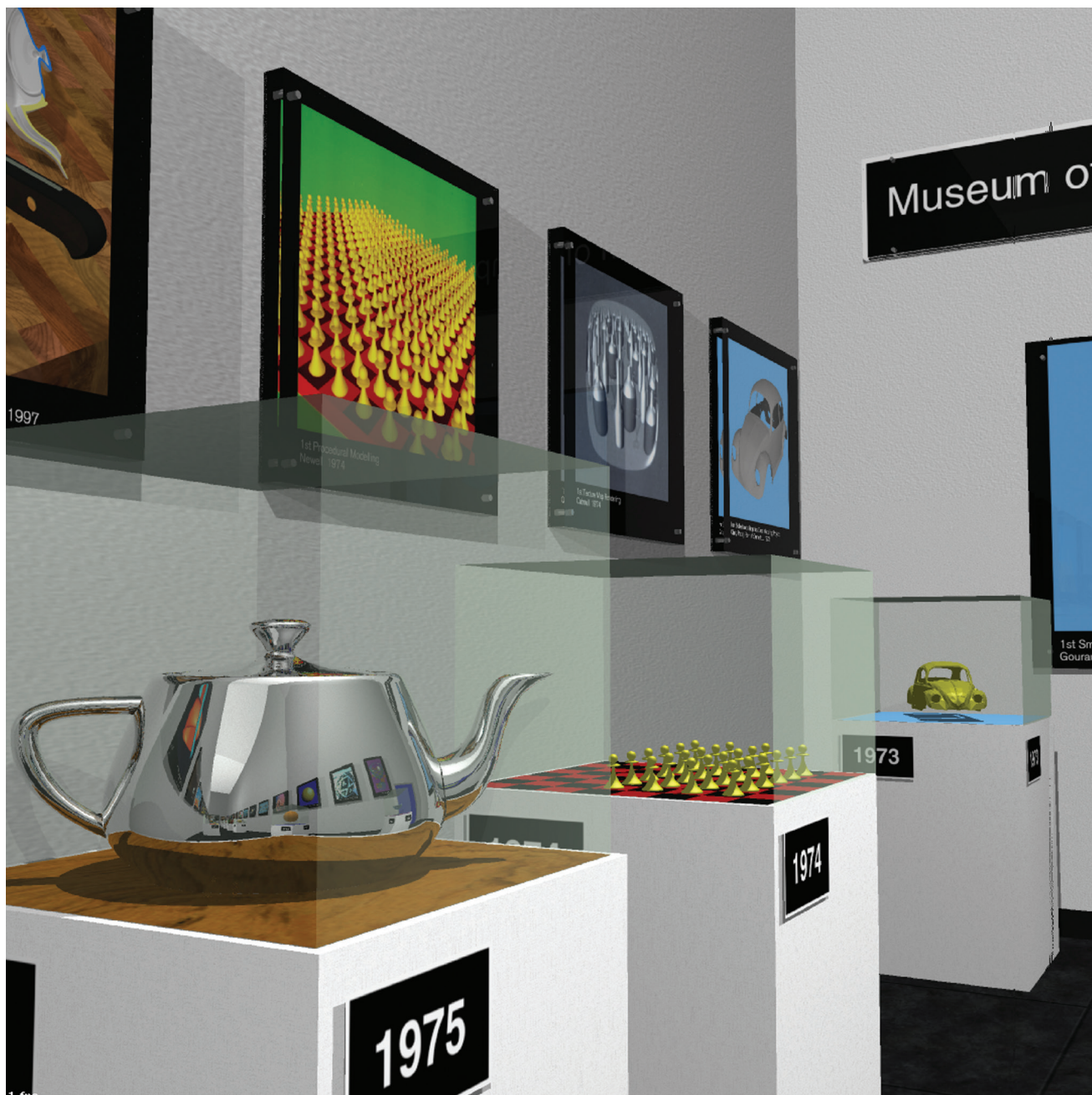


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www.cs.utah.edu

SCHOOL OF COMPUTING
UNIVERSITY OF UTAH
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SALT LAKE CITY, UTAH 84112



**MESSAGE FROM
THE DIRECTOR**



After five and a half very interesting years as Director it is time for a somewhat overdue sabbatical and to welcome Al Davis, the new Director of the School of Computing.

It is also time to say thank-you to all those staff, faculty and students who made my job such and interesting and often enjoyable one. Dean Rich Brown of the College of Engineering deserves particular thanks too.

Much has changed over the last few years, we have survived and even prospered under what once look like very severe budget cuts.

Since 2006 our undergraduate intake has grown by 25%. The graduate intake has doubled and research spending has nearly doubled to \$17.1M.

Over the last 5 years our faculty population has increased, welcoming 12 new faculty members to the School of Computing. These new faculty members have helped strengthened many core areas including theory, algorithms, image analysis, compilers, security, animation and graphics. Two positions in image analysis are being funded through the State of Utah USTAR initiative.

The computing degree has added tracks in Robotics, Scientific Computing, Information Technology, Image Analysis, Computer Engineering and Graphics and Visualization. The computing degree encourages students to pursue area-specific coursework and to undertake research at an early stage of their graduate study in a way that fits with the range of educational possibilities available in a very broad School.

A new research center has grown in parallel computing, the aptly named CPU, led by Ganesh Gopalakrishnan, and others centers are planned.

In 2007 we introduced a new undergraduate program in Entertainment Arts and Engineering, an interdisciplinary program between the School of Computing and the Department of Film and Media Arts. This program has grown significantly over the years and in 2010 we announced a graduate level program called the Entertainment Arts and Engineering Master Games Studio. This interdisciplinary master's program contains three tracks: game engineering, game arts, and game production. The level of student interest and excitement is such that the graduate level program went from planning, to an entering class of twenty or so students in not much more than a year.

The message is so clear, faculty, staff and students have all made tremendous efforts to move the School forward. There is no doubt that times still remain challenging and I am sure that the new directors job will be every bit as interesting as mine was.

Over to you Al!

Martin Berzins
Professor
School of Computing



ABOUT THE SCHOOL

Timeline

Department of Computer Science founded 1965
School of Computing created in 2000

Research Expenditures

2009 – \$11M
2010 – \$17.1M

Faculty

33 regular faculty
3 research faculty
16 adjunct faculty

Research Areas

- Algorithms
- Architecture & VLSI
- Computer Graphics
- Computer Systems
- Formal Verification
- Information Management
- Image Analysis
- Machine Learning
- Mobile and Embedded Systems
- Natural Language Processing
- Perception
- Programming Languages
- Robotics
- Scientific Computation
- Simulations & Electronic Animation
- Visualization

Undergraduate Population

396 enrolled in computer science major
110 enrolled in computer engineering major

Graduate Population

111 in master's program
131 in Ph.D. program

Undergraduate Degrees

Bachelor of Science in Computer Science
Bachelor of Science in Computer Engineering
Bachelor's/Master's
Entertainment Arts & Engineering Track

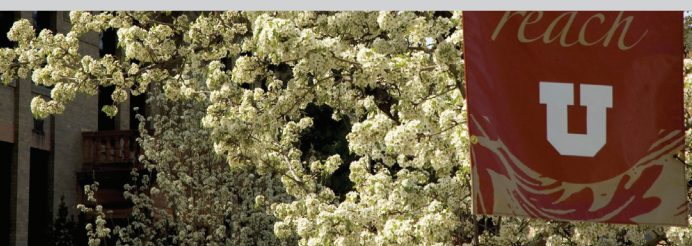
Graduate Degrees

Master's in Computer Science
Non-Thesis Master's in Computer Science
Master's in Computing

- Computer Engineering
- Data Management & Analysis
- Entertainment Arts & Engineering :
Master Games Studio
- Graphics and Visualization
- Image Analysis
- Information Technology
- Robotics

Ph.D. in Computer Science
Ph.D. in Computing

- Computer Engineering
- Data Management & Analysis
- Graphics and Visualization
- Robotics
- Scientific Computing



MEASURES OF EXCELLENCE

2009

- **Chris Johnson** awarded the Utah Cyber Pioneer Award
- **Chris Johnson** elected Fellow, Society for Industrial and Applied Mathematics (SIAM)
- **Elaine Cohen** presented with the Pierre Bezier Award
- **Mike Kirby** awarded Leverhulme Visiting Professorship
- **Rich Riesenfeld** presented with the Pierre Bezier Award

Best Paper Awards

“Non-Uniform Power Access in Large Caches with Low-Swing Wires”

Aniruddha Udipi, Naveen Muralimanohar, Rajeev Balasubramonian
HiPC 2009

“Physically-based Interactive Schlieren Flow Visualization”

Carson Brownlee, Vincent Pegoraro, Siddharth Shankar, Patrick McCormick*, Charles Hansen
IEEE Pacific Vis 2010

“Uintah – A Scalable Framework for Hazard Analysis”

Justin Luitjens, Qingyu Meng and Martin Berzins, Todd Harman, Charles A. Wight, Joseph Peterson
Teragrid 2010

“Using VisTrails and Provenance for Teaching Scientific Visualization”

Claudio Silva, Erik Anderson, Emanuele Santos, Juliana Freire
Eurographics 2010 Educator Program

“Manifold modeling for brain population analysis,” In Medical Image Analysis,

Sam Gerber, Tolga Tasdizen, Tom Fletcher, Sarang Joshi, Ross Whitaker
MICCAI 2010

2010

- **Guido Gerig** elected Fellow of the American Institute for Medical and Biological Engineering
- **Mary Hall** recognized as ACM Distinguished Scientist
- **Chris Johnson** honored with the IEEE Visualization Career Award
- **Chris Johnson** awarded the Rosenblatt Prize for Excellence

“Particle Systems for Adaptive, Isotropic Meshing of CAD Models”

Jonathan Bronson, Joshua Levine, Ross Whitaker
19th International Meshing Roundtable, 2010

“Handling the Problems and Opportunities Posed by Multiple On-Chip Memory Controllers”

Manu Awasthi, Dave Nellans, Kshitij Sudan, Rajeev Balasubramonian, Al Davis
PACT 2010

“Abstracting Abstract Machines”

David Van Horn and Matthew Might
ICFP 2010

* Northeastern University

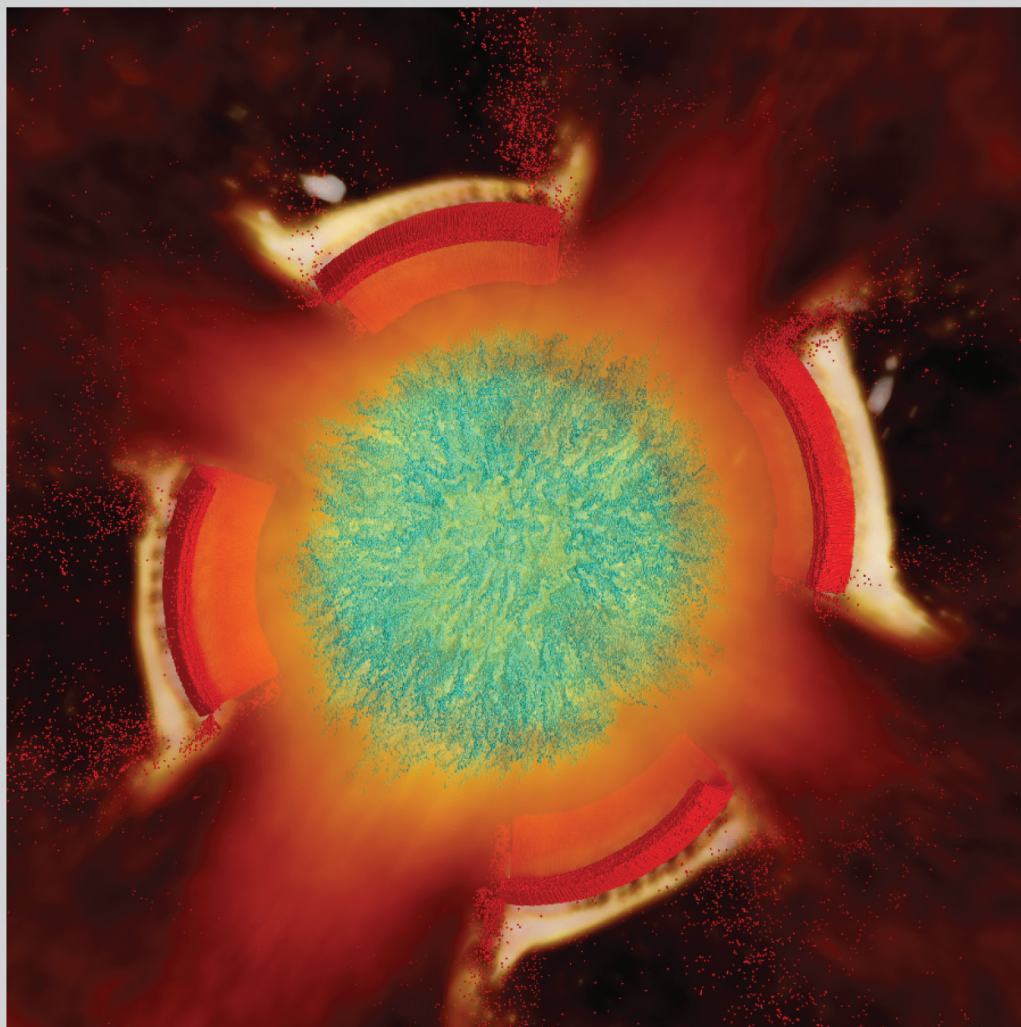
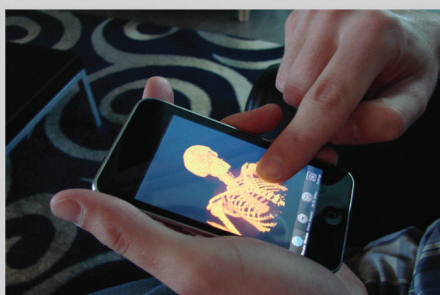
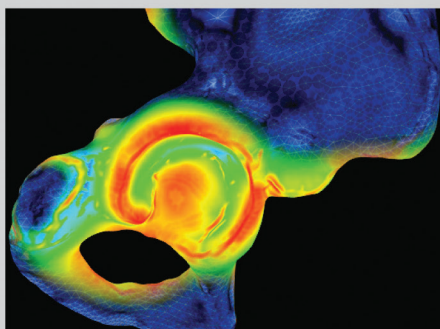
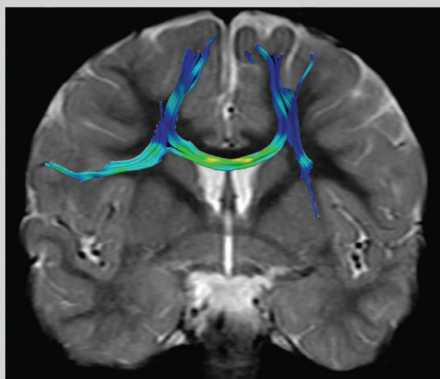
“CHOP: Adaptive Filter-based DRAM Caching for CMP Server Platforms”

Xiaowei Jiang*, Niti Madan, Li Zhao**, Mike Upton, Ravishankar Iyer**, Srihari Makineni**, Donald Newell**, Yan Solihin*, Rajeev Balasubramonian
HPCA 2010

(to appear in IEEE Micro’s Special Issue on Top Picks from 2010 Computer Architecture Conferences, one of the eleven papers recognized as “the year’s most significant research publications in computer architecture based on novelty and industry relevance”)

* North Carolina State University, ** Intel Labs

Scientific Computing and Imaging Institute (SCI)



The SCI research group was founded in 1994 by Drs. Chris Johnson and Rob MacLeod along with five graduate students. In 1996, we became the Center for Scientific Computing and Imaging and, in 2000, the SCI Institute. The SCI Institute is now one of eight permanent research institutes at the University of Utah and home to over 170 faculty, students, and staff. The 16 tenure-track faculty are drawn primarily from the School of Computing, Department of Bioengineering, and Department of Electrical and Computer Engineering and virtually all faculty have adjunct appointments in other, largely medical, departments. Recent growth in the SCI Institute has come in part from the award in 2007 from the state of Utah of a USTAR (Utah Science and Technology Advanced Research) cluster in Imaging Technology. This allowed the Institute to recruit four new faculty in image analysis: Professors Guido Gerig, Tom Fletcher, Tolga Tasdizen, and Orly Alter. During this same time period, we were also able to recruit Professor Valerio Pascucci in visualization. The SCI Institute's overarching research objective is to

conduct application-driven research in the creation of new scientific computing techniques, tools, and systems. An important application focus of the Institute continues to be biomedicine; however, SCI Institute researchers also address challenging computational problems in a variety of application domains such as manufacturing, defense, and energy. Within our overarching research objective, SCI Institute research interests generally fall within four core tracks. The first track involves research into new techniques for scientific visualization and the development of visual analysis tools to facilitate understanding of increasingly complex and rich scientific data. The second track focuses on technical research into computational and numerical methods requisite for scientific computing. The third track involves creating new image analysis techniques and tools. The final track emphasizes research and development of scientific software environments. SCI Institute researchers also apply many of the above computational techniques within their own particular specialties, including fluid dynamics, atmospheric dynamics,

biomechanics, electrocardiography, bioelectric fields, adaptive techniques, parallel computing, inverse problems, and medical imaging.

A particular hallmark of SCI Institute research is the development of innovative and robust software packages, including the SCIRun scientific problem solving environment, Seg3D, ImageVis3D, VisTrails, and map3d. All these packages are broadly available to the scientific community under open source licensing and supported by web pages, documentation, and users groups.

The SCI Institute either directs or is associated with several national research centers: the NIH Center for Integrative Biomedical Computing (CIBC), the DoE Visualization and Analytics Center for Enabling Technologies (VACET), the NIH National Alliance for Medical Image Computing (NA-MIC), the NIH Center for Computational Biology, the Center for Computational Earth Sciences and the DoE Center for the Simulation of Accidental Fires and Explosions (C-SAFE). In July, 2008, SCI was chosen as one of three NVIDIA Centers of Excellence in the U.S. (University of Illinois and Harvard University are the other two NVIDIA Centers).

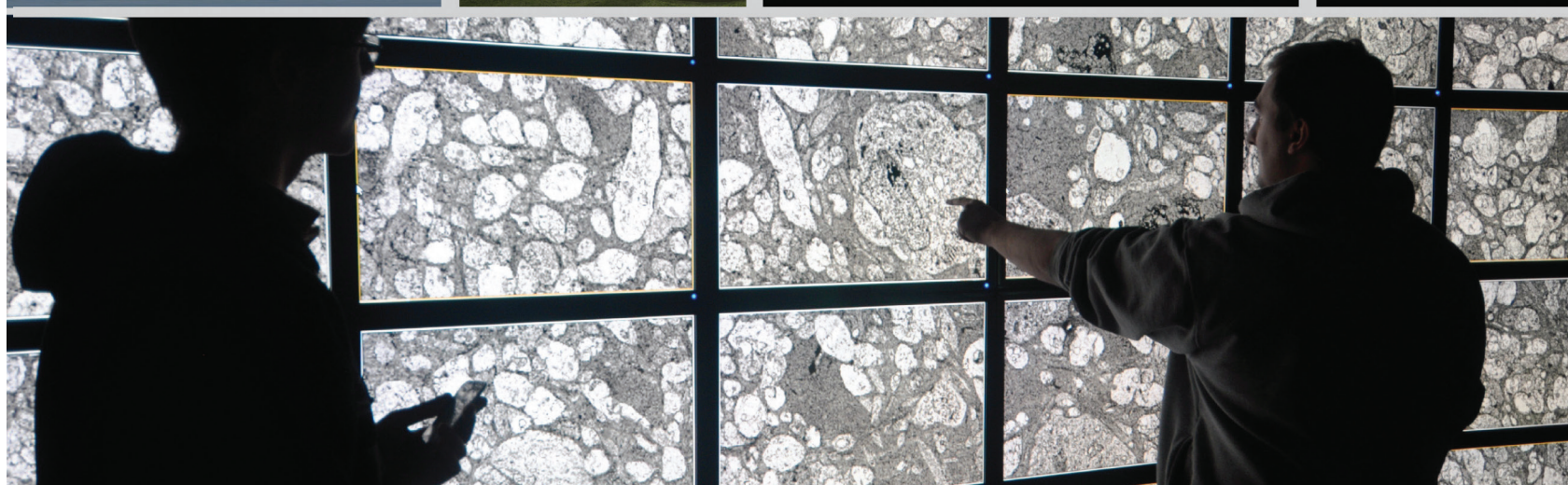
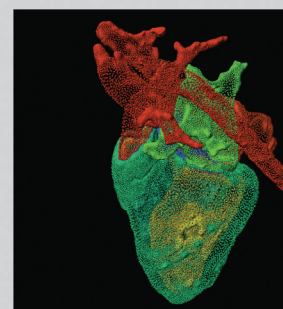
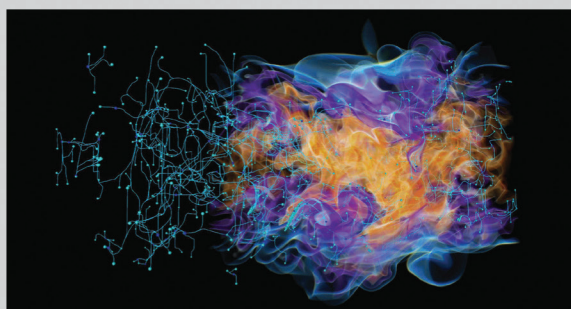
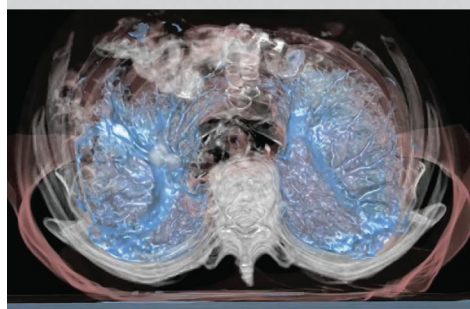
The SCI Institute is also heavily invested in the academic training of University of Utah students. SCI has collaborated with the School of Computing to create a graduate degree in Computing, which offers tracks in Scientific Computing and Graphics and Image Analysis. Additionally, SCI is again, looking to collaborate with the School of Computing and several other departments to create an academic program

in the area of data center management. SCI faculty also provide leadership in developing educational and research tracks in biomedical engineering through the Bioengineering Department. There are undergraduate and graduate tracks in computing and imaging, in part created and directed by SCI faculty. There is also a graduate track in cardiac electrophysiology and biophysics, directed by SCI faculty and supported through collaboration between SCI and the Cardiovascular Research and Training Institute (CVRTI).

The facilities at SCI are also outstanding with several large-scale computing facilities at the disposal of students and trainees, perhaps most exciting is the NVIDIA computing cluster and new Silicon Graphics UV system, which, along with a new graduate course in Parallel Programming for GPUs, provide opportunities for developing unique expertise in large-scale streaming architectures.

The combination of Mission, Faculty, Staff and Students, Academic Programs, and Facilities allows SCI to create a general atmosphere for its members where the whole of the institute is dedicated to some aspect of scientific computing. There is extensive expertise within the SCI Institute that covers all the topics required for simulation, modeling, and visualization including high performance computing, efficient numerical algorithms, large data management and storage, database management, and scientific visualization of all forms of scalar, vector, tensor, and volume data.

www.sci.utah.edu



Flux Research Group

Systems researchers work with the computing infrastructure that most people take for granted. This includes operating systems, virtual machines, compilers, and middleware. All this software must be reliable and secure because it is the foundation supporting all of a computer's applications. However, building reliable systems software is an extremely challenging endeavor. It is challenging because systems software must deal with the complexity and hazards of the real world: complex hardware, limited resources, concurrent activities, real-time deadlines, machine and network failures, network attacks, and on and on. At the same time, systems software is expected to provide rich features to application programmers and users.

The School of Computing's Flux Research Group is attacking the challenge head-on. Founded in the mid-1990s, the Flux Group invents and tests visionary ideas that make systems software more reliable, more flexible, easier to build, and easier to use. The group includes faculty, research staff, graduate students, and undergraduates who work together to tackle the problems of modern systems design and implementation. Their approach is to test new solutions in the context of the real world. This means working with large-scale and distributed systems, with legacy software and programming languages, and with real users. The result is that Flux research leads to real-world impact, both in delivered software and in proven ideas.

Languages, Components, System Structure, and Security

The Flux Group has a long history of advancing language and component technology, especially in the context of operating systems. Their advances include the OSKit component collection, the Knit composition language, and multiple contributions to operating systems based on safe languages. The Flux Group used Java to create the KaffeOS and Janos operating systems: this work directly shaped JSR-121, the Java Application Isolation API Specification. The STP system lets machines use untrusted mobile code, written in safe C, to remotely upgrade each other's network protocols while protecting both the hosts and network. The Safe TinyOS system also uses a safe dialect of C, in conjunction with static program analysis, to increase the reliability of software that runs on embedded and networked sensors. Utah's Safe TinyOS software has been incorporated into the primary TinyOS software distribution, which is used by hundreds of sensor-network projects worldwide.

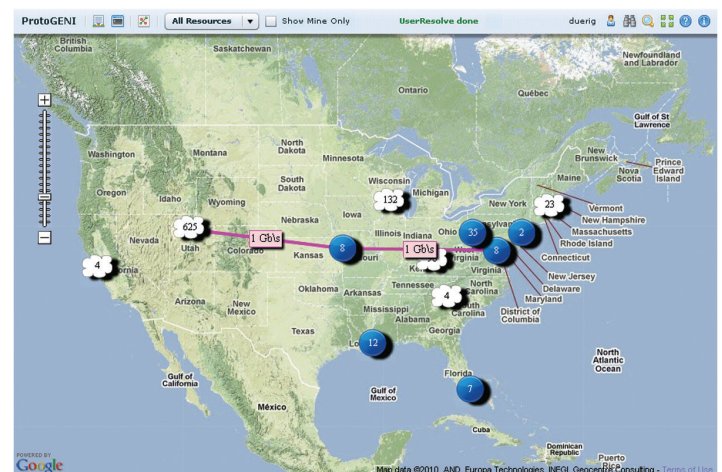
The Flux Group also does "pure" OS work with impact. Well

before virtual machines resurged in popularity, Flux pushed the limits of VM-based operating systems by developing a fully recursive OS called Fluke. Motivated by Fluke's strong protections, the National Security Agency worked with Flux to refine a flexible security architecture and integrate it with Fluke. This architecture broke new ground in terms of policy flexibility. It is also the security architecture in today's leading secure Linux, SELinux, now supported by the mainline Linux kernel. Today, as participants in the DARPA CRASH program, Flux is using VM technology to create "application containers" to improve security. Using selective replay and VM-based state partitioning, application containers seek to improve the robustness and trustworthiness of the computer systems that people use every day.

Compiler testing is another current effort with real-world impact. Using random program generation, members of Flux have found and reported literally hundreds of defects in production C compilers. This project is improving the correctness and trustworthiness of C compilers, which is essential for trustworthy systems overall: today's popular operating systems are written mostly in C, and C is at the heart of countless, deployed mission-critical and safety-critical applications.

Network Testbeds and Experimental Environments

The Flux Group is well known for its work in pioneering advances in testbed technologies. Its flagship facility, Emulab,



The ProtoGENI project is federating network experimentation facilities across the country

is a central resource for the worldwide systems and networking research communities; it supports over 3,000 users from more than 340 institutions, who run over 14,000 experi-



Utah testbed

ments a year. Emulab established the automated testbed as a new way to perform experimental research, addressing the resource allocation, virtualization, security, management, and performance challenges of such testbeds. The software that runs Emulab is a cutting-edge “operating system” for network and distributed-system experimentation, and it has been adopted by more than three dozen other universities and companies to run testbeds of their own. Emulab’s architecture supports over a dozen device types, ranging from PCs and network switches to software radios, from specialized network processors to wireless links—all integrated in a single framework and presented through common interfaces.

The software and technologies developed for Emulab are being used as the basis for other experimental environments as well. The NSF’s Global Environment for Network Innovation (GENI) is a large, collaborative effort between fifty universities and industrial partners to build a facility for research on the future of the Internet. The Flux Group is building ProtoGENI, one of GENI’s four “control frameworks.” ProtoGENI is based on Emulab and defines a set of protocols, APIs, and data structures that together comprise a platform on which the next generation of network innovations can be prototyped and evaluated. ProtoGENI ties together over twenty collaborative projects including substrate networks, tools to help researchers conduct their experiments, and measurement and monitoring frameworks. The ProtoGENI federation provides experimenters complete top-to-bottom control over a distributed network with PCs, programmable networking devices, wireless equipment, and sensor-network nodes. Many of these devices are connected by a layer-2 backbone being built in partnership with Internet2, giving researchers the ability to configure or replace most of the network stack. ProtoGENI has already been used by a number of early adopters, and its user community is growing rapidly.

PRObE, the Parallel Reconfigurable Observational Environment, is another new facility that will make use of Emulab at its core. Funded by the NSF and run by the New Mexico Consortium, Los Alamos National Laboratory, CMU, and the University of Utah, PRObE will offer systems researchers the ability to conduct experiments with raw access to high-performance computing hardware at a scale that has not previously been available. It is being built from a decommissioned supercomputer and will open for use in 2011.

Improving the Scientific Process

Finally, the Flux Group is looking at ways to improve the entire scientific process in experimental computer science research—and eventually, perhaps in other scientific domains. They are evolving Emulab into an experimentation workbench that helps users manage their activities and data, using concepts from scientific workflow. The idea is to change the way that researchers approach their work: to graduate from running isolated experiments and move toward the notion of managing entire courses of study. The ultimate goals of the project are to change how systems research is done and to advance science within the systems community. Emulab provides a unique environment in which this kind of scientific workflow management can succeed.

Testbeds like Emulab changed systems research by enabling realistic research at scale. Now, the workbench seeks to change the scope of activities that can be managed by testbeds and similar facilities. The Flux Group envisions that tomorrow’s Emulab-derived software could be central in managing all aspects of systems experimentation. It is another example of the Flux Group’s approach to performing leading-edge systems research: visionary goals for future computer systems, combined with the group’s deep and broad technical experience, and driven by a pragmatic, incremental, and user-focused philosophy.

In summary, the Flux Research Group catalyses the transition from today’s systems research to tomorrow’s systems practices. From languages to operating systems, from testbeds to scientific workflow, the Flux Group brings a wide range of new ideas to bear on real-world problems. It makes new solutions available to users through continual publications, software distributions, online services, and academic and industrial collaborations. In short, Flux has impact.

The Center for Parallel Computing at Utah (CPU)

BACKGROUND

The story of scientific progress begins with a period of initial denial followed by a wholehearted embrace of the new that leaves the old in a wake of obsolescence. This is how we have moved on to embrace ink jet printers and electronic submission of conference papers, leaving behind their dot matrix counterparts and late night drives to the airport post office. In almost all cases, the new technology was full and complete, and there was no vital missing piece after its adoption.

The current transition from sequential to parallel and concurrent programming, however, follows a less than perfect storyline. For a very long time, it has been abundantly clear to computer system manufacturers that the steadily increasing clock frequencies and the corresponding increase in processor energy consumption cannot be sustained. As early as the 1990s, some early pioneers had foreseen various avenues forward: multi microprocessor solutions forecast by Patterson, the NESL functional algorithm design and programming approach by Blelloch; and work stealing runtimes by Leiserson, to name a few. Microprocessor manufacturers took another decade before shifting their roadmap toward parallel computing, meanwhile performing heroic acts of hardware design. For example, in 1993, the Pentium-2 was clocked at a “whopping” 67 MHz. The DEC Alpha that was introduced soon thereafter ran at over a gigahertz. It drew 10 amps of current—50 amps during clock switching—with its clock driver having an effective width of 20 inches! Clearly these trends, as well as many others such as deep pipelines and excessively speculative execution schemes burned more energy without commensurate performance gains.

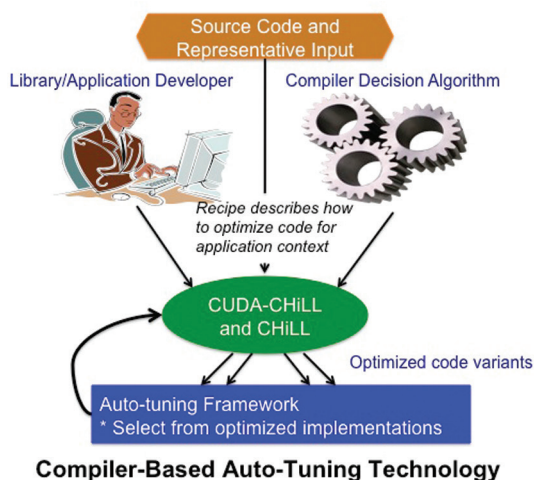
Unfortunately, after this period of denial and rapid forward lurch toward parallelism, we have several crucial pieces missing. We have yet to develop good organizational principles for parallel computation; we have very weak methods to ensure their correctness; and we have a whole confused legacy of languages and libraries that must still be used because of their wide adoption, but they have many drawbacks with respect to their use in a parallel computing context. In this sense, the progress toward parallel programming has unfortunately emerged more as a belated admission, exposing the decades of neglect in languages, API and compiler design, and pedagogical methods that must now accelerate to catch up with the changing hardware realities. Addressing this acceleration is precisely the goal of the Center for Parallel Computing (CPU).

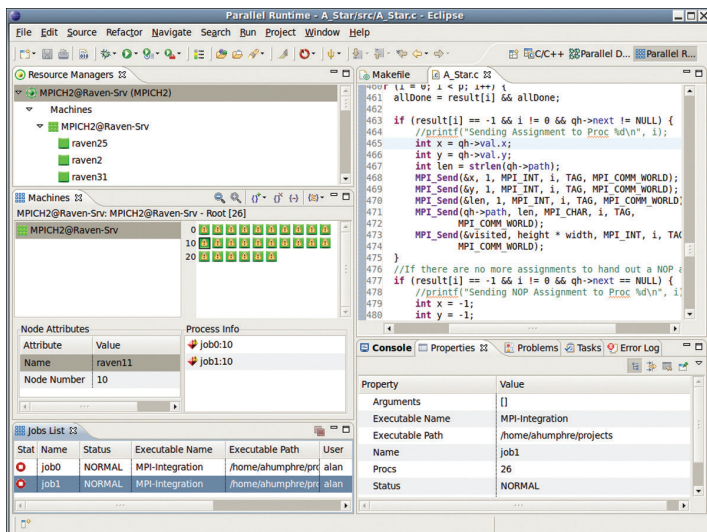
THE CENTER FOR PARALLEL COMPUTING AT UTAH

Given the inexorable increase in the demand for computing power and energy efficiency, all areas of computer application must now embrace parallel computing. This affects applications ranging from weather prediction done by powerful supercomputers, data storage on Cloud Computing facilities that are often larger than a dozen football fields, Science and Engineering research that is conducted on multi-million dollar supercomputers; all the way to desktop computers and even to personal communication devices (e.g., “phones”) that are being sold in counts of billions. The whole approach to programming these computers must change. We must invent new ways to develop the electronics underlying these computers. We must develop and teach new parallel programming approaches best suited for each problem type. Application scientists who ignore these trends will find that their existing codes will become slower with each generation of processors, unable to exploit the shared memory multicores and vector/accelerator hardware units that will be the norm in the coming years.

An important aspect of the aforementioned crises is that successfully addressing them not only requires Computer Scientists but also application developers. These researchers and engineers specialized in various branches of engineering and natural sciences must collaborate with the computer scientists. Together, they stand the only chance to meet the growing computational demands and various societal demands such as for communication and privacy. The Center for Parallel Computing (CPU) is directed toward fostering these collaborations.

Given that future innovations in parallel computing will





Architecture of ISP: Dynamic Formal Verifier for MPI programs

occur at the seams between areas, we fully expect collaborative projects to be launched between members of the CPU. The CPU will also launch seminar series as well as pilot classes experimenting with new curricular approaches. The recently concluded MSR/CPU Distinguished Lecture Series [*1] and the Practical Parallel and Concurrent Programming pilot course [*2] are indicative of more to come. CPU's academic mission will include a strong emphasis on developing and disseminating new curricular material such as PPCP. There is an acute shortage of information on parallel programming techniques, verification techniques, and performance evaluation/tuning techniques. CPU will maintain a prominent web presence where educational resources in these areas will be maintained. It will also form an external advisory board comprised of members from various local and national/international industries.

We invite you to follow the activities of CPU at its website [*3] and become involved by attending meetings sponsored by CPU as well as suggesting avenues for further impact. The more we can push on this front, the more our students and fellow researchers will truly benefit from timely knowledge and derive benefits in selecting their future careers that are perfectly aligned with future academic and industrial needs. The research of the CPU members is supported by grants from NSF, DARPA, DOE, SRC, Microsoft, HP and Intel. Equipment grants from Nvidia, Oracle, and Xilinx.

[*1] www.cs.utah.edu/events/CPUDLS

[*2] research.microsoft.com/ppcp

[*3] www.parallel.utah.edu

MEMBERS

Ganesh Gopalakrishnan, *Professor*
 Director, Center for Parallel Computing at Utah
 School of Computing

Rajeev Balasubramonian, *Associate Professor*
 School of Computing

Martin Berzins, *Professor*
 School of Computing

Mary Hall, *Associate Professor*
 School of Computing

Mike Kirby, *Associate Professor*
 School of Computing

Matt Might, *Assistant Professor*
 School of Computing

John Regehr, *Associate Professor*
 School of Computing

Julio Facelli, *Professor*
 Dept. of Biomedical Informatics

James C. Sutherland, *Professor*
 Dept. of Chemical Engineering

AFFILIATED MEMBERS

Al Davis, *Professor*
 School of Computing

Erik Brunvand, *Associate Professor*
 School of Computing

Steve Corbato, *Director of Cyberinfrastructure*
 Office of Information Technology

Matthew Flatt, *Associate Professor*
 School of Computing

Eric Eide, *Project Engineering Manager*
 School of Computing

Gianluca Lazzi, *Professor*
 Dept. of Electrical & Computer Engineering

Tim Ameal, *Professor*
 Dept. of Mechanical Engineering

Milind D. Deo, *Professor*
 Dept. of Chemical Engineering

RESEARCH @ THE SCHOOL OF COMPUTING

- APPLIED COMPUTATION
- ARTIFICIAL INTELLIGENCE
- COMPUTER GRAPHICS
- COMPUTER SYSTEMS
- INFORMATION MANAGEMENT
- PROGRAM ANALYSIS &
FORMAL METHODS

APPLIED COMPUTATION

IMAGE ANALYSIS // SCIENTIFIC COMPUTING // VISUALIZATION

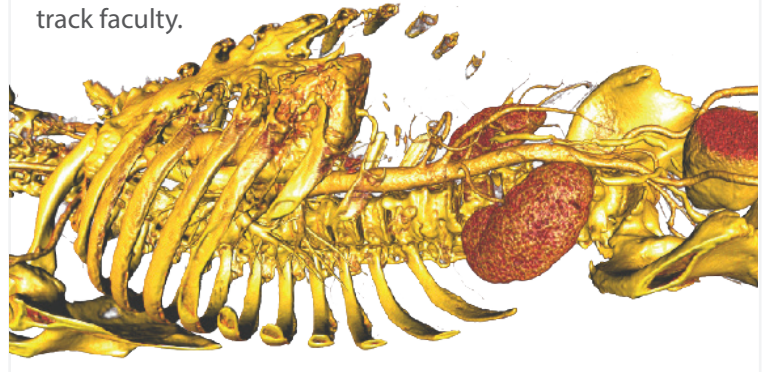
IMAGE ANALYSIS

Image analysis research addresses fundamental questions in 2D and 3D images and applications in a variety of fields including energy, defense, biology, and medicine. This research spans a wide range of areas including new methods for low-level image processing, such as filtering, segmentation, and surface reconstruction. Work on image analysis also focuses on statistical methods for analyzing shapes and applications of these methods to problems in medicine and biology. The work in image processing also includes applications of advanced computing to 3D images, which has resulted in new parallel algorithms and real-time implementations on graphics processing units (GPUs). A particularly important application area is neuroimage analysis, and collaborations with the University of Utah Brain Institute focus on disorders and diseases such as autism and Alzheimers. Examples are the analysis of diffusion-weighted MRI images for quantifying brain connectivity, the analysis of longitudinal pediatric images to understand brain development, and analysis of functional data for understanding brain function and the affects of disease. These applications drive the development of new methods for image processing, shape representation and analysis, and computational statistics.



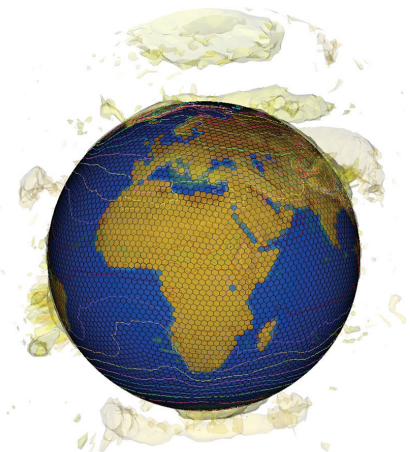
SCIENTIFIC COMPUTING

The Scientific Computing faculty within the School of Computing perform cutting edge research in all of the aspects of the scientific computing pipeline: mathematical and geometric modeling; advanced methods in simulation such as high-performance computing and parallelization; numerical algorithm development; scientific visualization; and error quantification and evaluation. The School of Computing has scientific computing research efforts in a wide variety of areas, including adaptive methods, inverse and imaging problems, numerical analysis, uncertainty and error quantification, distributed and parallel computing, problem solving environments, integral methods, Monte Carlo algorithms, computational complexity and computational science applications. Students at both the undergraduate and graduate level working under faculty guidance are able to apply this knowledge to real-world problems in important scientific disciplines, including combustion, mechanics, geophysics, fluid dynamics, biology, and medicine. A collaborative base provides students with tremendous flexibility to seek out science which interests them, and strong mentoring from scientific computing track faculty.



VISUALIZATION

Scientific visualization, sometimes referred to as visual data analysis, is the graphical representation of data as a means of gaining understanding and insight into the data. Scientific visualization research at Utah has focused on applications spanning computational fluid dynamics, medical imaging and analysis, and fire simulations. Research involves novel algorithm development to building tools and systems that assist in the comprehension of massive amounts of scientific data. To comprehend spatial and temporal relationships between data, interactive techniques provide better cues and therefore, much of the scientific visualization research focuses on better methods for visualization and rendering at interactive rates.



ARTIFICIAL INTELLIGENCE

ROBOTICS // MACHINE LEARNING // NATURAL LANGUAGE PROCESSING

ROBOTICS

The robotics group conducts research on a wide variety of topics, particularly mobile robots, haptic interfaces, novel sensor and actuator systems, and intelligent sensor networks. A variety of novel mobility platforms are being developed for traversing varied terrain. For rough terrain, approaches include bipedal and quadrupedal legged robots, compliant-framed wheeled robots, and hybrid robots with legs that tuck into a ball for rolling downhill. Climbing robots include insect-like robots that utilize claws and spines to adhere to small features even in nearly smooth walls, and robot snakes that can crawl through pipes. Ornathopters (flying robots) are also being developed that use flapping wings for lift. Haptic interfaces are robot devices that physically interact with humans, and include both manual interfaces and locomotion interfaces. The virtual prototyping project seeks to add a sense of touch to the mechanical design process. Aside from feeling the force of contact, the tactile feel of contact is also being provided by pressing on the fingertip with a moving indenter that simulates the point of contact. A method of measuring human grasp force is being developed, that utilizes imaging coloration changes in a fingernail with a camera. The Sarcos Treadport Locomotion Interface seeks to provide a multi-sensory experience of walking, including visual, mechanical, auditory, and wind displays. Wet robots are being developed that embed Shape Memory Alloy “muscles” within a network of biologically inspired “robotic blood vessels” that fluidically distributes thermal energy to and from any actuators in the array using only a small number of valves. Smart sensor networks are being developed that are capable of computation, communication and sensing for many distributed sensors.



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MACHINE LEARNING

Machine learning technology aims to solve problems of inference and prediction. Based on past data, we desire algorithms that can reliably forecast the future. Machine learning techniques have led to significant advances in the fields of natural language processing, computational biology, robotics and medicine. The machine learning group at Utah works in several areas, ranging from basic technology building to application development and from mathematical modeling to algorithmic implementation. These areas include structured prediction, domain adaptation, semi-supervised learning, bootstrapping and Bayesian statistics. Structured prediction aims at developing algorithms that can predict complex outputs, such as those found in natural language or biology. Domain adaptation, semi-supervised learning and bootstrapping address the frequently occurring problems of mismatches between past data and anticipated future data.

NATURAL LANGUAGE PROCESSING

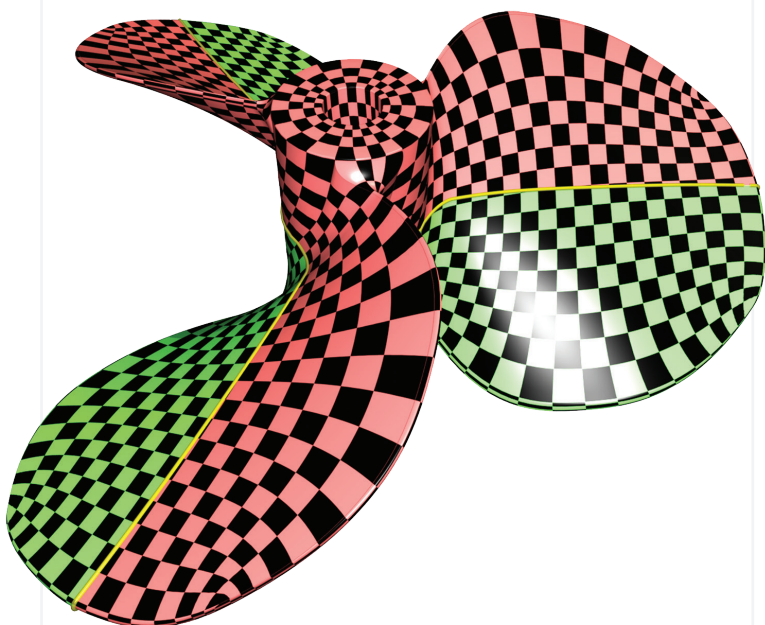
The goal of natural language processing (NLP) research is to create computational models for understanding natural (human) languages, such as English. The natural language processing group at the University of Utah works on a variety of problems in human language technology, including event extraction, semantic analysis, and coreference resolution. Event extraction technology reads texts such as news articles and identifies important facts associated with events, such as the perpetrators and targets of a terrorist attack or the diseases and victims associated with infectious disease outbreaks. To understand text, our research group develops new techniques to determine the semantic meaning of words and phrases in context and through the automatic creation of semantic dictionaries. We also conduct research on coreference resolution to recognize when different words and phrases are referring to the same real-world entity or concept. The NLP group at Utah specializes in weakly supervised learning techniques that use bootstrapping to automatically acquire knowledge for natural language processing using unannotated text collections with minimal human supervision.

COMPUTER GRAPHICS

GEOMETRIC DESIGN & COMPUTATION // PERCEPTION // SIMULATION & ANIMATION

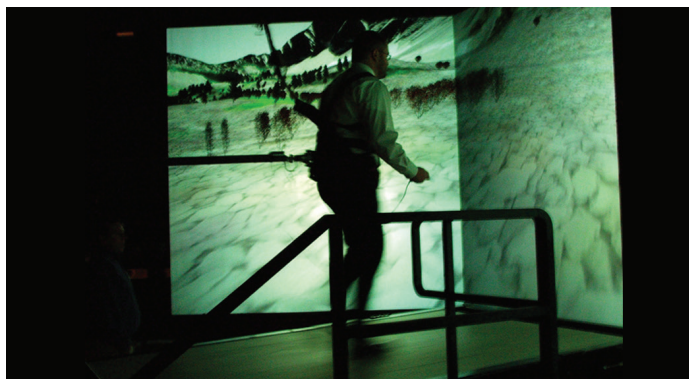
GEOMETRIC DESIGN & COMPUTATION

The Geometric Design and Computation group has engaged in both fundamental and applied research in developing methods for representing, specifying, manipulating, and visualizing geometric models. The group has projects ranging from early conceptual design methods to innovative manufacturing processes and from detail modeling applications to large-scale assembly systems. Supporting these applications is fundamental work on surface and model representation, computational geometry, topology, differential geometry, and numerical methods.



PERCEPTION

Perception research focuses on two complimentary goals. One aims to increase the effectiveness of computer graphics in conveying information about the three-dimensional world. We are interested in better understanding the spatial information potentially available in CG imagery, determining what spatial cues are actually used when CG imagery is viewed, and using this information to inform the development of improved rendering algorithms. A major thrust of this work has been directed at improving the accuracy of spatial actions conducted within virtual environments. The other goal uses the tools of computer graphics and visually immersive environments to probe basic questions about human perception. We are exploring fundamental issues concerning the processes used to scale distance judgments and the interaction between visual perception and locomotion. This is an interdisciplinary effort involving computer graphics, perceptual psychology, and computational vision.



SIMULATION & ANIMATION

While exploding trucks and collapsing buildings are rare occurrences in everyday life, they are frequently depicted in films, video games, and training simulations. Filming such effects in the real world can be dangerous and obtaining a specific outcome is often difficult. Consequently, such effects are increasingly generated through physical simulations where initial conditions and parameters can be tuned to produce the desired effect. Research in the Simulation and Electronic Animation Lab is focused in developing tools that allow artists to create high-quality, realistic, visually-detailed animations of complex materials for applications in computer graphics.



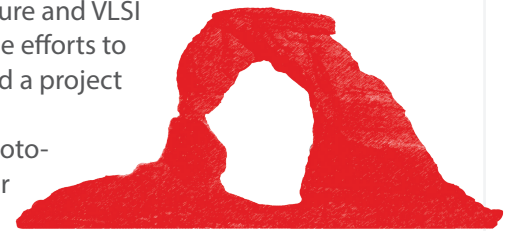
COMPUTER SYSTEMS

ARCHITECTURE & VLSI // PARALLEL COMPUTING // MOBILE & EMBEDDED SYSTEMS // NETWORKING & OS // PROGRAMMING LANGUAGES

ARCHITECTURE & VLSI

Computer architecture and VLSI design are inexorably intertwined. At Utah, Architecture and VLSI researchers are tackling issues related to the synergy of these fields, including multiple efforts to understand and reduce the architectural impact of interprocessor communication and a project designing custom hardware for interactive ray tracing.

On modern multi-core chips, it is critical that on-chip interconnects and coherence protocols enable fast and power-efficient data transfers between parallel threads. Professor Balasubramonian's research focuses on architectural mechanisms, such as heterogeneous wire technology, that improve the efficiency of on-chip communication. Professors Brunvand and Davis, in conjunction with computer graphics colleagues, are designing special-purpose hardware for ray tracing, a form of computer graphics that generates much higher quality and more realistic images than commodity graphics chips. The resulting processor employs multiple ray tracing pipelines and is based on previous work designing domain specific processors that support run-time configuration of the datapath. This allows it to operate at very close to the speed and power efficiency of a fully custom pipeline, but with enough programmability so that a variety of ray trace algorithms can be supported.



UTAH ARCH
www.cs.utah.edu/arch-research

PARALLEL COMPUTING

We are entering the multi-core era where every computer, whether embedded, laptop, desktop, server or supercomputer, is a parallel computer. As parallel computing is reaching the masses, faculty at Utah are developing new courses and expanding their research to embrace the changes in programming tools and systems software that naturally must arise in response to this paradigm shift, in collaboration with the previously-described architecture and VLSI research in this area. In particular, the newly formed Center for Parallel Computing at Utah (CPU) fosters collaborations between the School of Computing faculty and faculty across campus on a variety of correctness and performance challenges being faced by the parallel computing community. We now describe some specific efforts. Professor Hall is developing performance tuning tools, called autotuners, designed to ease the programming burden in the face of the growing complexity and diversity of modern computer architectures. Autotuners experiment with a set of alternative strategies for mapping application code to hardware to automatically select the mapping that yields the best performance. Such programming tools increase programmer productivity by reducing the effort of porting to new architectures, and empowering the programmer to maintain code that is simpler, and architecture independent. Advances in parallel computing are ultimately tied to delivering correct and efficient systems. The Gauss group lead by

Professors Gopalakrishnan and Kirby is engaged in researching and developing formal analysis tools that can analyze and help debug parallel and concurrent programs. One of their tools ISP (In-Situ Partial Order Analysis) has the ability to analyze large-scale message passing programs written using the MPI library. A framework called GEM (Graphical Explorer of MPI programs) enhances one's ability to use ISP on complex programs, and has been officially released as part of the Eclipse Parallel Tools Platform. The Gauss group also has built tools for debugging GPU kernels through symbolic analysis, and a host of other tools to debug multi-core communication, thread libraries, and cache coherency protocols. Professor Gopalakrishnan, director of the CPU center, is also active in Concurrency Education, and collaborates with Microsoft Research in helping develop a Practical Parallel and Concurrent Programming curriculum called PPCP.

```
C/C++ - MPI_MatrixMultiply-4/src/MPI
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer
  MPI_MatrixMultiply-3
  MPI_MatrixMultiply-4
    Binaries
    Includes
    src
      gem
      MPI_MatrixMultiply-4.c
buffering-sensitive- MPI_TwoDead
119 else {
120 MPI_Bcast(b, brows*bcols, MPI_FLOAT, master,
121 while (1) {
122 MPI_Recv(buffer, acols, MPI_FLOAT, master,
123 if (status.MPI_TAG == 0) break;
124 row = status.MPI_TAG - 1;
125 for (i = 0; i < bcols; i++) {
126 ans[i] = 0.0;
127 for (j = 0; j < acols; j++) {
128 ans[i] += buffer[j]*b[j*bcols+i];
129 }
130 }
```


MOBILE & EMBEDDED SYSTEMS

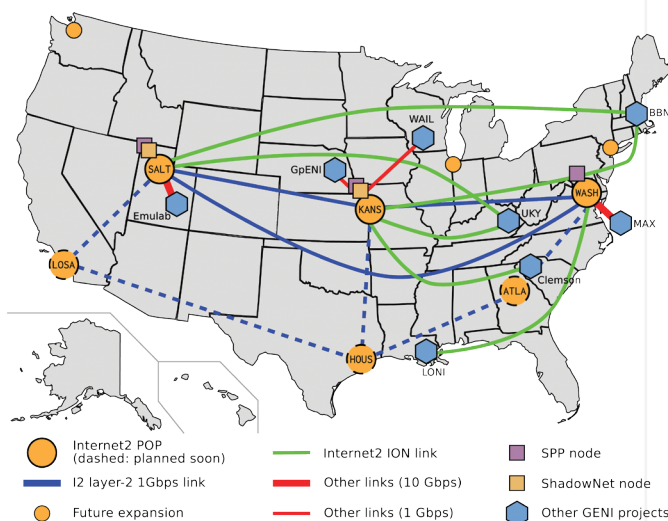
Mobile and embedded computer systems have become pervasive in all aspects of human life: transportation, entertainment, communication, etc. This trend will continue. Professor Kessler's group is working on context-aware web search systems where context can include physical location and activity type. Professor Regehr's efforts address problems in creating dependable embedded software, particularly for highly constrained platforms. His group has created tools that take existing sensor network applications and enforce type-safe execution, detect the possibility of stack overflow, and reduce RAM usage using data compression techniques. Professor Davis' group is designing high performance, low-power, flexible domain-specific architectures which do things like speech and visual feature recognition. They are also designing tools to automate the design process.

PROGRAMMING LANGUAGES

Professor Flatt's group is investigating how multiple programming languages can be made to interoperate without forcing all interactions to be defined in terms of a single shared language (such as JVM bytecode). They are also exploring how individual programming languages can be made more extensible. Professor Kessler's research group is developing a new requirements specification technique that incorporates use cases, class diagrams and simple state machines to automatically generate concrete scenarios for the various stakeholders. They are also working on an investigation into techniques to improve meta-modeling in UML. Professor Hall's research group is developing compiler optimization technology that exploits performance-enhancing features of modern architectures, including multi-core microprocessors, SIMD compute engines, accelerators, complex memory hierarchies, and software-controlled storage. Professor Might's research team investigates software analysis technology that optimizes performance, detects security vulnerabilities, improves parallelism and eliminates bugs.

NETWORKING & OS

Computer systems research at Utah spans operating systems, distributed systems, networking, and security. Much of this work is done in collaboration with researchers in programming languages and compilers, mobile and embedded systems, software engineering, and formal methods. The Flux Research Group, led by several systems faculty and senior technical staff, develops the internationally acclaimed Emulab network emulation testbed. Technologies and ideas from Emulab are being used to build NSF's new GENI and PROBE experimental environments. Current Flux projects also include software containers to protect applications, and securing testbed systems. Past projects include operating systems like Fluke and Janos, which pushed the envelope in terms of OS design and features. Professor Kasera's networking research encompasses mobile systems and wireless networks, network security, new network architectures, and networks measurements. Ongoing research includes developing novel methods for enhancing wireless network security using unique device fingerprints and link signatures, developing distributed medium access protocols for next generation wireless communication technologies, building social networking platforms to facilitate collective decision making, and building robust overload control. Professor Kasera's group is also building mobile ad hoc network routing and security using accurate network performance characterizations and cross layer approaches.



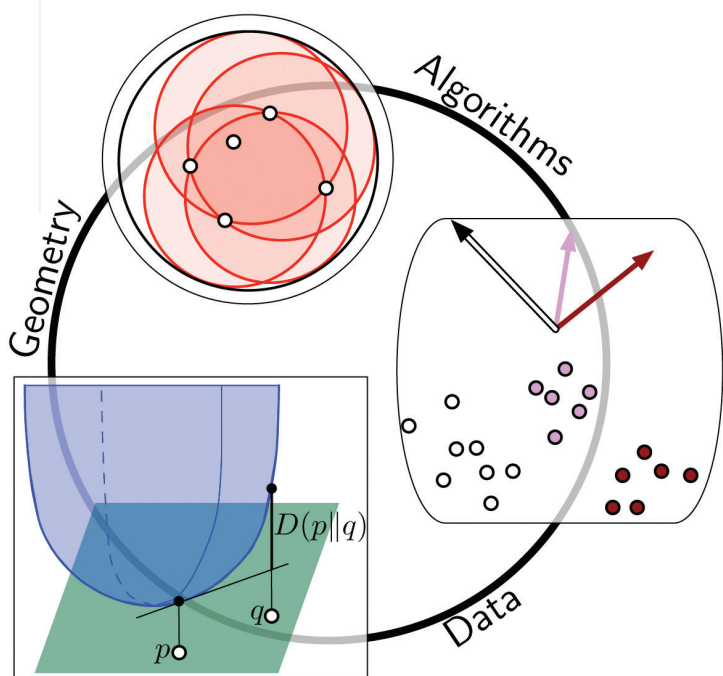
PROGRAM ANALYSIS & FORMAL METHODS

ALGORITHMS // VERIFICATION

ALGORITHMS

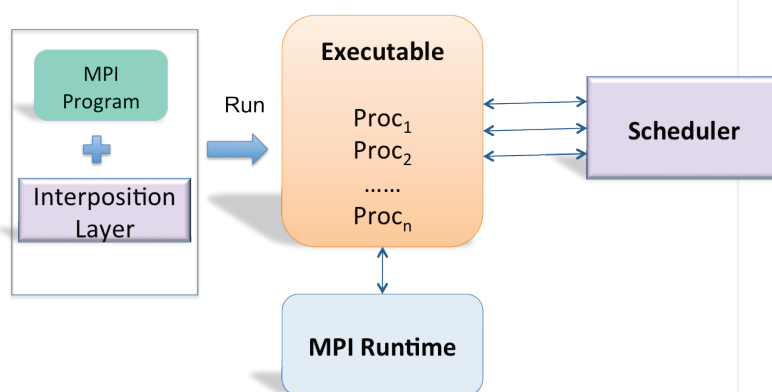
Algorithms research at the School of Computing explores problems in numerous areas, including topics in massive data sets, data mining, computational geometry, shape analysis and data visualization. One strand of current research being developed by Prof. Venkatasubramanian deals with the computational challenges of doing statistics on large data sets, and how information-theoretic methods can be brought to bear on a variety of problems in data management, with application in general data cleaning scenarios, as well as bioinformatics.

Another research effort involves understanding algorithms in non-Euclidean spaces: a particular application of this effort is in the analysis of shape, particularly the shapes extracting from medical imaging modalities like MRI scanning and diffusion tensor imaging. Prof. Venkatasubramanian, together with Profs. Fletcher (CS) and Joshi (Bioengineering), is developing scalable, accurate algorithms for data analysis in non-Euclidean domains.



VERIFICATION

Research on formal methods in the School of Computing is unique in its tight integration with systems research activities at Utah and elsewhere. In one research thrust, Profs. Gopalakrishnan and Kirby are collaborating to verify the correctness of communication structures in large-scale aggressively optimized parallel simulations written using the Message Passing Interface (MPI). Another effort led by Prof. Gopalakrishnan is aimed at improving the reliability of hardware cache coherence protocols through formal verification. Prof. Regehr's group builds tools that use lightweight formal methods to verify novel properties of embedded software. For example one tool uses abstract interpretation to bound the stack memory consumption of a compiled sensor network application. This is difficult because real embedded software uses many idioms that are hard to analyze, such as interrupts, recursion, and function pointers.

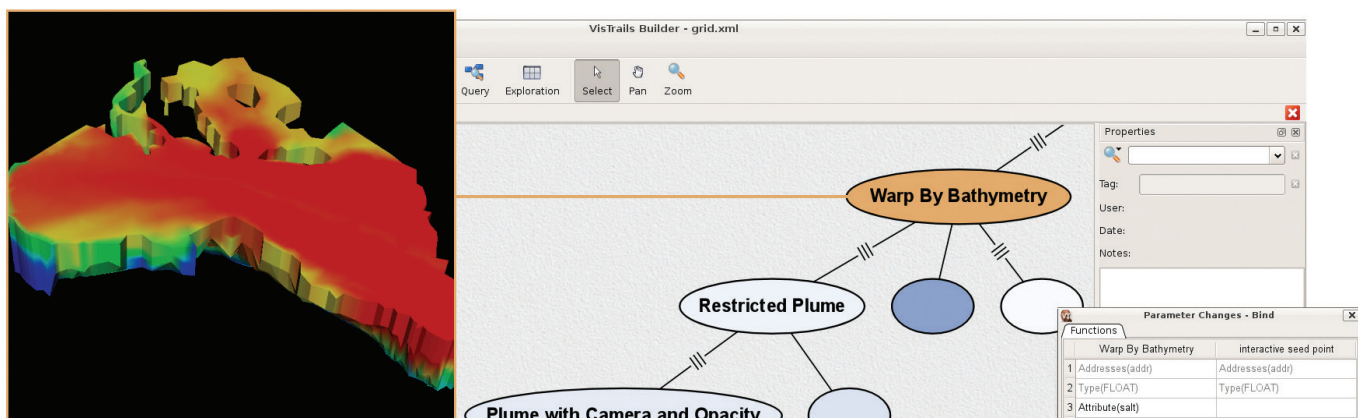


INFORMATION MANAGEMENT

MANAGING SCIENTIFIC DISCOVERY PROCESS // LARGE-SCALE WEB INFORMATION INTEGRATION

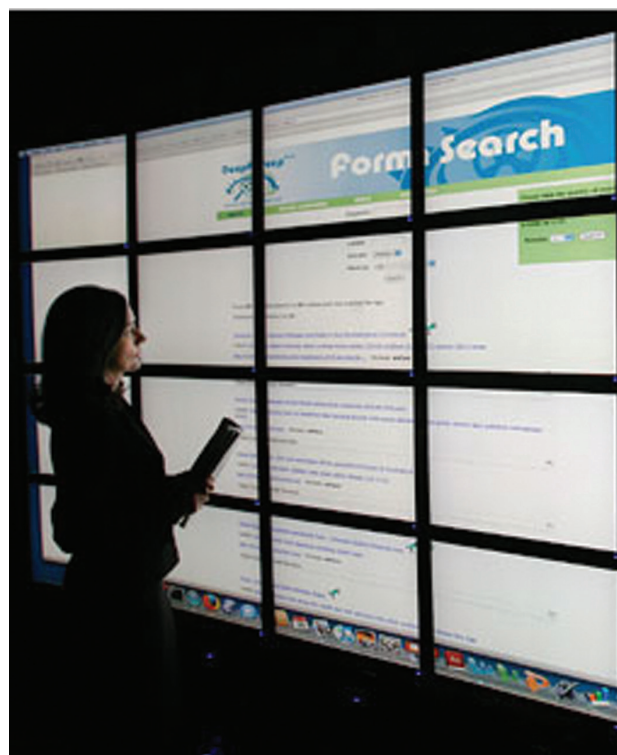
MANAGING SCIENTIFIC DISCOVERY PROCESS

The Information Management group has been working on building new cyberinfrastructure that streamlines the creation, execution and sharing of complex visualizations, data mining and other large-scale data analysis applications. We developed VisTrails (<http://www.vistrails.org>), a new open –source, scientific workflow and provenance management system that was designed to manage rapidly evolving workflows common in exploratory applications. VisTrails provides novel mechanisms for capturing and interacting with provenance that greatly simplify the data exploration process. VisTrails has been adopted as part of the cyberinfrastructure in large scientific projects, as well as a teaching and learning tool in graduate and undergraduate courses, both in the U.S. and abroad.



LARGE-SCALE WEB INFORMATION INTEGRATION

There has been an explosive growth in the volume of structured information on the Web. This information often resides in the *hidden* (or deep) Web, stored in databases and exposed only through queries over Web forms. A recent study by Google estimates that there are several millions of such form interfaces. However, the high quality information in online databases can be hard to find: it is out of reach for traditional search engines, whose index include only content in the surface Web. Our group is combining techniques from machine learning, information retrieval and databases to build infrastructure that automates, to a large extent, the process of discovering and organizing hidden-Web data sources, a necessary step to large-scale retrieval and integration of Web information. This infrastructure will enable people and applications to more easily find the right databases and consequently, the hidden information they are seeking on the Web. We have used our hidden-Web infrastructure to build DeepPeep (<http://www.deeppeep.org>), a new search engine for Web forms.



EDUCATION @ THE SCHOOL OF COMPUTING

- [COURSE LIST](#)
- [UNDERGRADUATE PROGRAM](#)
- [GRADUATE PROGRAM](#)
- [COMPUTING TRACKS](#)
- [EAE : MGS](#)
- [M.S. & PH.D. GRADUATES](#)

Course List



- CS 1000 Engineering Computing
- CS 1001 Engineering Computing using MATLAB
- CS 1010 Introduction to UNIX
- CS 1020 Introduction to Programming in C++
- CS 1021 Introduction to Programming in Java
- CS 1040 Creating Interactive Web Content
- CS 1050 Computers in Society
- CS 1060 Explorations in Computer Science
- CS 1400 Introduction to Computer Science
- CS 1410 Introduction to Computer Science I

- CS 2000 Introduction to Programming in C
- CS 2100 Discrete Structures
- CS 2420 Introduction to Computer Science II
- CS 2960 Apple Certification
- CS 2961 Cisco CCNA Level 1
- CS 2962 Cisco CCNA Level 1
- CS 2963 LPI level 1
- CS 2964 LPI level 2

- CS 3010 Industry Forum
- CS 3100 Model of Computation
- CS 3130 Engineering Probability and Statistics
- CS 3200 Scientific Computation
- CS 3500 Software Practice I
- CS 3505 Software Practice II
- CS 3650 3D Modeling for Video Games and Machinima
- CS 3660 Interactive Machinima
- CS 3700 Fundamentals of Digital System Design
- CS 3710 Computer Design Laboratory
- CS 3810 Computer Organization
- CS 3991 Computer Engineering Junior Seminar
- CS 3992 Computer Engineering Pre-Thesis/Pre-Project

- CS 4005 Honors Research Practice
- CS 4150 Algorithms
- CS 4400 Computer Systems
- CS 4500 Software Engineering Laboratory
- CS 4510 EAE Senior Project I
- CS 4515 EAE Senior Project II
- CS 4540 Web Software Architecture
- CS 4550 Simulation
- CS 4710 Computer Engineering Senior Project

- CS 5010 Software Practice I
- CS 5020 Software Practice II
- CS 5040 Teaching Introductory Computer Science
- CS 5060 Legal Protection of Digital Information
- CS 5100 Foundations of Computer Science
- CS 5150 Advanced Algorithms
- CS 5160 Computational Geometry
- CS 5300 Artificial Intelligence
- CS 5310 Robotics
- CS 5320 Computer Vision
- CS 5340 Natural Language Processing
- CS 5350 Machine Learning
- CS 5460 Operating Systems
- CS 5470 Compiler Principles and Techniques
- CS 5480 Computer Networks
- CS 5510 Programming Language Concepts
- CS 5520 Anatomy of a Modern Programming Language
- CS 5530 Database Systems
- CS 5540 Human/Computer Interaction
- CS 5600 Introduction to Computer Graphics
- CS 5605 Honors Introduction to Computer Graphics
- CS 5610 Interactive Computer Graphics
- CS 5630 Scientific Visualization

- CS 5650 Perception for Graphics
- CS 5710 Digital VLSI Design
- CS 5720 Analog Integrated Circuit Design
- CS 5740 Computer-Aided Design of Digital Circuits
- CS 5745 Testing and Verification of Digital Circuits
- CS 5750 Synthesis and Verification of Asynchronous VLSI Systems
- CS 5780 Embedded System Design
- CS 5785 Advanced Embedded Systems
- CS 5830 VLSI Architecture

- CS 6020 Conducting, Publishing and Presenting Early-Career Research
- CS 6100 Foundations of Computer Science
- CS 6110 Formal Methods for System Design
- CS 6150 Advanced Algorithms
- CS 6160 Computational Geometry
- CS 6210 Advanced Scientific Computing I
- CS 6220 Advanced Scientific Computing II
- CS 6230 High Performance Parallel Computing
- CS 6300 Artificial Intelligence
- CS 6310 Robotics
- CS 6320 Computer Vision
- CS 6340 Natural Language Processing
- CS 6350 Machine Learning
- CS 6360 Virtual Reality
- CS 6370 Geometric Computation for Motion Planning
- CS 6380 Multi-agent Systems
- CS 6470 Advanced Topics in Compilation
- CS 6480 Advanced Computer Networks
- CS 6490 Network Security
- CS 6510 Functional Programming
- CS 6530 Database Systems
- CS 6540 Human/Computer Interaction
- CS 6610 Advanced Computer Graphics I
- CS 6620 Advanced Computer Graphics II
- CS 6630 Scientific Visualization
- CS 6640 Image Processing
- CS 6650 Perception for Graphics
- CS 6670 Computer-Aided Geometric Design I
- CS 6680 Computer-Aided Geometric Design II
- CS 6710 Digital VLSI Design
- CS 6712 Digital IC Project Testing
- CS 6720 Advanced Integrated Circuit Design
- CS 6721 Analog Integrated Circuits Lab
- CS 6722 Analog Integrated Circuits Project Testing
- CS 6740 Computer-Aided Design of Digital Circuits
- CS 6745 Testing and Verification of Digital Circuits
- CS 6750 Synthesis and Verification of Asynchronous VLSI Systems
- CS 6760 Modeling and Analysis of Biological Networks
- CS 6770 Advanced Digital VLSI Systems Design
- CS 6780 Embedded Systems Design
- CS 6785 Advanced Embedded Systems
- CS 6810 Computer Architecture
- CS 6830 VLSI Architecture

- CS 7010 Writing Research Proposals
- CS 7120 Information-Based Complexity
- CS 7240 Sinc Methods
- CS 7250 Advanced Topics in Scientific Computing
- CS 7310 Advanced Manipulation and Locomotion
- CS 7320 System Identification for Robotics
- CS 7460 Distributed Operating Systems
- CS 7520 Programming Language Semantics
- CS 7640 Image Processing
- CS 7650 Realistic Image Synthesis
- CS 7810 Advanced Computer Architecture
- CS 7820 Parallel Computer Architecture



Undergraduate Program



COMPUTER SCIENCE

The School of Computing offers the only nationally ranked B.S. computer science degree program in Utah and is consistently rated in the top 50 computer science departments in the country. The undergraduate program provides a firm grounding in programming skills, followed by a study of more advanced topics such as algorithm analysis, software engineering, computer architecture, and systems programming. Beyond this level, students have complete flexibility in selecting from a wide selection of elective classes in areas of interest to them. Popular options are graphics, scientific visualization, operating systems, networks, compilers, artificial intelligence, programming languages, databases, robotics, natural language processing, and many others. The program culminates in a capstone experience, in which students work in groups to produce a significant software product of their choice.

COMPUTER ENGINEERING

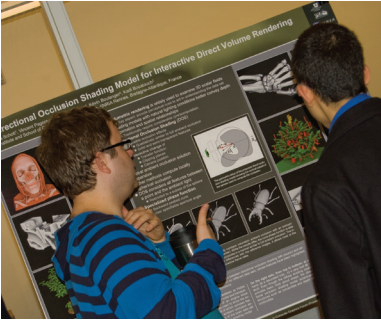
The primary technical objective of the Computer Engineering program at the University of Utah is to provide an in-depth study of hardware for both information-processing systems and digital control systems. To help meet this objective, we bring problems of current relevance in industry and research into the classroom. Virtually every faculty member is involved in research or other scholarly activity, and most spend part of their time consulting in the private sector. Faculty members teach classes in the areas of their research and consulting activities, thereby bringing to the students an up-to-date knowledge of the material.

B.S. / M.S. PROGRAM

The School of Computing's B.S./M.S. program was created to allow students the opportunity to earn both a bachelor and a master's degree in five years. Students typically apply for admission in their junior year and begin to take graduate-level courses during their senior year. The B.S./M.S. program primarily benefits local students who otherwise would have been unlikely to pursue an advanced degree.

ENTERTAINMENT ARTS & ENGINEERING

The School of Computing provides a specialty track through the Computer Science (CS) program with an emphasis on Entertainment Arts and Engineering (EAE). The EAE track is a joint program between the School of Computing and the College of Fine Arts (currently the fine arts side is housed in the Division of Film Studies). The purpose of this program is to provide an undergraduate, interdisciplinary academic path for those students who wish to have careers in the digital entertainment industry (video games, digital animation, computer generated special effects, etc.). There are currently two specified tracks: video games and animation, differing by the junior year Game/Animation series of classes. The key feature of this program is its interdisciplinary nature. Students from both CS and Fine Arts will take common classes throughout their undergraduate years, culminating in a yearlong senior project in which students build a video game or animation from the ground up. Students in the program can choose either a bachelor's degree in Film Studies or Computer Science.



Graduate Program



MASTER'S IN COMPUTER SCIENCE

The School of Computing's M.S. program offers a spectrum of curriculum options ranging from a research oriented option culminating in a written M.S. thesis, to a coursework only option emphasizing flexibility and breadth in material studied. In between these two extremes is a project option, where a taste of research can be obtained on a one semester basis, while continuing to focus on coursework.

The School of Computing offers 8 master's degree options

Master of Computer Science

Computing Degrees

Computer Engineering

Data Management and Analysis

EAE : Master Games Studio

Graphics and Visualization

Image Analysis

Information Technology

Robotics

PH.D. IN COMPUTER SCIENCE

The Ph.D. program is a traditional research-centered doctoral program emphasizing an in-depth, innovative scientific investigation leading to results publishable in respected professional journals and conferences. Sustained, close interaction with a faculty advisor and supervisory committee is a central aspect of a student's dissertation experience. All regular faculty and selected auxiliary faculty supervise Ph.D. research, often in the context of ongoing funded research projects.

The School of Computing offers 7 Ph.D. degree options

Ph.D. of Computer Science

Computing Degrees

Computer Engineering

Data Management and Analysis

Graphics and Visualization

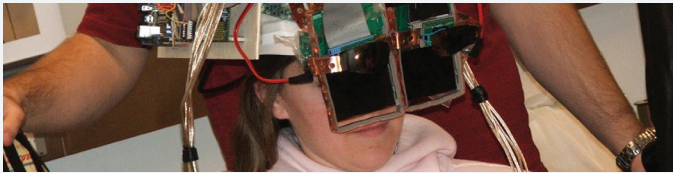
Image Analysis

Robotics

Scientific Computing

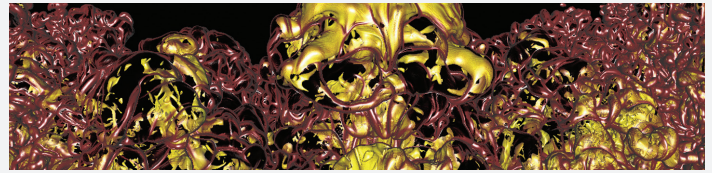
Computing Degree Program

The computing degree program encourages students to pursue area specific coursework and advanced research at an early stage of their graduate study. Aimed at maximizing a student's learning opportunities and research experiences, these tracks engage students in research activities as soon as possible.



COMPUTER ENGINEERING TRACK

Computer Engineering is a discipline that combines elements of both Electrical Engineering and Computer Science. Computer engineers design and study computer systems at many levels from the circuits that make up computers, to the architecture of processors and subsystems, to the programming interfaces of those processors. This usually involves an interesting mix of software and hardware skills and the integration of both skills. The Computer Engineering graduate track allows students to pursue a graduate degree with a focus on these sorts of issues. The track offers M.S. (course-based, project, and thesis) and Ph.D. degrees. The Computer Engineering graduate track is offered with essentially the same requirements in both the School of Computing and the Department of Electrical and Computer Engineering. Students may choose to apply to either department depending on their background and interests within computer engineering. There is also a B.S. computer engineering track that is jointly administered by the two departments and involves courses from both.



GRAPHICS & VISUALIZATION TRACK

As part of the Computing Degree Program, the School of Computing offers a specialized graduate track in Computer Graphics and Visualization. This track in the degree program encourages students to pursue area specific coursework and advanced research at an early stage of their graduate study. Aimed at maximizing a student's learning opportunities and research experiences, this track engages students in research activities as soon as possible. The Computer Graphics and Visualization degree track draws heavily on the many faculty and excellent facilities that have contributed to making Utah one of the nation's top-ranked graphics programs. The graphics program at the School of Computing is quite comprehensive, with research efforts in most areas of computer graphics, including geometric modeling, CAD/CAM, scientific visualization, biomedical visualization, computer vision, terrain modeling and rendering, haptics (force-feedback), realistic rendering, digital geometry processing, point-based graphics, immersive environments, and non-photorealistic rendering.

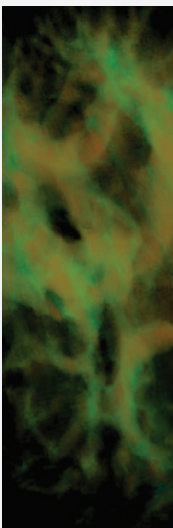


IMAGE ANALYSIS TRACK

The Image Analysis track provides students with training and research opportunities in image processing, image analysis and computer vision. Students study a wide range of topics, including mathematical principles, numerical implementations, software engineering, applications to real image data, scientific visualization of results, computational statistics and machine learning. Students have the opportunity to apply this knowledge to 2D and 3D imaging problems driven by challenging applications from a variety of fields including medicine, biology, energy, defense and more – in principle from every field that uses cameras or scanners as sensors. Image processing by definition is multidisciplinary, covering aspects from mathematics, physics, numerical analysis, scientific computing, programming, and from the disciplines providing the driving applications such as clinical research, biology, geosciences, robotics, industrial inspection and surveillance. Students therefore have the chance to be exposed to concepts and cutting-edge research in all those disciplines and to actively interact with researchers who are part of these collaborative projects.



ROBOTICS TRACK

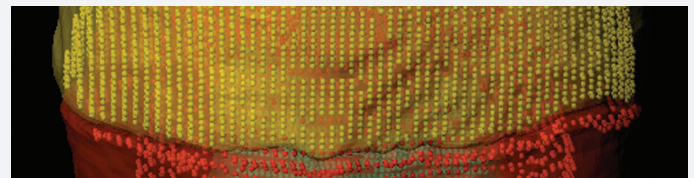
The Robotics Track is a program of study for the M.S. or Ph.D., with virtually identical course requirements for students in either department. Prospective students will choose one or the other of the departments to apply to, guided primarily by undergraduate preparation and by which department the student wishes the graduate degree to be in. The field of robotics has expanded tremendously since its early focus on industrial robots, and now includes very diverse topics such as autonomous vehicles, medical robots, smart sensor networks, micro robots, robot vacuum cleaners, sentry robots, and pet robots. Robotics technology is embedded in many devices, which are not usually thought of as robots. Knowledge of how to model motion and an emphasis on real-time computation finds application in graphics, animation, and computer games. Utah is world-famous for the robotics systems it has produced, including manipulators such as the Utah/MIT Dexterous Hand and the Sarcos Dexterous Arm, humanoid robots such as DB2, entertainment robots such as Disney figures and Jurassic Park the Ride dinosaurs, and virtual reality systems such as the Sarcos Treadport and Biport. Faculty expertise encompasses the entire theory-to-market stream, including ties to a U of U spin-off, Sarcos, piloted by a participating faculty member and a CAD/CAM system prototyping device for Ford Motor Co. and the oil exploration industry.

DATA MANAGEMENT & ANALYSIS TRACK

The rate at which scientists and businesses are producing data is increasing at an unstoppable rate. Being able to efficiently process and make sense of such data has become a key scientific challenge in computer science. Not only must one be able to store such information compactly, but one must be able to develop algorithms to process it efficiently and produce intelligent systems that can interpret this data to find interesting patterns or make decisions. These topics form the core of the Data Management and Analysis track. Students in this track may pursue a M.S. degree (course-based, project, and thesis) and Ph.D. degrees.

INFORMATION TECHNOLOGY TRACK

The goal of the M.S. Computing Degree in Information Technology (MSIT) is to train a new generation of technologists. It offers a mix of technology and management courses to provide students with a solid background in both areas. This unique combination of skills is currently in high demand in the IT industry. The MSIT degree is a good investment for both information technologists and business professionals who want to deepen their technical knowledge and develop their management skills. The curriculum for this degree draws from internationally recognized faculty in the School of Computing and David Eccles School of Business.



SCIENTIFIC COMPUTING TRACK

The Scientific Computing track trains students to perform cutting-edge research in all of the aspects of the scientific computing pipeline: mathematical and geometric modeling; advanced methods in simulation such as high-performance computing and parallelization; numerical algorithm development; scientific visualization; and evaluation with respect to basic science and engineering. Students apply this knowledge to real-world problems in important scientific disciplines, including combustion, mechanics, geophysics, fluid dynamics, biology, and medicine. Students integrate all aspects of computational science, yielding a new generation of simulation scientists who are performing fundamental research in scientific computing, as well as being interdisciplinary "bridge-builders" that facilitate interconnections between disciplines that normally do not interact. Our mission is to provide advanced graduate training in scientific computing and to foster the synergistic combination of computer and computational sciences with domain disciplines. The School of Computing has scientific computing research efforts in a wide variety of areas, including adaptive and high-order methods, inverse and imaging problems, numerical analysis, distributed and parallel computing, problem solving environments, validation and verification, uncertainty quantification, computational complexity and computational science applications.

Entertainment Arts & Engineering: Master Games Studio

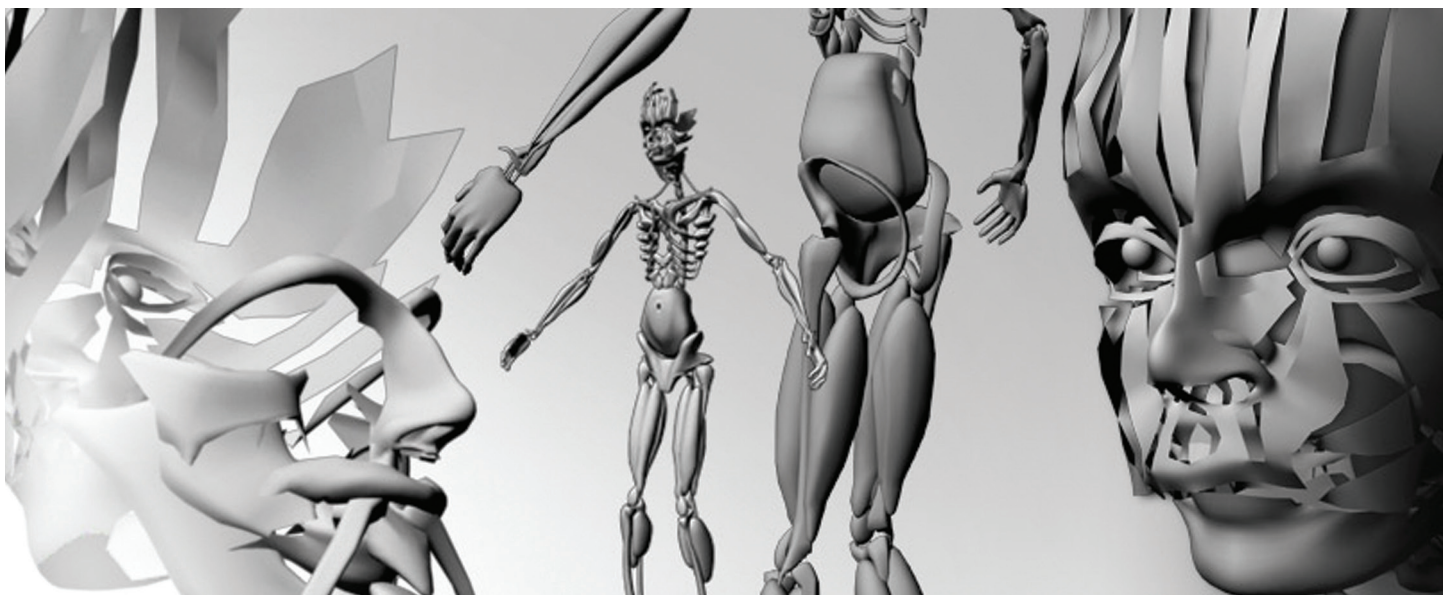


SCHOOL OF COMPUTING

Department of
FILM & MEDIA ARTS

In the fall of 2010, we admitted our first cohort of students (23) in the Entertainment Arts and Engineering Master Games Studio (EAE: MGS), an interdisciplinary master's program with three tracks: game engineering, game arts, and game production. Students in the game engineering track are awarded the M.S. in Computing degree from the School of Computing, while students in the game arts and production tracks are awarded the MFA degree from the Department of Film and Media Arts. The EAE: MGS program operates during fall and spring semesters over two consecutive years in a cohort model in which the students remain together throughout the entire program.

All students in each of the three tracks have a series of common classes including game design, rapid prototyping, pre-production, and final project. The students also have courses that will focus on the specialty of each of the tracks. These classes are exclusive to the students enrolled in the Entertainment Arts and Engineering Master Games Studio. Also each track will have a concentrated set of explicit electives to choose from the School of Computing, Film and Media Arts, and other departments on campus. The last semester will require a professional level internship, an internal internship, or an individual research project. Completion of the program requires 48 credits for each of the three tracks.



Entertainment Arts & Engineering: Undergraduate Program

Entertainment Arts and Engineering (EAE) is an interdisciplinary program between the School of Computing and the Department of Film and Media Arts. The focus is on where computers and art meet in areas such as video games, computer animation, and special effects. EAE began back in 2007 as an undergraduate emphasis (EAE: Emphasis). Students from Computer Science and Film take classes together every semester from their freshman through senior years, collaborating and working on interdisciplinary projects. EAE: Emphasis culminates in a year long senior project where large teams of students construct a video game from inception through commercial release.



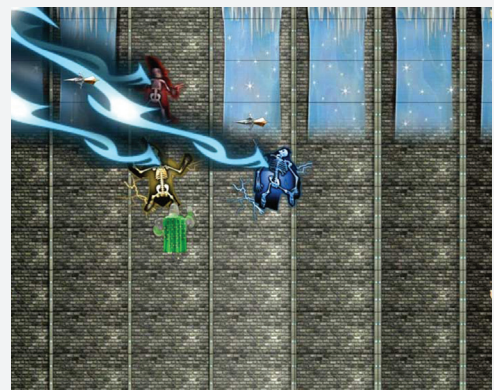
"As the digital entertainment industry continues to grow, employers are focusing more on students who understand both sides of the industry, whether it is a computer science students with additional fine arts skills or fine arts students with computing skills."

- Bob Kessler, Professor



entertainment arts & engineering

XBOX LIVE
community games



OUTREACH @ THE SCHOOL OF COMPUTING

- GREAT SUMMER CAMP
- EAE SUMMER PROGRAM



G/R/E/A/T

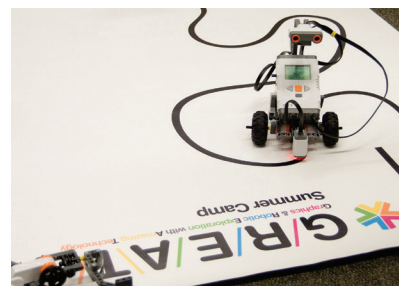
Graphics & Robotic Exploration with Amazing Technology

SUMMER CAMP

The School of Computing has continued and expanded its successful summer technology camp program. This last year, the camps expanded into different tracks for elementary, middle school, and high school students. These camps are designed to introduce students to exciting tools in computer graphics, robotics, and applications in computer programming.

David Johnson, who directed the camp, said, "We were delighted to have almost 200 children attend the camps this year. The fun and intensive curriculum really pays off with students making games and animations in just a short period of time." Erin Parker was also instrumental in teaching and guiding the camps as were six very capable student teachers.

Contributions from Novell, Microsoft and NDEP/Hill AFB were instrumental in funding the program and making it both affordable and of high quality.



EAE

SUMMER PROGRAM

The School of Computing debuted the new Entertainment Arts and Engineering Summer Program Summer (EAESP) in June 2008. The two-week long camp was created for high school students and designed to introduce the students to the concepts of 3D modeling, texturing, rigging, animation, and rendering, using some of the most advanced software in the industry such as Autodesk Maya and Adobe Photoshop.

The curriculum was based on a final project where the students chose a character and then produced them in MAYA. During the two weeks the students worked on abstract designs for their characters by producing clay sculptures, drawings, and verbal descriptions as preliminary steps to creating a 3D version in MAYA. The students learned engineering principles and art concepts and applied both to the production of their character. The camp also involved visits to research laboratories in the School and fieldtrips to local game and modeling studios.

The camp was taught by Mark van Langeveld, a clinical assistant professor in the School of Computing. Mark pioneered this same summer program at the University of Pennsylvania in 2004 and has been offering it every year since then.



Samples of student work

RESEARCH AWARDS

RESEARCH EXPENDITURES

2009 - \$11.8M

2010 - \$17.1M

Disclaimer:

The following information provided only includes the PI's and Co-PI's within the School of Computing. Many of the grants reported are multi-University/lab grants, the amounts shown are the research dollars that have come to Utah.

Rajeev Balasubramonian

"CAREER: Exploring Heterogeneity Within Chip Multiprocessors"(PI), NSF CAREER Award, \$300,000 (5/ 2006 – 4/ 2011)

"Reconfiguration within Large Cache Hierarchies" (PI), Intel Corporation, \$50,000 per year (renewable up to three years), (10/2007 – 9/ 2010)

"CPA-CSA: Algorithms and Implementations for Scalable Transactional Memory" (PI), NSF, \$275,000 (7/ 2008 – 6/ 2011)

"Formal Specification, Verification, and Test Generation for Multi-core CPUs" (co-PI), SRC-GRC, \$187,291 (10/ 2008 – 9/ 2011)

"SHF: Small: Hardware/Software Management of Large Multi-Core Memory Hierarchies" (PI), Mary Hall NSF, \$372,000 (9/ 2009 – 8/ 2012)

"Meeting Datacenter Demands with Novel DRAM Architectures" (PI), HP Labs Innovation Research Program award, \$75,000 per year, (8/ 2010)

Adam Bargteil

"EAGER (G&V): Exploring Morse Theoretic Tools for Automatic Mesh Generation and Simulation on Surfaces" (co-PI), NSF, \$100,000 (9/1/2010)

"II-NEW: The Utah Acquisition and Rapid Prototyping Laboratory" (PI), NSF, \$391,200 (8/1/2009)

Martin Berzins

Peta-apps (PI), NSF, \$999,280 (2009-2013)

SDCI-HPC (PI), NSF, \$703,916 (2007-2010)

"Center for Simulation of Fires and Explosions" (co-PI), DOE-LLNL, \$2,982,650 (2002-2010)

Richard Brown

"An Engineering Research Center in Wireless Integrated Microsystems" (sub-contract with University of Michigan) NSF, \$90,300 (9/08-8/10)

"Student Travel Assistance for the Symposium of 35 Years of Chemical Sensors in 215th ECS" NSF, \$6,000 (5/09-8/09)

"Detection and Mitigation of Hazardous Releases in Infrastructure" (sub-contract with University of Michigan), NSF, \$70,114 (8/09-7/12)

"Glucose Management Food Tray," Joel Ehrenkranz, MD, \$10,000 (5/10-12/10)

Erik Brunvand

"Hardware Support for Real Time Ray Tracing" (PI), NSF, \$499,382 (2006-2010)

"Hardware Support for Real Time Ray Tracing REU" (PI) \$6,000 (2006-2010)

"Flexible Architectures for Future Graphics Processing Systems" (PI), NSF \$499,709 (2010-2013)

"Embedded Systems and Kinetic Art" (PI) University Teaching Committee, \$4,300, 2009

Elaine Cohen

"Curvature Reparameterization" (PI), MIT, \$40,040 (2008-2009)

REU Supplement (PI), NSF, \$6,000 (2006-2010)

"Solving of Symbolic Problems" (PI), NSF, \$375,000 (2006-2010)

Al Davis

"Biologically Motivated Scaling"(PI), NSF \$160K (2006-2010)

"Flexible Architectures for Future Graphics Processing Systems" (co-PI), \$499,709, (7/2010-6/2013)

Matthew Flatt

Extensible Gradual Type System (PI), NSF, \$419,565 (2009-2012)

Thomas Fletcher

Language Development in Autism (PI), UU Research Foundation, \$22,400 (2009-2010)

"ITK Algorithms for Analyzing Time-Varying Shape with Application to Longitudinal Heart Modeling" (PI), NIH/NLM, \$148,157 (6/2010-5/2011)

"ADNI Atlases" (co-PI), NIH, \$327,263 (7/2008-3/2012)

Juliana Freire

"Supplement for CAREER: Storing, Querying and Re-Using Provenance of Computational Tasks" (PI), NSF, 60,000 (2010-2013)

III:EAGER:Collaborative Research: A Community Experiment Platform for Reproducibility and Generalizability" (PI), NSF, 190,000 (2010-2012)

"SBIR Phase I and Phase II: Provenance-Enabling DOE Visualization Applications" co-PI) DOE, \$850,000 (2008-2011)

"Supporting Pipelines of Retrieval, Analysis and Visualization of Web Data" (PI), SNL-DOE, \$103,430 (2009-2010)

"Provenance Analytics Tools to Improve the Measurement of Usability and Insight in Visualization Applications" (co-PI), SNL-DOE, \$100,000 (2009-2010)

“NCRR ARRA Administrative Supplement – Translational” (co-PI), NIH, \$998,137 (2009-2011)

“III: Medium: Provenance Analytics: Exploring Computational Tasks and their History” (PI), NSF, \$957,467 (2009–2012)

“Where the Ocean Meets the Cloud: Ad Hoc Longitudinal Analysis and Collaboration Over Massive Mesh Data” (co-PI), NSF, \$190,001 (2009–2011)

“Center for Management of Provenance and Exploratory Workflows” (co-PI), State of Utah, Centers of Excellence, \$200,000 (2008–2010)

“CAREER: Storing, Querying and Re-Using Provenance of Computational Tasks” (PI), NSF, \$499,999 (2008–2013)

“CRI: IAD: A Service-Oriented Architecture for The Computation, Visualization, and Management of Scientific Data” (co-PI), NSF, \$500,000 (2007–2010)

“III-COR: Discovering and Organizing Hidden-Web Sources” (PI), NSF, \$27,212; REU Supplement \$15,000. (2007–2011)

“SBIR Phase I and II: Provenance-Enabling DOE Visualization Applications” (co-PI), DOE, \$850,000 (2008–2011)

“Science and Technology Center for Coastal Margin Observation and Prediction” (co-PI for Utah subcontract), NSF, \$478,563 – Utah portion (2006–11)

“CT-T: A Laboratory Workbench for Security Research” (PI), NSF, \$1,466,000. (2005–2010)

Guido Gerig

“A Longitudinal MRI Study of Infants at Risk for Autism” (PI), UNC, \$147,723 (06/01/07-05/30/12)

“Characterization of Normal Brain Development Using Parallel MRI” (co-PI), NIH NIBIB, \$74,714 (07/01/07-06/30/12)

“Prospective Studies of the Pathogenesis of Schizophrenia, Silvio O. Conte Center for the Neuroscience of Mental Disorders” (PI Imaging Core), NIH NIMH, \$82,359 (08/01/07-07/31/12)

“Neurobiological and Behavioral Consequences of Cocaine Use in Mother-Infant Dyads” (PI Imaging Core), NIH NIDA, \$117,625 (06/01/08-05/31/13)

“NA-MIC: National Alliance for Medical Image Computing” (co-PI), NIH NIBI, \$196,530 (09/30/2010 – 08/31/2014)

“Prospective studies of Early Brain Development in Twins, Role” (PI UofU), NIH, \$57,938 (05/01/10 – 11/30/14)

“Score: Systematic Comparison through Objective Rating and Evaluation” (PI), NIH NLM, \$150K (06/25/2010 – 08/31/2011)

“Development of a web-based Infrastructure for Comparison and Validation of Image Computing methods (COVALIC)” (PI), NIH, \$100K (07/01/10 – 06/30/11)

Ganesh Gopalakrishnan

“CPS: Medium: Safety-Oriented Hybrid Verification for Medical Robotics” (co-PI), CNS, \$500,000 (2010-2012)

“Collaborative Research: MCDA: Formal Analysis of Multicore Communication APIs and Applications” (PI), NSF, \$188,299 (2009 – 2012)

“Formal Analysis of Multicore Communication APIs and Applications” (PI), SRC, \$45,000 (2009-2012)

“Formal specification, verification, and test generation of Multi-core CPUs” (PI), SRC, \$180,000 (2008-2011)

REU Supplements, NSF, \$32K (2010-2011)

8-core server (equipment grant) (PI), SUN

Mary Hall

“A Dynamic Data-Driven Application System for Signal and Image Processing” (co-PI), NSF-DDDAS, \$356K (12/ 2005-11/ 2009)

“Intelligent Optimization of Parallel and Distributed Applications” (PI), NSF-CSR, \$885K (8/2006-1/ 2010)

“Petascale Hierarchical Simulations of Biopolymer Translocation through Silicon Nitride and Silica Nanopores and Nanofluidic Channels” (co-PI), NSF, \$160K (9/2007-9/2012)

“SHF:SMALL: Hardware/Software Management of Large Multi-Core Memory Hierarchies” (co-PI), NSF, \$350K (9/2009-8/2012)

“Compiler-Based Autotuning” (PI), DOE, \$510K to Utah (2/1/2010 -1/31/2012)

“Performance Engineering Research Institute” (Utah PI), DOE, \$290K to Utah (12/15/2008-01/31/2012)

“SHF Small: A Compiler-Based Auto-Tuning Framework for Many-Core Code Generation” (PI) \$481K (7/1/2010-6/30/2013)

“Performance Engineering Research Institute SciDAC-e Augmentation: Performance Enhancement of Simulating the Dynamics of Photoexcitation for Solar Energy Conversion” (co-PI), DOE, \$150K to Utah (9/1/2010 - 12/15/2011)

“Echelon: Extreme scale Compute Hierarchies with Efficient Locality Optimized Nodes,” Mary Hall (Utah PI), Nvidia Corporation (Lead) DARPA, (\$1.256M to Utah) (8/15/10- 05/31/14)

“CRI: CRD: Raising the Standard of Scientific Publishing Through an Experiment Archive”, PI, co-PI Eric Eide, original PI Jay Lepreau, \$40K (10/01/07-09/30/10)

Chuck Hansen

“Enabling Transformational Science and Engineering Through Integrated Collaborative Visualization and Data Analysis for the National User Community” (co-PI), NSF, \$848K (8/2009-8/2012)

"Image Processing of Large Data Sets" (co-PI), Exxon Mobil, \$1,895,855 (12/2004-12/2011)

"Institute for Applied Mathematics and Computational Science" (co-PI), KAUST (subcontract from TAMU), \$1.67M (6/2008-6/2013)

"CRI: A Hierarchical Data Storage System for Large Data Simulation, Comparison" (co-PI), NSF, \$430K (3/2006-2/2010)

"Center for Simulation of Fires and Explosions" (Senior Investigator) DOE LLNL, \$2,982,650 (10/2002-9/2010)

"Advanced Volume Visualization" (PI), NSF, \$250K (2/2006-1/2010)

"An Advanced Interactive Multifield, Multisource Atmospheric Visual Analysis Environment" (PI), NSF, \$178K (7/2005-6/2009)

"Visualization Research for Multicore Processors" (co-PI), Sandia, \$250K (6/2009-6/2010)

Tom Henderson

"Innate Theories in Cognitive Robotics" NSF, \$36,000 (2010-2011)

"IPA Agreement," NSF, \$203,000 (2010-1011)

John Hollerbach

"CPS: Medium: Safety-Oriented Hybrid Verification for Medical Robotics" (co-PI), NSF, \$500K (1/2010-9/2013)

"Evaluation of a Robotics Virtual Reality Treadmill for Advanced Spinal Cord Injury Gait Rehabilitation" (PI), UofU Seed Grant, \$25K (1/2010-12/2011)

"IGERT: Interdisciplinary Research Training in Biocentric Robotics" (PI), NSF, \$2,399,331 (7/2007-6/2010)

"ITR-(ASE+NHS+ECS)-(int+dmc+sim): Generation of Complex Environmental Flow Patterns for Virtual Environments" (PI), NSF, \$1,119,215 (10/2004-9/2010)

"Measuring Finger Forces by Imaging the Fingernail" (PI), NIH, \$392,677 (7/2006-6/2010)

Chris Johnson

"Center for Integrated Biomedical Computing" (PI), NIH/NCRR, \$11,205,029 (09/29/05-07/31/15)

"Visualization and Analytics Center for Enabling Technologies" (PI), DOE, \$2,628,230 (09/15/06-09/14/11)

"CRI: A Hierarchical Data Storage System for Large Data Simulation, Comparison, and Visualization" (co-PI), NSF, \$506,243 (03/16/06-02/28/11)

"Institute for Mathematics and Computational Science" (Visualization Subcontract) (PI), KAUST, \$1,675,830 (06/01/08-05/31/12)

"Open Wildland Fire Modeling" (PI), NSF CDI, \$641,588 (11/01/08-10/31/12)

"End to End High Performance Visualization and Data Analysis" (PI), DOE, \$7,500,000 (03/08/10 - 02/28/13)

Sneha Kasera

"CPS: Medium: Collaborative Research: Enabling and Advancing Human and Probabilistic Awareness for Smart Facilities and Elder Care" (co-PI), NSF, \$749,998 (9/15/2010-9/14/2013)

"An Infrastructure for Robust Authentication Systems Research" (PI), DURIP, \$150K (9/2010-9/2011)

"Development of Self-Adapting Resource Management and DDoS Prevention Techniques for Computing Clouds" (PI), NTT/Verio Inc., \$32,603 (7/15/2009-12/31/2010)

"II-NEW: An Infrastructure for Researching Wireless Link Signatures" (PI), NSF, \$224,326 (8/1/2009-7/31/2012)

"CT-ISG: Opportunistic Secret Key Exchange Using Wireless Link Characteristics and Device Mobility" (PI), NSF, \$349,995 (9/1/2008-8/31/2011)

"Next Generation Communication Networks Using Multi-carrier Filter Bank" (co-PI), NSF, \$299,991 (5/15/2008-5/14/2011)

"ARSENAL: A Cross Layer Architecture for Secure Resilient Tactical Mobile Networks" (PI), ONR/ARO, \$400K (6/17/2007-8/31/2011)

"Utah's Engineers: A Statewide Initiative for Growth" (Computer Science Lead), NSF, \$1,998,013 (9/1/2007-8/31/2011)

"NeTS- ProWin: Software Radio Testbeds: One Large, Many Small" (PI - original PI - Jay Lepreau), NSF, \$1M (9/1/2005-8/31/2011)

"NeTS-ProWin: An Open, Low Cost, High Quality Software Radio Platform and Testbed" (PI - original PI - Jay Lepreau), NSF, \$1,999,998 (9/1/2004-8/31/2010)

"Robust Location Distinction Using Temporal Link Signatures" (co-PI), University of Utah, \$70K (8/1/2007-7/31/2009)

Mike Kirby

"High-Finite Order Element" (PI), ARO, \$154,284 (9/2008-9/2011)

"Vascular Assess" (co-PI), NIH, \$27,241 (9/2008-8/2009)

"SIAC Methods" (PI), Air Force Office, \$151,662 (3/2008-2/2010)

"Message Passing Software" (co-PI), NSF, \$199,998 (7/2005-6/2010)

"Computational Inverse Problems" (PI), NSF, \$406,262 (1/2004-12/2009)

REU Supplement (PI), NSF, \$24K (10/2003-12/2009)

Matthew Might

"Safety-Oriented Hybrid Verification for Medical Robotics" (PI), NSF, \$500K (10/2010-10/2013)

"Gnosys: Raising the level of discourse in systems programming" (Utah:PI), DARPA, \$1.4 million (10/2010-10/2014)

Valerio Pascucci

"ARRA: Enabling Transform Science" (PI), UT Austin, \$278,481 (8/2009-7/2012)

"Visualization of Noisy Data" (PI), UC Davis, \$112,793 (3/2010-9/2011)

LLNL Support (PI), DOE, \$269,636 (4/2009-9/2011)

"Topology for Statistical Model" (PI), DOE, \$260K (9/2009-9/2011)

SCI-DAC VIS (PI), DOE, \$657,634 (9/2006-3/2011)

Sandia VTK (PI), DOE-SNL, \$126,750 (11/2009-9-2010)

"Time Varying Graphs" (PI), DOE-SNL, \$120,718 (12/2009-9/2010)

Sandia: 3 month project (PI), DOE-SNL, \$75,624 (6/2010-12/1210)

"Scalable Algorithms" (PI), NSF, \$795,520 (3/2010-2/2015)

"EAGER" (PI), NSF, \$100K (9/2010-8/2011)

"Image Process of Large Data Sets" (co-PI), Exxon Mobil, \$1,895,855 (12/2004-12/2011)

"End to End High Performance" (co-PI), DOE-LLNL, \$2,485,111 (3/2010-2/2013)

UV-CDAT (co-PI), DOE, \$800K (9/2010-8/2012)

John Regehr

"Containers for Advanced Adaptive Applications" (PI), DARPA, \$1.4M (9/2010-8/2014)

"A Cross-Layer Approach for Improving Embedded Software Reliability" (PI), DARPA, \$474,340 (5/2009-4/2011)

"MRI: Evolutionary Development of an Advanced Distributed Testbed" (PI), NSF, \$1,704,000 (9/01/07 – 08/31/11)

DARPA Computer Science Study Group program (PI), \$95,989 (3/2009-3/2009)

"Improving Sensor Network Software Reliability through Language, Tool, and OS Co-Design" (Utah PI), NSF, \$210K (9/2006-8/2009)

Robert Ricci

"End-To-End ProtoGENI" (PI), GENI Project Office, \$759,662, (11/01/08 - 11/01/11)

"Experiment Workflow Tools and Services for GENI" (PI), GENI Project Office, \$592,994, (10/01/09 - 09/30/12)

"Integrating New Projects into the ProtoGENI Control Framework" (PI), GENI Project Office, \$448,665, (10/01/09 - 09/30/12)

"MRI: Evolutionary Development of an Advanced Distributed Testbed" (co-PI), NSF, \$1,704,000 (9/01/07 – 08/31/11)

"NeTS-ProWin: Software Radio Testbeds: One Large, Many Small", (co-PI), NSF, \$1,000,000, (09/01/05 - 08/31/11)

"NeTS-ProWin: An Open, Low Cost, High Quality Software Radio Platform and Testbed", (co-PI), \$1,199,998, (09/01/04 - 08/31/10)

Rich Riesenfeld

"Legacy Engineering Modeling" (PI), Hampton University, \$75K (5/2008-7/2009) Ellen Riloff

"RI:Small:Acquiring Domain Knowledge from Text through Cooperative Bootstrapping" (PI), NSF, \$383,845 (7/1/10-6/30/13)

"RACR: Reader and Contextual Reasoner", Key Personnel, subcontract to IBM, DARPA, \$769,550 (8/1/09-5/30/14)

"Text Mining Infrastructure for the Entire Biological Literature" Key Personnel, subcontract to USC/ISI, NSF, \$119,917 (10/1/09-9/30/2012)

"POET: Consolidated, Comprehensive Clinical Text Preprocessing", Key Personnel, NIH, \$335,903 (9/15/08-8/31/10)

"Information Extraction of Events and Beliefs from Text" (co-PI), Department of Homeland Security, \$498,200 (10/16/06-5/31/10)

"Coreference Resolution Research" (PI), LLNL, \$109,992 (10/1/07-10/31/09)

Claudio Silva

"STC For Coastal Margin" (PI), OHSU, \$329,176 (7/2006-6-2011)

SCI-DAC Enabling Technologies (PI), NSF, \$910K (8/2006-11/2011)

"Integrating Visit and VisTrails" (PI), DOR-ONL, \$53,209 (12/2008-12/2009)

"Multi-Threaded Data Driven" (PI), DOE-SNL, \$158,688 (5/2009-9/2010)

"Provenance Analytics Tools" (PI), DOE-SNL, \$157,317 (1/2009-9/2010)

UV-CDAT (PI), DOE, \$800K (9/2010-8/2013)

"Feature Preserving Reconstruction" (PI), NSF, \$275,599 (8/2005-7/2009)

"Complex Visualizations" (PI), NSF, \$259,127 (5/2005-6/2009)

CRI:IAD (PI), NSF, \$500K (6/2008-5/2011)

"Massive Mesh Data" (PI), NSF, \$190K (2/2009-1/2012)

REU Supplement (PI), NSF, \$16K (6/2008-5/2011)

"Image Processing of Large Data Sets" (co-PI), Exxon Mobil, \$1,895,855 (12/2004-12/2011)

SCI-DAC Visualization (co-PI), DOE, \$2,102,584 (9/2006-3/2011)

"DCI II – Fire Modeling E-Communication" (co-PI), NSF, \$641,588 (11/2008-10/2012)

"End to End High Performance" (co-PI), DOE-LLNL, \$2,485,111 (3/2010-2/2013)

"III: Medium: Provenance Analytics: Exploring Computational Tasks and their History" (co-PI), NSF, \$957,467 (2009-2012)

William Thompson

"A New Method for Evaluating Perceptual Fidelity" (PI), NSF, \$498,893 (08/01/2009-07/31/2012)

"Designing Visually Accessible Spaces" (PI-Utah portion), NIH, \$1,192,000 (03/01/2007-02/28/2012)

"Increasing Student Motivation Without Compromising Student Performance on Online Classes" (co-PI), NSF, \$499,370 (09/15/2008-08/31/2011)

"Improving Spatial Perception in Virtual Environments" (PI), NSF, \$99,970 (09/01/2007-02/28/2010)

Suresh Venkatasubramanian

"Spatial Algorithms" (PI), CRA, \$267K (9/2009-8/2011)

"Scalable Shape Analysis" (PI), NSF, \$49,868 (1/2009-8/2010)

"Scalable, Accurate and Efficient Data Analysis for Medical Imaging" (PI), University of Utah Research Foundation, \$34,952 (1/2009-6/2010)

"CAREER: Geometric Algorithms For Data Analysis In Spaces Of Distributions" (PI), NSF, \$489K (2/2010-1/2015)

"CPS: Medium: Collaborative Research: Enabling and Advancing Human and Probabilistic Context Awareness for Smart Facilities and Elder Care" (co-PI), NSF, 249,000, (9/2010-8-2013)

Ross Whitaker

"Image Processing of Large Data Sets" (PI), Exxon Mobil, \$1,895,855 (12/2004-12/2011)

"Iterative Regulated CT" (PI), GE, \$94,441 (3/2009-2/2010)

"Noise and Dose Reduction" (PI), GE, \$211,379 (8/2010-7/2011)

"NAMIC" (PI), Brigham and Womens Hospital, \$1,228,997 (9/2004-8/2014)

MSPA-MCS (PI), NSF, \$474K (1/2008-12/2011)

"Bioelectric Field Modeling" (co-PI), NIH, \$1,158,691 (8/2010-7/2015)

CRCNS (co-PI), NIH, \$1,148,296 (8/2005-5/2010)

"Center for Integrated Biomedical Computing" (co-PI), NIH/NCRR, \$11,205,029 (09/29/05-07/31/15)





**FACULTY @ THE
SCHOOL OF COMPUTING**



Rajeev Balasubramanian

Associate Professor

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Professor Balasubramanian's research focuses on many aspects of computer architecture. He is particularly interested in studying how future technology trends influence the design of high-performance microprocessors. In recent years, much of his research group's focus has been on the design of efficient memory hierarchies. His students have examined data placement in large caches (two papers each at HPCA'10 and HPCA'09) and novel organizations for DRAM main memory (papers at ISCA'10, ASPLOS'10, PACT'10). In the past five years, Prof. Balasubramanian has also worked on the design of efficient on-chip networks (papers at HPCA'10, HPCA'09, MICRO'07, ISCA'07, ISCA'06, HPCA'05).

Publications

Refereed Journals

D. Nellans, R. Balasubramanian, and E. Brunvand, "OS Execution on Multi-Cores: Is Out-Sourcing Worthwhile?", Position paper in ACM Operating System Review, Special Issue on Interaction among OS, Compilers, and Multicore Processors , Vol. 43 (2) pp. 104-105. April 2009.

Refereed Conference and Workshops

N. Chatterjee, S. H. Pugsley, J. Spjut, R. Balasubramanian, "Optimizing a Multi-Core Processor for Message-Passing Workloads", 5th Workshop on Unique Chips and Systems (UCAS-5), held in conjunction with ISPASS, Boston, April 2009.

N. Madan, L. Zhao (Intel), N. Muralimanohar, A. Udipi, R. Balasubramanian, Ravishankar Iyer (Intel), Srihari Makineni (Intel), Donald Newell (Intel), "Optimizing Communication and Capacity in a 3D Stacked Reconfigurable Cache Hierarchy", 15th International Symposium on High-Performance Computer Architecture (HPCA-15), pp. 262-274, Raleigh, February 2009.

M. Awasthi, K. Sudan, R. Balasubramanian, J. Carter, "Dynamic Hardware-Assisted Software-Controlled Page Placement to Manage Capacity Allocation and Sharing within Large Caches", 15th International Symposium on High-Performance Computer Architecture (HPCA-15), pp. 250-261. Raleigh, February 2009.

A. Udipi, N. Muralimanohar, R. Balasubramanian, "Non-Uniform Power Access in Large Caches with Low-Swing Wires", 16th International Conference on High Performance Computing (HiPC) , Kochi, pp. 59-63. December 2009 (Best paper award).

M. Awasthi, D. Nellans, K. Sudan, R. Balasubramanian, A. Davis, "Handling the Problems and Opportunities Posed by Multiple On-Chip Memory Controllers", 19th International Conference on Parallel Architectures and Compilation Techniques (PACT-19) , Vienna, September 2010. ISBN: 978-1-4503-0178-7

S. H. Pugsley, J. Spjut, D. Nellans, R. Balasubramanian, "SWEL: Hardware Cache

Coherence Protocols to Map Shared Data onto Shared Cache", 19th International Conference on Parallel Architectures and Compilation Techniques (PACT-19), Vienna, September 2010. ISBN: 978-1-4503-0178-7

A. Udipi, N. Muralimanohar, N. Chatterjee, R. Balasubramanian, A. Davis, N. Jouppi, "Rethinking DRAM Design and Organization for Energy-Constrained Multi-Cores", 37th International Symposium on Computer Architecture (ISCA-37) , St. Malo, France, June 2010. ISBN: 978-1-4503-0053-7

K. Sudan, N. Chatterjee, D. Nellans, M. Awasthi, R. Balasubramanian, A. Davis, "Micro-Pages: Increasing DRAM Efficiency with Locality-Aware Data Placement", 15th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS-XV) , Pittsburgh, pp. 419-431. March 2010.

A. Udipi, N. Muralimanohar, R. Balasubramanian, "Towards Scalable, Energy-Efficient, Bus-Based On-Chip Networks", 16th International Symposium on High-Performance Computer Architecture (HPCA-16) , Bangalore, pp. 1-12. January 2010.

X. Jiang, N. Madan, L. Zhao, M. Upton, R. Iyer, S. Makineni, D. Newell, Y. Solihin, R. Balasubramanian, "CHOP: Adaptive Filter-Based DRAM Caching for CMP Server Platforms", 16th International Symposium on High-Performance Computer Architecture (HPCA-16), pp. 1-12. Bangalore, January 2010.

Invited Talks & Presentations

Invited talk, Harvard University, February 2010

Professional Participation

- Program Chair, ISPASS 2011
- Workshop Co-Chair, CMP-MSI 2009, CMP-MSI 2010
- Registration Chair, ISPASS 2009, HPCA 2010
- Program Committee member: IEEE Micro Top Picks 2010, NOCS 2011, HPCA 2011, IISWC 2010, HiPC 2010, NOCS 2010, HiPC 2009, NOCS 2009, DOE panel

Honors & Awards

- Best Paper Award at PACT-19 , paper on Multiple On-Chip Memory Controllers
- Best Paper Award at HiPC-16 , paper on Non-Uniform Power Access in Large Caches
- HPCA'10 paper by Jiang et al. selected as one of the eleven best architecture papers of 2010 by IEEE Micro magazine's annual Top Picks issue



Adam Bargteil
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Adam W. Bargteil is an assistant professor at the University of Utah. He earned his Ph.D. in computer science from the University of California, Berkeley and spent two years as a post-doctoral fellow in the School of Computer Science at Carnegie Mellon University. He received dual BS degrees in computer science and mathematics (magna cum laude) from the University of Maryland in 2000. Adam was a U.C. Microelectronics Fellow in 2000 and a Siebel Scholar in 2006. From 2005 to 2007, he was a consultant at PDI/DreamWorks, developing fluid simulation tools that were used in "Shrek the Third" and "Bee Movie."

Professor Bargteil's research interests are in computer graphics and animation, especially physics-based animation. In essence, this subfield develops mathematical models of the real world and uses numerical methods to compute motion. For computer graphics applications, physical fidelity and standard notions of accuracy are less important than visual fidelity and plausibility. These unique requirements for computer graphics allow the use of new approximations to the real world, but also present challenges, such as temporally coherent tracking of liquid surfaces. With collaborators, Prof. Bargteil has explored techniques for animating liquids, deformable solids, and materials that demonstrate behavior of both fluids and solids, such as clay, slime, and goop. The interdisciplinary nature of his work leads to overlaps with scientific computing, numerical methods, computational physics, and computational geometry.

Publications

Refereed Conference and Workshops

D. Gerszewski, H. Bhattacharya, and A. W. Bargteil. "A Point-based Method for Animating Elastoplastic Solids," In the proceedings of ACM SIGGRAPH/Eurographics Symposium on Computer Animation. New Orleans, Louisiana, August 2009. pp. 133-138.

F. Sin, A. W. Bargteil, and J. K. Hodgins. "A Point-based Methods for Animating Incompressible Flow," In the proceedings of ACM SIGGRAPH/Eurographics Symposium on Computer Animation. New Orleans, Louisiana, August 2009. pp. 247-255.

Invited Talks & Presentations

DreamWorks Animation SKG. Animation with a Point: New Approaches to Point-based Animation, May 2010

University of California at Berkeley. Animation with a Point: New Approaches to Point-based Animation, May 2010

Pixar Animation Studios. Animation with a Point: New Approaches to Point-based Animation, May 2010

Columbia University. Animation with a Point: New Approaches to Point-based Animation, May 2010

Bellairs Workshop on Computer Animation: Reduced Physics, Simulation, and Control. Bezier Tetrahedra for Computer Animation, February 2010

Technical University of Denmark. Animation with a Point: New Approaches to Point-based Animation, December 2010

Professional Participation

- Associate Editor, Graphics Models, Spring 2010 - present
- Program Committee Member, SIGGRAPH Asia 2010
- Posters Chair, ACM/Eurographics Symposium on Computer Animation 2010
- Program Committee Member, ACM/Eurographics Symposium on Computer Animation 2010
- Program Committee Member, Pacific Graphics 2010
- General Jury Member, SIGGRAPH 2010
- NSF Panelist, 2010
- Program Committee Member, SIGGRAPH 2009
- Program Committee Member, ACM/Eurographics Symposium on Computer Animation 2009
- Program Committee Member, Pacific Graphics 2009



Martin Berzins

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Martin Berzins received his Ph.D. from the University of Leeds in 1981. Martin's research area is the study of serial and parallel novel computational algorithms for the numerical solution of partial differential equations (p.d.e.s). is a part of the discipline of Scientific Computing. The physical problems that are modeled by p.d.e.s are of great importance to a wide range of both industrial and academic research groups. Examples range from being able to design better harbors to understanding environmental pollution, modeling the behavior of lubricants in a car engine or modeling fires and explosions.

The approach taken in this research has been to derive numerical methods with adaptive error control and develop software on both serial and parallel computers for a broad, mathematically-defined problem class. This has made it possible for users from different physical applications areas to solve their problems by creating a mathematical model which fits inside the general problem class.

A focus of recent research has been to develop parallel asynchronous adaptive approaches inside the Uintah software.

Martin's current research areas are:

- Parallel adaptive mesh algorithms for tera-scale and peta-scale computers
- Adjoint based error estimation and error control algorithms
- Positivity preserving high-order methods
- Analysis of methods used in modeling fires and explosions
- Asynchronous adaptive parallel software

Publications

Refereed Journals

L.T. Tran, J. Kim, M. Berzins. "Solving Time-Dependent PDEs using the Material Point Method, A Case Study from Gas Dynamics," In *International Journal for Numerical Methods in Fluids*, Vol. 62, No. 7, pp. 709--732. 2009.

J. Schmidt, M. Berzins. "Development of the Uintah Gateway for Fluid-Structure-Interaction Problems," In *Proceedings of the Teragrid 2010 Conference*, No. 17, pp. (ACM, published online). 2010.

M. Steffen, R.M. Kirby, M. Berzins. "Decoupling and Balancing of Space and Time Errors in the Material Point Method (MPM)," In *International Journal for Numerical Methods in Engineering*, Vol. 82, No. 10, pp. 1207--1243. 2010.

D.E. Hart, M. Berzins, C.E. Goodyer, P.K. Jimack. "Using Adjoint Error Estimation Techniques for Elastohydrodynamic Lubrication Line Contact Problems," In *International Journal for Numerical Methods in Fluids*, Vol. 00, pp. 1-26. 2010.

M. Berzins. "Nonlinear Data-Bounded Polynomial Approximations and their Applications in ENO Methods," In *Numerical Algorithms*, Vol. 55, No. 2, pp. 171. 2010.

Refereed Conference and Workshops

J. Luitjens, M. Berzins. "Improving the Performance of Uintah: A Large-Scale Adaptive Meshing Computational Framework," In *Proceedings of the 24th IEEE International Parallel and Distributed Processing Symposium (IPDPS10)*, Atlanta, GA, pp. 2010.

M. Berzins, J. Luitjens, Q. Meng, T. Harman, C.A. Wight, J.R. Peterson. "Uintah - A Scalable Framework for Hazard Analysis," In *Proceedings of the Teragrid 2010 Conference*, No. 3, Awarded Best Paper in the Science Track!, (ACM, published online). 2010.

Q. Meng, J. Luitjens, M. Berzins. "Dynamic Task Scheduling for the Uintah Framework," In *Proceedings of the 3rd IEEE Workshop on Many-Task Computing on Grids and Supercomputers (MTAGS10)*, 2010, co-located with IEEE/ACM Supercomputing 2010. ISBN: 978-1-60558-818-6

Invited Talks & Presentations

2009

- Fields Institute Workshop on Hyperbolic Equations, Waterloo Canada, Invited Talk, April
- US Computational Mechanics Congress Ohio, invited Mini symposium talk, July
- IMACS World Congress Invited talk August
- DWCA09 Italy Contributed talk, September
- Supercomputing 09 Invited talk at TACC booth, November
- Visiting Professor Seminar, University of Leeds, December
- Seminar at CWI, Amsterdam, December

2010

- SIAM Parallel Processing for Scientific Computing Conference Seattle, Organizing Committee and Minisymposium organizer
- NAG Technical Policy Meeting Oxford, UK, June Invited Talk
- WCCM Invited Mini Symposium talk Sidney Australia, July
- TG10 Conference. Best Science Track paper for contributed paper and talk
- CnC Workshop Houston October paper presented
- MASCOT10 Workshop Las Palmas invited paper presented
- SC10 Conference. Invited talk at BOF session on multidisciplinary Science, talk at NICS Booth

Professional Participation

- Institute on Mathematics and its Application Fellow (UK)
- Visiting Professor University of Leeds, UK
- Member of NAG (software non-profit) member of NAG Inc Board of Directors
- NSF Reviewer on seven panels (2009-2010) for NSF Office of CyberInfrastructure NSF Review on Teragrid Allocations Committee (Six panels)



Richard Brown
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Richard B. Brown received B.S. and M.S. degrees in electrical engineering (computer emphasis) from Brigham Young University in 1976, and then worked in industry for five years before returning to school at the University of Utah, where he earned his Ph.D. in Electrical Engineering in 1981. He joined the Electrical & Computer Engineering (EECS) faculty at the University of Michigan, where he served as associate chair for EE and as interim chair of EECS. In July 2004, Professor Brown was appointed the 11th Dean of the College of Engineering at the University of Utah. He is Professor in the departments of Electrical & Computer Engineering and School of Computing and Adjunct Professor in Bioengineering. He also has an appointment at the University of Michigan as Adjunct Professor in Electrical Engineering & Computer Science.

Prof. Brown conducts research in two general areas, solid-state sensors and integrated circuits. Related sub-areas are Chemical Sensors; Neural Interfaces; Electronic Circuit Clocking; Circuit Design; High Performance Microprocessors; Mixed Signal Microprocessors. In the sensor work, he has enjoyed fruitful collaborative relationships with researchers in chemistry and medicine. He has been active in technology transfer and is a founder of Sensicore, i-sens, and Mobius Microsystems.

Publications

(* indicates that the person was his postdoctoral student when the published work was done.)

Full Articles in Refereed Journals

S. S. Kellis, P. A. House, K. E. Thomson, R. B. Brown, B. E. Greger, "Human Neocortical Electrical Activity Recorded on Nonpenetrating Microwire Arrays: Applicability for Neuro Prosthesis," *Neurosurgical Focus*, vol. 27, no. 1, E9, July 2009. (DOI: 10.3171/2009)

M. S. McCorquodale, G. A. Carichner, J. D. O'Day, S. M. Pernia, S. Kubba, E. D. Marsman, J. J. Kuhn, R. B. Brown, "A 25-MHz Self-Referenced Solid-State Frequency Source Suitable for XO-Replacement," *IEEE Transactions on Circuits and System*, vol. 56, issue 5, pp. 943-956, May 2009.

S. M. Martin, F. H. Gebara, T. D. Strong, R. B. Brown, "A Fully Differential Potentiostat," *IEEE Sensors Journal*, vol. 9, issue 2, pp. 135-142, Feb. 2009.

S. Kellis, K. Miller, K. Thomson, R. Brown, P. House, B. Greger, "Decoding Spoken Words Using Local Field Potentials Recorded from the Cortical Surface," *Journal of Neural Engineering*, vol. 7, no. 5, Oct. 2010. (DOI: 10.1088/1741-2560/7/5/056007)

Refereed Conferences (* Indicates archival proceedings)

R. K. Franklin, S. Joo*, S. Negi, F. Solzbacher, R. B. Brown, "A Comparison of Fabrication Methods for Iridium Oxide Reference Electrodes," 2009 IEEE Sensors, Christchurch, New Zealand, Oct. 25-28, 2009, pp. 1086-1089.

S. S. Kellis, P. A. House, K. E. Thomson, R. B. Brown, B. E. Greger, "Neuroprosthetic Application of Human Neocortical Electrical Activity Recorded on Nonpenetrating Microwire Arrays," Society for Neuroscience Annual Meeting, Chicago, IL, Oct. 17-21, 2009, Abstract 216.10

A. Ghosh, R. Rao, R. Brown, "A Centralized Supply Voltage and Local Body Bias-Based Compensation Approach to Mitigate Within-die Process Variation," Proceedings of the International Symposium on Low Power Electronics and Design 2009, San Francisco, CA, Aug. 19-21, 2009, pp. 45-50.

A. Ghosh, R. B. Brown, R. M. Rao, Ching-Te Chuang, "A Precise Negative Bias Temperature Instability Sensor Using Slew-Rate Monitor Circuitry," IEEE International Symposium on Circuits and Systems, Taipei, Taiwan, May 24-27, 2009, pp. 381-384.

S. Kellis, N. Gaskin, B. Redd, E. Marsman, R. Brown, "Hybrid On-Chip Clocking for Sensor Nodes," 2010 International Symposium on System-on-Chip, Tampere, Finland, Sept. 28-30, 2010, pp. 129-132.

S. Kellis, K. J. Miller, K. Thomson, R. Brown, P. House, B. Greger, "Classification of Spoken Words Using Surface Local Field Potentials," 2010 Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Buenos Aires, Argentina, Aug. 31 -Sept. 4, 2010, pp. 3827-3830.

S. Kellis, N. Gaskin, B. Redd, J. Campbell, R. Brown, "Energy Profile of a Microcontroller for Neural Prosthetic Application," Proceedings of 2010 IEEE International Symposium on Circuits and Systems (ISCAS), May 29-June 2, 2010, Paris, France, pp. 3841-3844.

K. Wu, R. B. Brown, H.-H. Cheng, "Schottky Barrier Quantum Well Resonant Tunneling Transistor (SBQWRTT), a.k.a. H Transistor," MBE Taiwan 2010, Taipei, Taiwan, May 24-25, 2010, pp. 31-32.

K. Wu, R. B. Brown, H.-H. Cheng, "Schottky Barrier Quantum Well Resonant Tunneling Transistor (SBQWRTT) a.k.a. H Transistor," Ultimate Limits of Integration in Semiconductors (ULIS), Glasgow, Scotland, March 17-19, 2010, pp. 229-232.

A. Ghosh, R. Franklin, R.B. Brown, "Analog Circuit Design Methodologies to Improve Negative-Bias Temperature Instability Degradation," 23rd International Conference on VLSI Design, Bangalore, India, Jan. 3-7, 2010, pp. 369-374.



M. S. McCorquodale, R. B. Brown, "On Modern and Historical Short-Term Frequency Stability Metrics for Frequency Sources," IEEE International Frequency Control Symposium, joint with the 22nd European Frequency and Time Forum, Besancon, France, April 2009, pp. 328-333.

Other Presentations and Publications

Richard B. Brown, "Interfacing to the Brain with Electrochemical Sensors," Lecture Series for the College of Technology and Computing, Utah Valley University, Orem, UT, April 2, 2009

Richard B. Brown, "Engineering a Healthier World," BYU-Idaho University Forum, Rexburg ID, Nov. 18, 2010

Richard B. Brown, "ECE as a Career in the 21st Century", Honored Distinguished Alumnus talk, Brigham Young University, Provo UT, Oct. 14, 2010.

Richard B. Brown, panel member, "Managing Up – Partnering with your Dean" at the Computing Research Association Conference at Snowbird, Utah, July 18-20, 2010

Richard B. Brown, "Way to Grow", American Society for Engineering Education PRISM Magazine, April 2010, pg. 60

Government Reports

Richard B. Brown, Environmental Sensors, Report on Micro Nano Systems Horizon 2040 Workshop, Denver, CO, June 21, 2009, p. 1-15.

Honors & Awards

Distinguished Alumnus of the Department of Electrical and Computer Engineering, Brigham Young University, October 2010.

Professional Participation

University of Washington, College of Engineering Visiting Committee, November 2010 (Committee provides advice and support to the College of Engineering)



University of Utah Campus



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Erik Brunvand received a B.S. in Computer Science and a B.S. in Mathematics at the University of Utah in 1982, his M.S. in Computer Science at the University of Utah in 1984, and his Ph.D. in Computer Science at Carnegie Mellon University in 1991.

Professor Brunvand joined the Department of Computer Science in 1990. He has interests in computer architecture and VLSI systems in general, and self-timed and asynchronous systems in particular. One aspect of his research involves compiling concurrent communicating programs into asynchronous VLSI circuits. The current system allows programs written in a subset of occam, a concurrent message-passing programming language based on CSP, to be automatically compiled into a set of self-timed circuit modules suitable for manufacture as an integrated circuit. His most recent research project is involved with designing custom hardware to accelerate ray tracing graphics. The end goal of this research is to develop technology to enable commodity ray tracing-based graphics chips that can replace or augment today's GPUs and enable higher quality and more realistic graphics capabilities for future computers.

Publications

Refereed Journals

J. Spjut, A. Kensler, D. Kopta, and E. Brunvand, "TRaX: A Multicore Hardware Architecture for Real-Time Ray Tracing," *IEEE Transactions on CAD*, Vol 28, No. 12, Dec 2009.

D. Nellans, R. Balasubramonian, and E. Brunvand, "OS Execution on Multi-Cores: Is Out-Sourcing Worthwhile?" *ACM Operating Systems Review*, Vol 43, No. 2, April 2009.

Refereed Conference and Workshops

D. Kopta, J. Spjut, and E. Brunvand, "Grid-based Ray Tracing with CUDA," *ACM/Eurographics High Performance Graphics*, New Orleans, LA, August 2009.

J. Spjut, A. Kensler, and E. Brunvand, "Hardware-Accelerated Gradient Noise for Graphics," *ACM Great Lakes Conference on VLSI (GLSVLSI09)*, Boston, MA, May 2009. pp.457-462.

D. Nellans, K. Sudan, E. Brunvand, R. Balasubramonian, "Improving Server Performance on Multi-Cores via Selective Off-loading of OS Functionality," *LNCS* 2010

J. Kopta, J. Spjut, E. Brunvand, A. Davis, "Efficient MIMD Architectures for High-Performance Ray Tracing," *ICCD*, Amsterdam, The Netherlands, October 2010. pp. 9-16.

D. Nellans, K. Sudan, E. Brunvand, R. Balasubramonian, "Improving Server Performance on Multi-Cores via Selective Off-loading of OS Functionality," *WIOSCA*, Saint-Malo, France, June 2010 Extended version also appears as invited submission to *LNCS* 2010

D. Nellans, K. Sudan, E. Brunvand, R. Palasubramonian, "Hardware Prediction of OS Run-Length for Fine-Grained Resource Customization," *ISPASS*, White Plains, NY, March 2010. pp. 111-112.

Books

Erik Brunvand, *Digital VLSI Chip Design with Cadence and Synopsys CAD Tools*, Addison-Wesley, 2010. ISBN : 978-0321547996.

Invited Talks & Presentations

Erik Brunvand, "Printmaking with Extreme Technology," *Southern Graphics Council Conference*, Chicago, IL, March 2009

E. Brunvand, A. Denyer "Printmaking at a Micro Scale," *Impact Conference*, Bristol, U.K., September 2009.

Professional Participation

- Technical Program co-Chair of the Great Lakes Symposium on VLSI (GLSVLSI) 2010
- Steering Committee for IEEE Symposium on Asynchronous Circuits and Systems (2009, 2010)
- NSF Research Funding Panels (2009(2), 2010)

Program committees

- IEEE Symposium on Asynchronous Circuits and Systems (2009, 2010)
- ACM/Eurographics High Performance Graphics (2009, 2010)
- ACM Great Lakes Conference on VLSI (2009)



Elaine Cohen

Professor

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Elaine Cohen received her B.A. in Mathematics from Vassar College in 1968, her M.S. and Ph.D. in Mathematics from Syracuse University in 1970 & 1974.

Prof. Cohen has focused her research in computer graphics, geometric modeling, virtual prototyping, haptics, and manufacturing, with emphasis on complex sculptured models represented using NURBS (Non-Uniform Rational B-splines) and NURBS-features. Also, Prof. Cohen has been working on issues related to design collaborations and reverse engineering in immersive environments. Results in manufacturing research have been focused on automating process planning, automatic toolpath generation for models having many surfaces, optimizing both within and across manufacturing stages and fixture automation. Recent research has produced algorithms for determining both visibility and accessibility of one object by another. Computation of such information is necessary for manufacturing, assembly planning, graphics, and virtual environments. Research in haptics has been focused on developing new approaches to solving geometric computations such as fast and accurate contact and tracking algorithms for sculptured models.

Publications

Refereed Journals

S. R. Musuvathy and E. Cohen, "Extracting Principal Curvature Ridges from BSpline Surfaces with Deficient Smoothness," *Lecture Notes in Computer Science*, v. 5875, Proc. of International Symposium on visual Computing, pp. 101-110, 2009.

J.-K. Seong, W.-K. Jeong and E. Cohen, "Curvature based Anisotropic Geodesic Distance Computations for Parametric and Implicit Surfaces," *The Visual Computer*, v. 25 (8), pp. 743-755, 2009.

T. Martin, E. Cohen, and R. M. Kirby, "Volumetric Parameterization and Trivariate BSpline Fitting using Harmonic Functions," *CAGD*, vol. 26, pp. 648-664, 2009.

J. Daniels, C. Silva, and E. Cohen, "Semi-regular, Quad-only Remeshing from Simplified Base Domains," *Computer Graphics Forum*, v. 28 (9), pp. 1427-1435, 2009.

J. Daniels, C. Silva, and E. Cohen, "Localized Quadrilateral Coarsening," *Computer Graphics Forum*, v. 28, n.9, pp. 1437-1444, 2009.

X. Chen, R. F. Riesenfeld, and E. Cohen, "An Algorithm for Direct B-spline Multiplication," *IEEE Transactions on Automation Science and Engineering*, pp. 433-442, v. 6, n. 3, Jul. 2009.

E. Cohen, T. Lyche, and R. Riesenfeld, "MCAD: Key Historical Developments," *Computer Methods in Applied Mechanics and Engineering*, Vol. 199 (5-8) pp. 224-228. 2010

E. Cohen, T. Martin, M. Kirby, T. Lyche, and R. Riesenfeld, "Analysis-aware Modeling: Understanding Quality Considerations in Modeling for Isogeometric Analysis," *Computer Methods in Applied Mechanics and Engineering*, pp. 334-356. 2010

Refereed Conference and Workshops

T. C. Henderson, X. Fan, A. Alford, E. Grant, and E. Cohen, "Innate Theories as a Basis for Autonomous Mental Development, to appear, IROS 2009 Workshop: Autonomous Mental Development for Intelligent Robots & Systems . pp. 207-213.

D.E. Johnson and E. Cohen, "Computing Surface Offsets and Bisectors Using a Sampled Constraint Solver", *Proceedings of Graphics Interface*, pp. 31-37, 2009. ISBN: 978-1-56881-470-4

S. R. Musuvathy, E. Cohen, J-K Seong and J. N. Damon, "Tracing Ridges on BSpline Surfaces," *Proc. of 2009 SIAM/ACM Joint Conference on Geometric and Physical Modeling*, pp. 55-66, 2009.

D. E. Johnson, R. Riesenfeld, E. Cohen, and S. Drake, "Interactive Functional Reparameterization of Geometric Models," *Proceedings of the 2009 International Design Engineering Technical Conference & Design Automatic Conference*, 2009. ISBN: 978-0-7918-4902-6

Invited Talks & Presentations

"Synergies in Computational Mechanics and Geometry: A Symposium in Honor of Prof. Thomas J. R. Hughes" as part of the 10th U.S. National Congress on Computational Mechanics on "Isogeometric Analysis" at the 2009 SIAM/ACM Joint Conference on Geometric & Physical Modeling

"Isogeometric Analysis" at the 2009 SIAM/ACM Joint Conference on Geometric & Physical Modeling

"Isogeometric Methods" at the 2009 ASME International Mechanical Engineering Congress & Exposition Symposium

Honors & Awards

SIAM/ACM Siggraph/Solid Modeling Foundation Best Paper Award 2009

Bezier Prize, Solid Modeling Association (co-recipient) 2009



Al Davis
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Al Davis received his B.S. in Electrical Engineering at MIT in 1969, and his Ph.D. in Electrical Engineering, Computer Science Division at the University of Utah in 1972. Traditionally Professor Davis has worked in the areas of high performance computer architecture, asynchronous circuits and systems, VLSI, parallel computation, and domain specific embedded systems. His current focus areas are silicon nanophotonics and main memory micro-architecture. Modern multi-core processor performance is increasing rapidly but system performance improvement is increasingly constrained by main memory bandwidth starvation and by power and thermal limits. In collaboration with Professor Rajeev Balasubramonian and a number of graduate students, Professor Davis has created new DRAM micro-architectures and interfaces, developed more error resilient main memory architectures, and novel memory controller techniques. In collaboration with colleagues at HP Laboratories, Professor Davis is working on replacing long wires, which are increasingly problematic in terms of power consumption, with photonic signaling. The advantage of photonics is that it promises to provide much higher bandwidth at significantly lower power than the electrical alternative.

Publications

Refereed Journals

J-H Ahn, M. Fiorentino, R. G. Beausoleil, N. Binkert, A. Davis, D. Fattal, N. P. Jouppi, M. McLaren, C. M. Santori, R. S. Schreiber, S. M. Spillane, D. Vantrease, and Q. Xu. "Devices and architectures for photonic chip-scale integration," *Journal of Applied Physics A*, Vol 95(4), pp. 998-997, June 2009

Refereed Conference and Workshops

N. Binkert, A. Davis, M. Kipasti, R. Schreiber, D. Vantrease. "Nanophotonic Barriers," *Workshop on Photonic Interconnects and Computer Architecture (PICA)*, New York City, Dec. 13, 2009.

J-H. Ahn, N. Binkert, A. Davis, M. McLaren, R. S. Schreiber. "HyperX: Topology, Routing, and Packaging of Efficient Large-Scale Networks," *Proceedings of Supercomputing 2009*, Portland, OR, Nov. 14-20, 2009. ISBN: 978-1-60558-744-8

M. Awasthi, D. Nellans, K. Sudan, R. Balasubramonian, A. Davis. "Handling the Problems and Opportunities Posed by Multiple On-Chip Memory Controllers," *PACT 2010*, Vienna. (Received the "Best Paper" award.) pp. 319-330.

G. B. P. Bezerra, S. Forrest, M. Moses, A. Davis, P. Zarkesh-Ha. "Energy Prediction in NOC using Rent's Rule Communication Probability Distribution," *SLIP 2010*, Anaheim, CA. pp. 3-8.

A. Udipi, R. Balasubramonian, N. Muralimanohar, A. Davis, N. Jouppi. "Rethinking DRAM Design and Organization for Energy Constrained Multi-Cores," *ISCA 2010*. pp.175-186.

K. Sudan, N. Chatterjee, D. Nellans, M. Awasthi, R. Balasubramonian, A. Davis. *Micro-Pages: Increasing DRAM Efficiency with Locality-Aware Data Placement*. *ASPLOS XV*, Pittsburgh, PA, 2010. pp. 219-230.

K. Ramani, C. P. Gribble, A. Davis. *StreamRay: A Stream Filtering Architecture for Coherent Ray Tracing*. *Proceedings of ASPLOS 2009*, pp. 325-336, March 2009.

Book Chapter

J-H Ahn, R. G. Beausoleil, N. Binkert, A. Davis, M. Fiorentino, N. P. Jouppi, M. McLaren, M. Monchiero, N. Muralimanohar, R. Schreiber, D. Vantrease. *CMOS Nanophotonics: Technology, System Implications, and a CMP Case Study*. Chapter 9 in "Low Power Networks-on-Chip" – edited by C. Silvano, M. Lajolo, and G. Palermo. Springer, New York, October 2010, ISBN 978-1-4419-6910-1

Patents

M. McLaren, R. G. Beausoleil, M. Fiorentino, N. Binkert, N. Jouppi, A. Davis. "Resonator Systems and Methods for Tuning Resonator Systems" (patent filed October 2010).

M. McLaren, J-H Ahn, N. Binkert, A. Davis, R. Schreiber. "Methods and Apparatus to determine and Implement Multidimensional Network Topologies" (patent filed Oct. 2010)

M. McLaren, R. G. Beausoleil, N. Jouppi, M. Fiorentino, N. Binkert, A. Davis. "Use of multiple ring resonator modes to minimize thermal tuning requirements" (disclosure filed April 2010)

A. Udipi, N. Muralimanohar, R. Balasubramonian, N. Jouppi, A. Davis. "A Slot-Based Memory Interface with Single-Point Arbitration and Simplified Memory Controllers" (disclosure filed March 2010).

N. Muralimanohar, A. Udipi, N. Chatterjee, R. Balasubramonian, A. Davis, N. Jouppi. "Redesigning DRAM for Reduced Power Consumption" (patent filed Jan. 2010).

M. McLaren, N. Binkert, A. Davis, N. Jouppi. "Flow control for optical multi bus systems" (patent filed Jan. 2010).

M. McLaren, N. Binkert, A. Davis, M. Fiorentino. "Partitionable resonator based WDM communication links" (patent filed Feb. 2010).

N. Binkert, M. McLaren, M. Tan, A. Davis "All Optically Interconnected Data Center Switches" (patent filed Mar. 2010).

M. McLaren, A. Davis "Packet-Based Networking System" (filed Dec. 2009).

M. McLaren, A. Davis "Scalable mechanism for ensuring correct order of delivery in



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packet networks” (patent filed Nov. 2009).

J-H Ahn, R. S. Schreiber, N. Binkert, A. Davis, M. McLaren “Incremental Adaptive Packet Routing In A Multi-Dimensional Network” (pending, filed 13-OCT-2009).

Invited Talks and Other Presentations

“Future Memory Architectures”, invited presentation at LANL workshop, Santa Fe, NM, Oct. 2010

“Photonics and Future Data Centers”, tutorial presentation at Hot Chips, Aug. 2010.

“Present and Future Memory Systems” invited presentation, Technion, Haifa ISRAEL, May 2010.

Invited poster at the NSF “lunch and research expo” on Cyber Physical Systems at the Senate Committee on Commerce, Transportation, and Science, July 9, 2009, Washington DC. G. Bezzerra, S. Forrest, M. Moses, A. Davis, J. Brown. “The Elephant and the Computer Chip”.

Professional Participation

ISCA 2010 – Program Committee
CASES - Program Committee



Graduation

Professor Flatt received his B.S. in Math and Computer Science and his B.S. in Physics at Carnegie Mellon University in 1993, his M.S. and Ph.D. in Computer Science at Rice University in 1998 & 1999.

Professor Flatt’s research interests include practical and theoretical aspects of programming languages and programming environments. He is especially interested in programming environments and tools for extensible and interoperating programming languages.

Publications

Refereed Conference and Workshops

M. Flatt, E. Barzilay, and R.B. Findler, “Scribble: Closing the Book on Ad Hoc Documentation Tools” ACM International Conference on Functional Programming (ICFP) Pages 109—120, 2009 ISBN: 978-1-60558-332-7

M. Felleisen, R.B. Findler, M. Flatt, and S. Krishnamurthi, “A Functional I/O System (or Fun for Freshman Kids)” ACM International Conference on Functional Programming (ICFP) Pages 47—58, 2009 ISBN: 978-1-60558-332-7

J. Rafkind, A. Wick, J. Regehr, and M. Flatt, “Precise Garbage Collection for C” ACM International Symposium on Memory Management (ISMM) Pages 39—48, 2009 ISBN: 978-1-60558-347-1

M. Flatt and E. Barzilay, “Keyword and Optional Arguments in PLT Scheme” Workshop on Scheme and Functional Programming (Scheme Workshop) 2009

K. Atkinson, M. Flatt, and G. Lindstrom, “Using Macros to Address ABI Compatibility” Conference on Generative Programming and Component Engineering (GPCE) 2010

J. Swaine, K. Tew, P. Dinda, R.B. Findler, and M. Flatt, “Back to the Futures: Incremental Parallelization of Existing Sequential Runtime Systems” ACM Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA) 2010

C. Klein, M. Flatt, and R.B. Findler, “Random Testing for Higher-Order, Stateful Programs” ACM Conference on Object-Oriented Programming Systems, Languages, and Applications (OOPSLA) 2010

I. Barland, R.B. Findler, and M. Flatt, “The Design of a Functional Image Library” Workshop on Scheme and Functional Programming (Scheme Workshop) 2010

Matthew Flatt continued on next page

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Books

M. Felleisen, R.B. Findler, and M. Flatt, "Semantics Engineering with PLT Redex" MIT Press, 2009 ISBN: 978-0-262-06275-6

M. Sperber, R.K. Dybvig, M. Flatt, and A. van Straaten, "Revised Report on the Algorithmic Language Scheme" editors Cambridge University Press, 2009 ISBN: 978-0-521-19399-3

Invited Talks & Presentations

Colloquium, Brigham Young University, Provo, UT 2009

Professional Participation

- Member-at-large, ACM SIGPLAN Executive Committee 2009-2012
- Chair, ACM SIGPLAN Outstanding Doctoral Dissertation Award Committee 2009-2010
- Program committee member, ACM Conf. on Principles of Programming Languages (POPL) 2009
- Program committee member, Sym. on Implementation and Application of Functional Languages (IFL) 2009
- Program committee member, Workshop on Dynamic Languages and Applications (Dyla) 2010
- Editorial board member, Journal of Functional Programming 2009-2011



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Tom Fletcher received his B.A. degree in Mathematics at the University of Virginia in 1999. He received an M.S. in Computer Science in 2002 followed by a Ph.D. in Computer Science in 2004 from the University of North Carolina at Chapel Hill.

Dr. Fletcher's research is focused on creating novel methods at the intersection of statistics, mathematics, and computer science to solve problems in medical image analysis. He is currently collaborating with researchers in Autism and Alzheimer's disease at the University of Utah on the statistical analysis of combined imaging modalities, including structural MRI, DTI, fMRI and PET in longitudinal studies.

Publications

Refereed Journals

J. Hinkle, P.T. Fletcher, B. Wang, B. Salter, S. Joshi. "4D MAP image reconstruction incorporating organ motion," In Information Processing in Medical Imaging, Lecture Notes in Computer Science LNCS, Vol. 5636, pp. 676--687. 2009.

C. Goodlett, P.T. Fletcher, J.H. Gilmore, G. Gerig. "Group analysis of DTI fiber tract statistics with application to neurodevelopment," In Neuroimage, Vol. 45, No. 1 (suppl 1), pp. S133--S142. 2009.

Hinkle, J, Fletcher, PT, Wang, B, Salter, W, Joshi, S. "4D MAP Image Reconstruction Incorporating Organ Motion," Information Processing in Medical Imaging (IPMI), pp. 676-678, 2009.

Fletcher, PT, Venkatasubramanian, S, Joshi, S. "The geometric median on Riemannian manifolds with application to robust atlas estimation," NeuroImage, Volume 45, Issue 1, Supplement 1, pp. S143-S152, March 2009.

Oguz, I, Cates, J, Whitaker, R, Fletcher, PT, Niethammer, M, Styner, M, "Cortical Correspondence with Probabilistic Fiber Connectivity," Information Processing in Medical Imaging (IPMI), Vol. 21, pp. 651-663, 2009.

R. Tao, P.T. Fletcher, R.T. Whitaker. "An Variational Image-Based Approach to the Correction of Susceptibility Artifacts in the Alignment of Diffusion Weighted and Structural MRI," In Information Processing in Medical Imaging, Lecture Notes in Computer Science LNCS, Vol. 5636, pp. 664--675. 2009.

E. Jurrus, M. Hardy, T. Tasdizen, P.T. Fletcher, P. Koshevoy, C.-B. Chien, W. Denk, R.T. Whitaker. "Axon Tracking in Serial Block-Face Scanning Electron Microscopy," In Medical Image Analysis (MEDIA), Vol. 13, No. 1, Elsevier, pp. 180--188. February, 2009.

Fletcher, PT, Whitaker, RT, Tao, R, DuBray, MB, Froehlich, A, Ravichandran, C, Alexander, AL, Bigler, ED, Lange, N, Lainhart, JE, "Microstructural Connectivity of the Arcuate Fasciculus in Adolescents with High-functioning Autism," in press

NeuroImage, Vol. 51 (3) pp. 1117-1125, 2009.

S. Gerber, T. Tasdizen, P.T. Fletcher, S. Joshi, R.T. Whitaker, the Alzheimers Disease Neuroimaging Initiative (ADNI). "Manifold modeling for brain population analysis," In Medical Image Analysis, Special Issue on the 12th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI) 2009, Vol. 14, No. 5, Note: Awarded MICCAI 2010, Best of the Journal Issue Award, pp. 643--653. 2010. ISSN: 1361-8415

N. Singh, P.T. Fletcher, J.S. Preston, L. Ha, R. King, J.S. Marron, M. Wiener, S. Joshi. "Multivariate Statistical Analysis of Deformation Momenta Relating Anatomical Shape to Neuropsychological Measures," In Medical Image Computing and Computer-Assisted Intervention – MICCAI 2010, Lecture Notes in Computer Science (LNCS), Vol. 6363/2010, Note: DOI: 10.1007/978-3-642-15711-0_66, pp. 529-537. 2010.

M. Datar, J. Cates, P.T. Fletcher, S. Gouttard, G. Gerig, R.T. Whitaker. "Particle Based Shape Regression of Open Surfaces with Applications to Developmental Neuroimaging," In Medical Image Computing and Computer-Assisted Intervention – MICCAI 2009, Lecture Notes in Computer Science LNCS, Vol. 5762, pp. 167--174. 2009.

Refereed Conference and Workshops

W. Liu, P. Zhu, J.S. Anderson, D. Yurgelun-Todd, P.T. Fletcher. "Spatial Regularization of Functional Connectivity Using High-Dimensional Markov Random Fields," In Medical Image Computing and Computer-Assisted Intervention (MICCAI 2010), Vol. 14, pp. 363--370. 2010.

Book Chapters

Pizer, S, Han, Q, Joshi, S, Fletcher, PT, Yushkevich, PA, Thall, A. "Synthesis, Deformation, and Statistics of 3D Objects via M-reps." In Medial Representations Mathematics, Algorithms and Applications, chp. 8, Springer, 2009.

Pizer, S, Styner, M, Terriberry, T, Broadhurst, R, Joshi, S, Chaney, E, Fletcher, PT. "Statistical Applications with Deformable M-Reps. In Medial Representations Mathematics," Algorithms and Applications, chp. 9, Springer, 2009.

Invited Talks & Presentations

Massachusetts Institute of Technology, Computer Science and Artificial Intelligence Laboratory, Invited Talk on "Robust Statistics on Riemannian Manifolds"

Summer School on Manifold Learning in Image and Signal Analysis, Ven, Sweden, Invited lecture on "Statistics on Manifolds"

Professional Participation

- Organized MICCAI 2010 Workshop on "Spatio-Temporal Image Analysis for Longitudinal and Time-Series Image Data"
- Organized ISBI 2009 Tutorial on "Statistical Shape Analysis: Theory, Software, and Applications"
- Program Committees, MICCAI Workshop on Probabilistic Models for Medical Image Analysis (PMMIA) 2009

Honors & Awards

Medical Image Analysis / MICCAI Best Paper Award, 2010



Students meet with gaming studio



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Juliana Freire is an Associate Professor at the School of Computing at the University of Utah. Before, she was member of technical staff at the Database Systems Research Department at Bell Laboratories (Lucent Technologies) and an Assistant Professor at OGI/OHSU. An important theme in Professor Freire's work is the development of data management technology to address new problems introduced by emerging applications, including the Web and scientific applications. Her recent research has focused on two main topics: Provenance management for computational tasks and Web mining. Professor Freire is an active member of the database community, having co-authored over 80 technical papers and holding 4 U.S. patents. She is a recipient of an NSF CAREER and an IBM Faculty award. She has chaired or co-chaired several workshops and conferences, and she has participated as a program committee member in over 50 events. Her research has been funded by grants from the National Science Foundation, Department of Energy, the University of Utah and the State of Utah, and gifts from IBM, Yahoo! and Microsoft.

Publications

Refereed Journals

E. Santos, L. Lins, J. Ahrens, J. Freire, C. Silva. "VishMashup: Streaming the Creation of Custom Visualization Applications, In the Proceedings of the 21st International Conference on Scientific and Statistical Database Management (SSDBM), pp. 292-301. 2009.

K. Vieira, A.L. da C. Carvalho, K. Berit, E.S.de Moura, A.S. da Silva, J. Freire, "On Finding Templates on Web Collections, In World Wide Web Journal, 12(2), pp. 171-211, 2009.

L. Stromback and J. Freire. "XML Management for Bioinformatics Applications," IEEE Computing in Science & Engineering, 2010. ISSN: 1521-9615

R. Mello, R. Pinnamaneni and J. Freire. "Indexing Web Form Constraints," Journal of Information and Data Management (JIDM), 1(2), 343-358, 2010.

S. Mergen, J. Freire, and C. Heuser. "Querying Structured Information Sources on the Web," In International Journal of Metadata Semantics and Ontologies, 5(3), pp. 208-221, 2010.

L. Barbosa and J. Freire. "Siphoning Hidden-Web Data through Keyword-Based Interfaces," Journal of Information and Data Management (JIDM) special issue including the most cited papers of the Brazilian Database Symposium, 1(1), pp. 133-144, 2010.

L. Barbosa and J. Freire. "Siphoning Hidden-Web Data through Keyword-Based Interfaces: Retrospective," Journal of Information and Data Management (JIDM) special issue including the most cited papers of the Brazilian Database Symposium, 1(1), pp. 145-146, 2010.

Refereed Conference and Workshops

E. Santos, D. Koop, H.T. Vo, E. Anderson, J. Freire, C.T. Silva. "Using Workflow Medleys to Streamline Exploratory Tasks," In 21st International Conference on Scientific and Statistical Database Management (SSDBM), pp. 292--301. 2009.

T. Ellkvist, L. Stromback, L. Lins, J. Freire. "A First Study on Strategies for Generating Workflow Snippets," In Proceedings of the ACM SIGMOD International Workshop on Keyword Search on Structured Data (KEYS), pp. 15-20. 2009.

T. Ellkvist, D. Koop, J. Freire, C.T. Silva, L. Stromback. "Using Mediation to Achieve Provenance Interoperability," In Proceedings of the IEEE International Workshop on Scientific Workflows, 2009, pp. 291-298. 2009.

E. Santos, L. Lins, J. Ahrens, J. Freire, and C. Silva. "VisMashup: Streamlining the Creation of Custom Visualization Applications," IEEE Transactions on Visualization and Computer Graphics, 15(6), pp. 1539-1546, 2009.

T. Nguyen, H. Nguyen and J. Freire. "PruSM: A Prudent Schema Matching Strategy for Web Form," In Proceedings of CIKM, pp. 1385-1388, 2010.

L. Barbosa and J. Freire. "Using Latent-Structure to Detect Objects on the Web," In Proceedings of WebDB, 2010. ISBN: 978-1-4503-0186-2

H. Nguyen, T. Nguyen, H. Nguyen and J. Freire. "Querying Wikipedia Documents and Relationships," In Proceedings of WebDB, 2010. ISBN: 978-1-4503-0186-2

D. Koop, C. E. Scheidegger, J. Freire, and C. Silva. "The Provenance of Workflow Upgrades," In Proceedings of the International Provenance and Annotation Workshop (IPAW), 2010. pp. 2-16.

D. Koop, E. Santos, B. Bauer, M. Troyer, J. Freire, and C. Silva. "Bridging Workflow and Data Provenance using Strong Links," In Proceedings of the 22nd International Conference on Scientific and Statistical Database Management (SSDBM), pp. 397-415, 2010.

L. Barbosa, H. Nguyen, T. Nguyen, R. Pinnamaneni and J. Freire. "Creating and Exploring Web Form Repositories," In Proceedings of SIGMOD, pp. 1175-1178, 2010.

C. Silva, E. Anderson, E. Santos and J. Freire. "Using VisTrails and Provenance for Teaching Scientific Visualization," In Proceedings of the Eurographics Education Program, 2010. DOI: 10.1111/j.1467-8659.2010.01830.x

S. Mergen, J. Freire, and C. Heuser. "Indexing Relations on the Web," In Proceedings of the 13th International Conference on Extending Database Technology (EDBT), pp. 430-440, 2010.

Book Chapters

B. Ludascher, I. Altintas, S. Bowers, J. Cummings, T. Critchlow, E. Deelman, D. D. Roure, J. Freire, C. Goble, M. Jones, S. Klasky, T. McPhillips, N. Podhorszki, C. Silva, I. Taylor, and M. Vouk) In A. Shoshani and D. Rotem, editors, "Scientific Process Automation and Workflow Management," Scientific Data Management: Challenges, Existing Technology, and Deployment, Computational Science Series, chapter 13. Chapman & Hall/CRC, 2009 ISBN: 978-1420069808.

D. Barbosa, P. Bohannon, J. Freire, C. Kanne, Y. Manolescu, V. Vassalos and M. Yoshikawa, "XML Storage," In Encyclopedia of Database Systems, L. Iiu and T. Oszu (Eds.) 2009. pp. 3627-3634

M. Ramanath, J. Freire and A. Polyzotis, "XML Selectivity Estimation," In Encyclopedia of Database Systems, L. Iiu and T. Oszu (Eds.) 2009. pp. 3623-3627.

Z. Lacroix, C. Kothari, P. Mork, R. Rifaieh, M. Wilkinson, J. Freire and S. Cohen-Boulakia, "Biological Resource Discovery," In Encyclopedia of Database Systems, L. Iiu and T. Oszu (Eds.) 2009. pp. 220-223.

Invited Talks & Presentations

"Provenance in Science: Challenges and Opportunities" International Workshop on The Next Generation of Quantum Simulations, Moorea, French Polynesia, May 6, 2009

"Provenance Management: Challenges and Opportunities" (Keynote) Technologie und Web (BTW), Munster, Germany, March 4, 2009

"Provenance in Science: Challenges and Opportunities" University of Utah Campus CyberInfrastructure Day, Salt Lake City, UT, March 13, 2009

"Infrastructure for Understanding Human Knowledge" ICIS Workshop on Integrating, Representing, and Reasoning over Human Knowledge: A Computational Grand Challenge for the 21st Century. Snowbird, August 8, 2010

"Supporting Provenance-Rich Science with VisTrails" CScADS Scientific Data and Analytics for Petascale Computing Workshop. Snowbird, July 26, 2010

The WebDB Group: Research Overview. Federal University of Amazonas, Manaus, Brazil, June 29th, 2010

"Provenance-Rich Science" (Keynote) DB/IR Day, AT&T Shannon Labs, Florham Park, NJ, October 22, 2010

"Provenance Management for Data Exploration" (Keynote) International Conference on Data Integration in the Life Sciences (DILS), Sweden, August 2010

Professional Participation

- Program Chair: International World Wide Web Conference (WWW), 2010
- Chair: The Second International Workshop on Role of Semantic Web in Provenance Management (SWPM 2010) – Shanghai, China, November 2010
- Co-Chair: First International Workshop on Traceability and Compliance of Semi-Structured Processes (TC4SP10) – Hoboken, New Jersey, Sept. 2010
- Panelist for NIH, 2010
- Co-Chair: International Workshop on Role of Semantic Web in Provenance Management (SWPM) Washington D.C., USA, October 2009
- Workshops Co-Chair: International Conference on Very Large Databases (VLDB) – Lyon, France, August 2009



Artist rendering of new James L. Sorenson Molecular Biotechnology Building - A USTAR Innovation Center - completion 2012



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Guido Gerig was recruited from the University of North Carolina at Chapel Hill to the University of Utah under the USTAR program. He received his Ph.D. in 1987 from the Swiss Federal Institute of Technology, ETH Zurich, Switzerland. Guido Gerig joined the faculty at UNC Chapel Hill as Taylor Grandy professor in August 1998 and with a joint appointment in the Departments of Computer Science and Psychiatry. In 2008, he accepted a new USTAR faculty position at the School of Computing and Scientific Computing and Imaging Institute (SCI) at the University of Utah, with adjunct appointments in Biomedical Engineering and Psychiatry.

Guido Gerig began research in the area of medical image analysis in 1985 at ETH Zurich, Switzerland. Since then, he has led a large number of national and international projects with close multidisciplinary collaboration between medicine, engineering, statistics, industry, and computer science. He is the director of the UTAH Center for Neuroimage Analysis (UCNIA) and supports a number of clinical neuroimaging projects with new methodology for image processing, registration, atlas building, segmentation, shape analysis, and statistical analysis. Current key research topics are analysis and modeling of the early developing brain, longitudinal analysis of multi-shape complexes, and new methodologies for statistical analysis of white matter using diffusion tensor imaging. Method developments are driven by challenging clinical applications that include research in schizophrenia, autism, multiple sclerosis, infants at risk for mental illness and aging. New tools and methods are open source and are made available to public.

Publications

Refereed Journals

H.C. Hazlett, M.D. Poe, A.A. Lightbody, G. Gerig, J. R. MacFall, A. K. Ross, J. Provenzale, A. Martin, A. L. Reiss and J. Piven, "Teasing apart the heterogeneity of autism: Same behavior, different brains in toddlers with fragile X syndrome and autism," *Journal of Neurodevelopmental Disorders*, Springer Verlag, Volume 1, Issue 1 (2009), Page 81

M. Prastawa, E. Bullitt, G. Gerig, "Simulation of brain tumors in MR images," *Medical Image Analysis* 13 (2009), pp. 297-311, PMID: 19119055

MW Mosconi, HC Hazlett, MD Poe, G. Gerig, R. Gimpel-Smith, J. Piven. "A longitudinal study of amygdala volume and joint attention in 2-4 year old children with autism," *Arch Gen Psychiatry*. 2009 May;66(5):509-16. PMID: 19414710

C. Goodlett, P. Thomas Fletcher, JH Gilmore, and G. Gerig, "Group Analysis of DTI Fiber Tract Statistics with Application to Neurodevelopment," *NeuroImage* 45 (1) Supp. 1, 2009.p. S133-S142, PMID: 19059345, PMCID 2727755

W. Gao, Y. Chen, G. Gerig, JK Smith, V. Jewells, JH Gilmore, W Lin, "Temporal and Spatial Development of Axonal Maturation and Myelination of White Matter in the Developing Brain," *American Journal of Neuroradiology (AJNR)* 30:290-296, 2009

N. Mukherjee, C. Kang, H.M. Wolfe, B.S.Hertzberg, J.K. Smith, W. Lin, G. Gerig, RM Hamer, J.H. Gilmore, "Discordance of Prenatal and Neonatal Brain Development in Twins," *Early Hum Dev*. 2009 Mar;85(3):171-5, PMID: 18804925

F. Zhang, ER. Hancock, C. Goodlett and G. Gerig, "Probabilistic White Matter Fiber Tracking using Particle Filtering and von Mises-Fisher Sampling," *Med Image Anal*. 2009 Feb;13(1):5-18, PMID: 18602332

J.H. Gilmore, C. Kang, D.D. Evans, H.M. Wolfe, JK Smith, J.A. Lieberman, W. Lin, RM Hamer, M Styner, G. Gerig, "Prenatal and Neonatal Brain Structure and White Matter Maturation in Children at High Risk for Schizophrenia," *Am J Psychiatry*. 2010 Sep;167(9):1083-91. Epub 2010 Jun 1. PMID: 20516153

F. Shi, D. Shen, P.T. Yap, Y. Fan, J.Z. Cheng, H. An, LL Wald, G. Gerig, JH Gilmore, and W. Lin, "CENTS: Cortical Enhanced Neonatal Tissue Segmentation," *Human Brain Mapping HBM*, in print

J.H. Gilmore, J.E. Schmitt, R.C. Knickmeyer, J.K. Smith, W. Lin, M. Styner, G. Gerig, MC Neale, "Genetic and environmental contributions to neonatal brain structure: A twin study," *Hum Brain Mapp*. 2010 31(8):1174-82. PMID: 20063301

M. El-Sayed, R. Steen, M.D. Poe, T.C. Bethea, G. Gerig, J. Lieberman, and L. Sikich, "Deficits in gray matter volume in psychotic youth with schizophrenia-spectrum disorders are not evident in psychotic youth with mood disorders," *J Psychiatry Neurosci*. 2010 Jul;35(4):229-36. PMID: 20569649

K. Gorcowski, M. Styner, J.Y. Jeong, JS Marron, J. Piven, HC Hazlett, SM Pizer, G. Gerig, "Multi-object Analysis of Volume, Pose, and Shape using Statistical Discrimination," *IEEE Trans Pattern Anal Mach Intell*. 2010 Apr;32(4):652-61 PMID: 2022412

Refereed Conference and Workshops

S. Gouttard, M. Prastawa, E. Bullitt, C. Goodlett and G. Gerig, "Constrained Data Decomposition and Regression for Analyzing Healthy Aging from Fiber Tract Diffusion Properties," *Springer LNCS 5761, Proc. MICCAI'09*, pp. 321-328, 2009

M. Datar, J. Cates, P. T. Fletcher, S. Gouttard, G. Gerig and R. Whitaker, "Particle Based Shape Regression of Open Surfaces with Applications to Developmental Neuroimaging," *Springer LNCS 5762, Proc. MICCAI'09*, pp. 167-174, 2009

S. Durrleman, X. Pennec, A. Trouve, G. Gerig, N. Ayache, "Spatiotemporal Atlas Estimation for Developmental Delay Detection in Longitudinal Datasets," *Springer LNCS 5761, Proc. MICCAI'09*, pp. 297-302, 2009

F. Shi, P.T. Yap, Y. Fan, J.Z. Cheng, L.L. Wald, G. Gerig, W. Lin, D. Shen, "Cortical Enhanced Tissue Segmentation of Neonatal Brain MR Images Acquired by a

Dedicated Phased Array Coil," Proc IEEE Comput Soc Conf Comput Vis Pattern Recognit. 2009;2009(5204348):39-45.PMID: 20862268 [PubMed]

Z. Liu, H. Zhu, BL Marks, LM Katz, C. Goodlett, G. Gerig, M. Styner, "Voxel-wise group analysis of DTI," Proceedings of the 6th IEEE International Symposium on Biomedical Imaging ISBI: From Nano to Macro 2009; 807-810.

Linh Ha, Marcel Prastawa, Guido Gerig, John H. Gilmore, Claudio Silva, Sarang Joshi, Image Registration Driven by Combined Probabilistic and Geometric Descriptors, Med Image Comput Comput Assist Interv. 2010;13(Pt 2):602-9.PMID: 20879365

C. Marc, C. Vachet, JE Blocher, G. Gerig, JH Gilmore, MA Styner, "Changes of MR and DTI appearance in early human brain development," SPIE Medical Imaging, Vol. 7623, February 2010

Z. Liu, C. Goodlett, G. Gerig, M. Styner, "Evaluation of DTI Property Maps as Basis of DTI Atlas Building," Vol. 7623, SPIE Medical Imaging, February 2010

Z. Liu, Y. Wang, G. Gerig, S. Gouttard, R. Tao, T. Fletcher, MA Styner, "Quality control of diffusion weighted images," Vol. 7628, SPIE Medical Imaging, February 2010

N. Sadeghi, M. Prastawa, JH Gilmore, W. Lin, G. Gerig, "Towards Analysis of Growth Trajectory through Multi-modal Longitudinal MR Imaging," SPIE Medical Imaging, Vol. 7623, February 2010

S. Gouttard, K. Grewen, G. Gerig, J. Gilmore, E. Bitaud, J. Johns, "Prenatal cocaine effects on infant brain development," Society for Neuroscience 2010, Nov, 2010

G. Gerig, K. Grewen, S. Gouttard, E. Bitaud, J. Gilmore, J. Johns, "Prenatal cocaine effects on neonatal white matter development," Society for Neuroscience, Nov, 2010

Rueckert D, Hawkes D, Gerig G, Yang GZ. MedIA Sept 2010, Special Issue, Med Image Anal. 2010 Oct;14(5):631-2. PMID: 20627174

N. Sadeghi, M. Prastawa, J. H. Gilmore, W. Lin, and G. Gerig, "Spatio-Temporal Analysis of Early Brain Development," in print Proceedings IEEE Asilomar Conference on Signals, Systems & Computers, Nov. 2010.

Prastawa, M., Sadhegi, N., Gilmore, J., Lin, W., Gerig, G., "A new framework for analyzing white matter maturation in early brain development," IEEE conf. ISBI 2010, pp. 97-100, April 2010.

Invited Talks & Presentations

March 2009, Invited presentation "Image Analysis In Neuroimaging: Recent Progress", Penn State University-Milton S. Hershey Medical Center, PA

April 2009, Invited Course ISMRM 2009 conference: Sunrise Session "Quantitative Neuro-anatomical and functional image assessment", titled: Recent progress on image registration and its applications. Outstanding Teacher Award ISMRM 2009

June 2009, Invited presentation "Advanced methodology for quantitative analysis of white matter tracts from MR Diffusion Weighted Imaging", EPFL Lausanne, Switzerland, Advanced Clinical Imaging Technology CIBM

Sept 2009, Presentation "DTI Fiber Cup Challenge" Workshop, titled: "Fiber Challenge, SCI Utah Solution

Sept 2009, Tutorial Co-organizer and invited speaker for MICCAI'09 Tutorial "Image Analysis for the Developing Brain", titled "Growth trajectory of the early developing brain derived from longitudinal MRI/DTI", London, Imperial College.

Oct 2009, Invited Lecture NA-MIC Satellite Workshop presentation "Diffusion tensor processing and visualization", Society for Neuroscience SfN, Neuroscience 2009 Meeting, Chicago.

Nov 2009, Invited presentation "Growth trajectory of the early developing brain derived from longitudinal MRI/DTI data", MIND Institute, Albuquerque, NM (invited by Vince Calhoun).

Jan 2010, "Computational Tools for Longitudinal Neuroimaging Infant Study", Advisory Board Meeting Silvio Conte Project, UNC Chapel Hill, NC

Sept 2010, Introduction STIA'10, Spatio-temporal Image Analysis, Workshop Organizer MICCAI 2010, Beijing, China

Sept 2010, "Atlas-Based Classification ABC", Workshop MICCAI'10 "The NAMIC Platform", Beijing, China

Sept 2010, "Infant Imaging Core: Structural MRI and DTI Processing of Neonates", UNC Chapel Hill, NC

Sept 2010, Progress update USTAR Imaging Cluster, USTAR governing board meeting, Salt Lake City, Utah

Oct 2010, "Fiber tract analysis in infants at risk for autism", ACE-IBIS Meeting, Chicago, USA

Oct 2010, Plenary Talk, Analysis of early brain growth trajectory from longitudinal neuroimage data, NEUROSPIN, Paris, France (invitation J-F Mangin)

Nov 2010, "Spatio-Temporal Image Analysis for Longitudinal and Time-Series Image Data", Asilomars, IEEE conference, Monterey, CA, USA

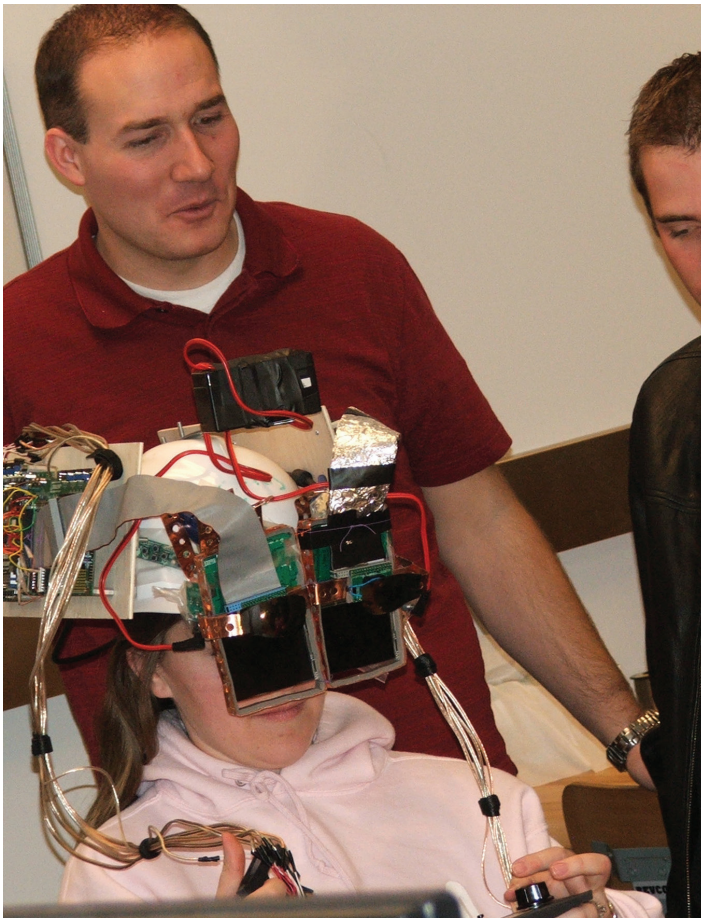
Guido Gerig continued on page 48

Professional Participation

- Editorial Board (Executive Committee) MEDICAL IMAGE ANALYSIS Journal, published by Elsevier B.V., 2000 – today
- Co-editor of MedIA Elsevier special issue on MICCAI'09 conference, published Sept. 2010
- Board Member Medical Image Computing and Computer Assisted Intervention MICCAI (2006- Jan 2010)
- Board Member SPIE Conference IMAGING (2008-today)
- Program Committee 2010: ISBI, CVR
- Reviewer for journals: IEEE TMI, MedIA, NeuroImage, IEEE PAMI, Academic Radiology, JMIV
- Program Committee MICCAI 2009 (area chair, paper selection comm., paper award coordination)
- Program Committee IPMI 2009 (paper selection)
- Program Committee 2009: SPIE, CVPR, ISBI, ICCV

Honors & Awards

Fellow of the American Institute for Medical and Biological Engineering (AIMBE) 2010



Students present projects during Computer Engineering Demo Day



Ganesh Gopalakrishnan
Professor

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Ganesh L. Gopalakrishnan earned his PhD in Computer Science from Stony Brook University in 1986, joining Utah the same year. He spent a year each at the University of Calgary (1988), visiting Stanford University (1995), and at Intel, Santa Clara (2002). During his 2009 sabbatical, he helped establish the Center for Parallel Computing at Utah and serves as its Director. He facilitated a pilot offering of Microsoft's Practical Parallel and Concurrent Programming course at Utah during Fall 2010. His currently active projects are in scalable dynamic verification methods for message passing interface (MPI) programs, symbolic verification methods for GPU kernels, building verification tool integration frameworks, and prototyping formal analysis methods for multicore communication APIs, and also building FPGA based multicore systems including these APIs. He advises many PhD, MS, BS/MS, and BS students on a variety of topics - all described at <http://www.cs.utah.edu/fv>. He will serve as PC co-chair for CAV 2011 at Snowbird, UT. He has authored a textbook "Computation Engineering: Applied Automata Theory and Logic," and about 130 research papers. His research is supported by NSF, Microsoft, and SRC.

Publications

Refereed Journals

I. Melatti, R. Palmer, G. Sawaya, Y. Yang, R. M. Kirby, and G. Gopalakrishnan, "Parallel and distributed model checking in Eddy," STTT 11(1): pp. 13-25 (2009).

S. Pervez, G. Gopalakrishnan, R. M. Kirby, R. Thakur, and W. Gropp, "Formal methods applied to high performance computing software design: a case study of MPI one-sided communication based locking," Software: Practice and Experience, Published online December 2009, Hardcopy issue is 2010: Vol 40, (1), pp. 23-43.

Y. Yang, X. Chen, G. Gopalakrishnan and R. M. Kirby, "Distributed dynamic partial order reduction," Journal on Software Tools for Technology Transfer, Vol. 12, Issue 2 (2010), pp. 113-122.

X. Chen, Y. Yang, G. Gopalakrishnan, and C-T. Chou, "Efficient Methods for Formally Verifying Safety Properties of Hierarchical Cache Coherence Protocols," Formal Methods in System Design, Vol. 36,(1), February, 2010, pp. 37-64.

Refereed Conference and Workshops

S. Ananthakrishnan, M. Delisi, S. S. Vakkalanka, A. Vo, G. Gopalakrishnan, R. M. Kirby, R. Thakur, "How Formal Dynamic Verification Tools Facilitate Novel Concurrency Visualizations," PVM/MPI 2009. pp. 261-270

S. S. Vakkalanka, G. Szubzda, A. Vo, G. Gopalakrishnan, R. M. Kirby, R. Thakur, "Static-Analysis Assisted Dynamic Verification of MPI Waitany Programs (Poster Abstract)," PVM/MPI 2009. pp. 329-330

Y. Yang, X. Chen, G. Gopalakrishnan, C. Wang, "Automatic Discovery of Transition Symmetry in Multithreaded Programs Using Dynamic Analysis," SPIN 2009. pp. 279-295

A. Vo, S. S. Vakkalanka, M. Delisi, G. Gopalakrishnan, R. M. Kirby, R. Thakur, "Formal verification of practical MPI programs," PPOPP 2009. pp. 261- 270

G. Gopalakrishnan, Y. Yang, S. S. Vakkalanka, A. Vo, S. Aananthakrishnan, G. Szubzda, G. Sawaya, J. Williams, S. Sharma, M. Delisi, S. Atzeni, "Some resources for teaching concurrency," PADTAD 2009. ISBN: 978-1-60558-655-7

A. Vo, S. S. Vakkalanka, J. Williams, G. Gopalakrishnan, R. M. Kirby, R. Thakur, "Sound and Efficient Dynamic Verification of MPI Programs with Probe Non-determinism," PVM/MPI 2009. pp. 271-281

S. S. Vakkalanka, A. Vo, G. Gopalakrishnan, R. M. Kirby, "Reduced Execution Semantics of MPI: From Theory to Practice," FM 2009. pp. 724-740

S. Sharma, G. Gopalakrishnan, E. Mercer, J. Holt, "MCC: A runtime verification tool for MCAPI user applications," FMCAD 2009: pp. 41-44

G. Li, R. Palmer, M. DeLisi, G. Gopalakrishnan, and R. M. Kirby, "Formal Specification of MPI 2.0: Case Study in Specifying a Practical Concurrent Programming API," Electronic Edition Available at DOI URL <http://dx.doi.org/10.1016/j.scico.2010.03.007>, 2010.

G. Gopalakrishnan and R. M. Kirby, "Top Ten Ways to make Formal Methods for HPC Practical," 2010 FSE/SDP Workshop on the Future of Software Engineering Research, Santa Fe, NM, November, ACM, 2010. pp. 137-141.

A. Vo, S. Aananthakrishnan, G. Gopalakrishnan, B. R. de Supinski, M. Schulz, and G. Bronevetsky, "A Scalable and Distributed Dynamic Formal Verifier for MPI Programs," Supercomputing 2010, New Orleans, LA. pp. 1-10.

S. Vakkalanka, A. Vo, G. Gopalakrishnan, and R.M. Kirby, "Precise Dynamic Analysis for Slack Elasticity: Adding Buffer Without Adding Bugs," Recent Advances in the Message Passing Interface, 17th European MPI Users' Group Meeting, EuroMPI 2010, September 2010, LNCS 6305, Stuttgart, Germany. pp.152-159.

W-F. Chiang, G. Szubzda, G. Gopalakrishnan, and R. Thakur, "Dynamic Verification of Hybrid Programs," EuroMPI, 2010, LNCS 6305, Stuttgart, Germany. pp. 298-301.

A. Humphrey, C. Derrick, G. Gopalakrishnan, and B. R. Tibbitts, "GEM: Graphical Explorer for MPI Programs," Parallel Software Tools and Tool Infrastructures (ICPP workshop), 2010. pp. 161-168.

G. Li and G. Gopalakrishnan, "Scalable {SMT}-based verification of {GPU} kernel functions," ACM Foundations of Software Engineering, 2010, pp. 187-196.

G. Li, G. Gopalakrishnan, R. M. Kirby, D. Quinlan, "A symbolic verifier for CUDA programs," PPOPP 2010: pp. 357-358.

Invited Talks & Presentations

G. Gopalakrishnan, M. S. Muller, and B. R. de Supinski, "Scalable Dynamic Formal Verification and Correctness Checking of MPI Applications," Half Day Tutorial, Supercomputing, New Orleans, Nov 15, 2010

Professional Participation

Editorial Board: Formal Methods in System Design journal (Springer).

2009

- *Tutorials Committee*, Supercomputing Conference (SC), Portland, OR, 2009
- *General Chair*, Workshop on Parallel and Distributed Systems: Testing, Analysis, and Debugging (PADTAD), Chicago, 2009
- One Day Invited Tutorial, The 16th EuroMPI Conference, Turku 2009
- *Organizing Committee*, Exploiting Concurrency Efficiently and Correctly (EC2), Edinburgh, UK 2010

PC Member,

- The 16th EuroMPI Conference, Turku 2009
- 8th International Workshop on Parallel and Distributed Methods in Verification (PDMC) 2009
- Formal Methods in Computer-Aided Design (FMCAD), 2009
- Methods and Models for CoDesign (MEMOCODE) 2009

2010

PC Member

- Workshop on Parallel and Distributed Systems: Testing, Analysis, and Debugging, Trento, 2010
- Computer Aided Verification 2010, Edinburgh, UK
- Exploiting Concurrency Efficiently and Correctly, Edinburgh, UK 2010
- MEMOCODE 2010, Methods and Models for Co-Design, Grenoble 2010
- The 17th EuroMPI Conference, Stuttgart 2010
- Parallel Software Tools and Tool Infrastructures 2010
- 9th International Workshop on Parallel and Distributed Methods in Verification, 2010
- 17th Spin Workshop, Twente University, 2010
- Formal Methods in Computer Aided Design, Lugano 2010

- Director, Center for Parallel Computing at Utah (CPU), formed in 2010



Mary Hall

Associate Professor

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Mary Hall is an associate professor. Her research focuses on compiler technology for exploiting performance-enhancing features of a variety of computer architectures, with a recent emphasis on many-core graphics processors and multi-core nodes in supercomputers. Prior to joining University of Utah, Professor Hall held positions at University of Southern California, Caltech, Stanford and Rice University.

Professor Hall's current research involves developing compiler-based autotuning technology, and applying it to application domains that include molecular dynamics, biomedical imaging, signal processing and social networks. Autotuners experiment with a set of alternative application mapping strategies to select the mapping that best exploits architectural features such as deep memory hierarchies, specialized compute engines and multiple cores.

Professor Hall is an ACM Distinguished Scientist. She has published over 70 refereed articles and given more than 50 invited presentations. She has led a total of 30 projects funded by NSF, DARPA, DOE, NSA and Intel Corporation. She has served on over 45 program committees in compilers and their interaction with architecture, parallel computing, and embedded and reconfigurable computing, including 2009 program chair of the Code Generation and Optimization Conference, and 2010 program chair of the ACM Symposium on Principles and Practice of Parallel Programming. She serves as chair of the ACM History Committee, and as a member of the IEEE Computer Society Awards Committee. She also participates in outreach programs to encourage the participation of women in computer science.

Publications

Refereed Journals

J. Shin, M. Hall and J. Chame, "Evaluating Compiler Technology for Control-Flow Optimizations for Multimedia Extension Architectures," *International Journal of Embedded Systems*, 2009. 33(4) pp. 235-243.

M. Hall, D. Padua and K. Pingali, "Compiler Research: The Next Fifty Years," *Communications of the ACM*, Feb. 2009. 52(2) pp. 60-67.

T. Kurc, S. Hastings, V. Kumar, S. Langella, A. Sharma, T. Pan, S. Oster, D. Ervin, J. Permar, S. Narayanan, Y. Gil, E. Deelman, M. Hall, J. Saltz "HPC and Grid Computing for Integrative Biomedical Research," *International Journal of High Performance Computing*, 2009. 23(3) pp. 252-264.

V.S. Kumar, T. Kurc, V. Ratnakar, J. Kim, G. Mehta, K. Vahi, Y.L. Nelson, P. Sadayappan, E. Deelman, Y. Gil, M. Hall and J. Saltz, "Parameterized specification, configuration and execution of data-intensive scientific workflows," *Cluster Computing*,

April 2010. 13(3) pp. 315-333.

Refereed Conference and Workshops

M. Demertzi, P. C. Diniz, M. W. Hall, A. C. Gilbert, and Y. Wang. "Computation reuse in domain-specific optimization of signal recognition (poster)." In *Proceeding of the ACM/SIGDA international symposium on Field programmable gate arrays (FPGA '09)*, Feb. 2009, p. 281.

A. Tiwari, C. Chen, J. Chame, M. Hall and J. K. Hollingsworth, "A Scalable Autotuning Framework for Compiler Optimization," *Proceedings of the International Parallel and Distributed Processing Symposium*, May, 2009. pp. 1-12.

V. S. Kumar, P. Sadayappan, G. Mehta, K. Vahi, E. Deelman, V. Ratnakar, J. Kim, Y. Gil, M. Hall, T. Kurc, J. Saltz, "An Integrated Framework for Parameter-based Optimization of Scientific Workflows," *Proceedings of the International Symposium on High Performance Distributed Computing*, June, 2009. pp. 177-186.

W. Chiang, M. DeLisi, T. Hummel, T. Prete, K. Tew, M. Hall, P. Wallstedt, and J. Guilkey, "GPU Acceleration of the Generalized Interpolation Material Point Method," *Symposium on Application Accelerators for High Performance Computing*, July, 2009.

K. Venkataraju, M. Kim, D. Gerszewski, J. R. Anderson, and M. Hall, "Assembling Large Mosaics of Electron Microscope Images using GPU," (poster) *Symposium on Application Accelerators for High Performance Computing*, July, 2009.

J. Shin, M. W. Hall, J. Chame, C. Chen, P. F. Fischer, P. D. Hovland, "Autotuning and Specialization: Speeding up Nek5000 with Compiler Technology," (poster) *SC'09*, Nov. 2009.

J. Shin, M. W. Hall, J. Chame, C. Chen, P. Fischer, P. D. Hovland, "Autotuning and Specialization: Speeding up Nek5000 with Compiler Technology," *International Conference on Supercomputing*, June, 2010. pp. 253-262.

B. Peterson, M. Datar, M. Hall and R. Whitaker, "GPU Accelerated Particle System for Triangulated Surface Meshes," (poster) *Symposium on Application Accelerators for High Performance Computing*, July, 2010.

Gagandeep S. Sachdev, Vishay Vanjani and Mary W. Hall, "Takagi Factorization on GPU using CUDA," (poster) *Symposium on Application Accelerators for High Performance Computing*, July, 2010.

G. Rudy, M. Khan, M. Hall, C. Chen, and J. Chame, "A Programming Language Interface to Describe Transformations and Code Generation," *Proceedings of the*

International Workshop on Languages and Compilers for Parallel Computing, Oct. 2010.

M. Khan, G. Rudy, C. Chen, M. Hall, J. Chame, "CUDA-CHILL: Using Compiler-Based Autotuning to Generate High-Performance GPU Libraries," (poster) SC'10, Nov. 2010.

Book Chapters

J. Shin, M. W. Hall, J. Chame, C. Chen, P. D. Hovland, "Software Autotuning and Specialization: Speeding up Matrix Multiply for Small Matrices with Compiler Technology," Automatic Tuning: from concepts to state-of-the-art results, edited by Keita Teranishi, John Cavazos, Ken Naono and Reiji Suda, 2010.

M. Hall, J. Chame, C. Chen, J. Shin and G. Rudy, "Loop Transformation Recipes for Code Generation and Auto-Tuning," Lecture Notes in Computer Science, 2010, Volume 5898, Languages and Compilers for Parallel Computing, Pages 50-64.

Invited Talks & Presentations

"Autotuning Compiler Technology to Support Architectural Diversity," Dept. of Electrical and Computer Engineering, Brigham Young University, Provo, UT, January, 2009

"Big Questions in Autotuning," DOE SciDAC Center for Scalable Application Development Software Workshop on Libraries and Autotuning for Petascale Applications, August, 2009

"Collaborative Autotuning of Scientific Applications," SIAM Parallel Processing Symposium, Feb. 2010

"Paving the Way for Programming Extreme Scale Systems," DOE Institute for Computing in Science, Future of the Field Workshop, Jul. 2010

"Compiler-Based Auto-tuning for Application and Library Code," DOE SciDAC Center for Scalable Application Development Software Workshop on Libraries and Autotuning for Petascale Applications, August, 2010

"Next Generation Compiler," Panelist, DOE SciDAC Center for Scalable Application Development Software Workshop on Libraries and Autotuning for Petascale Applications, August, 2010

"A Programming Language Interface to Describe Transformations and Code Generation for Auto-Tuning," ASPLOS Program Committee Symposium, CMU, October 2010

Professional Participation

National Technical Leadership

- Report co-author and study participant, "ExaScale Software Study: Software Challenges in Extreme Scale Systems," DARPA IPTO, Sept. 2009
- Participant, DOE Extreme Architecture and Technology Workshop, Dec. 2009
- Report co-author, "Seven Years of Computer Science Breakthroughs," DOE Office of Science, 2010 (report to appear)
- Participant, "The NSF Workshop on Future Directions of Computer System Research in 2010" Mar. 2010
- Workshop co-organizer and report co-author, "NSF Workshop on Archiving Experiments to Raise the Level of Scientific Research," May 2010 (report to appear)

Leadership in ACM and IEEE

- Chair, ACM History Committee, 2009 to present
- Member IEEE Computer Society Cray, Fernbach and Kennedy Awards Committee, 2009, 2010
- Chair, ACM and IEEE-CS Ken Kennedy Awards Committee, 2010
- Steering Committee, ACM SIGPLAN Programming Language Design and Implementation, 2010

Conference Organization

- Program Chair, CGO 2009
- Program Committee, International Workshop on Application Performance Tuning, 2009
- Program Committee, ACM/IEEE Parallel Architecture and Compilation Techniques, 2009
- Awards Chair, SC09
- Program Chair, ACM PPOPP 2010
- External Review Committee, ACM SIGPLAN Programming Language Design and Implementation, 2010

Honors & Awards

ACM Distinguished Scientist 2010



Chuck Hansen

Professor

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hansen@cs.utah.edu

Charles (Chuck) Hansen is a Professor of Computer Science and an Associate Director of the Scientific Computing and Imaging Institute at the University of Utah.

He received a B.S. in computer science from Memphis State University in 1981 and a Ph.D. in computer science from the University of Utah in 1987. He was a visiting scientist at INRIA-Rhone Alpes in the GRAVIR group in 2004-2005.

From 1997 to 1999, he was a research associate professor in Computer Science at Utah. From 1989 to 1997, he was a Technical Staff Member in the Advanced Computing Laboratory (ACL) located at Los Alamos National Laboratory, where he formed and directed the visualization efforts in the ACL. He was a Bourse de Chateaubriand PostDoc Fellow at INRIA, Rocquencourt France, in 1987 and 1988.

Chuck Hansen has published over 100 peer reviewed journal and conference papers and has been a co-author on three papers recognized with "Best Paper Awards" at the IEEE Visualization Conference (1998, 2001, 2002). He was co-author on the Best Paper at IEEE Pacific Visualization 2010. He was awarded the IEEE Technical Committee on Visualization and Graphics "Technical Achievement Award" in 2005 in recognition of seminal work on tools for understanding large-scale scientific data sets.

He has been Associate Editor in Chief of IEEE Transactions on Visualization and Computer Graphics. His research has made contributions to the fields of scientific visualization, computer graphics, parallel computation and computer vision.

Publications

Refereed Journals

J. Brouillat, C. Bouville, B. Loos, C. Hansen, K. Bouatouch, "A Bayesian Monte Carlo Approach to Global Illumination", *Computer Graphics Forum Journal*, Volume 28 Issue 8, Pages 2315 - 2329, October 2009.

E. W. Bethel, C. Johnson, S. Ahern, J. Bell, P.-T. Bremer, H. Childs, E. Cormier-Michel, M. Day, E. Deines, T. Fogal, C. Garth, C. G. R. Geddes, H. Hagen, B. Hamann, C. Hansen, J. Jacobsen, K. Joy, J. Kreuger, J. Meredith, P. Messmer, G. Ostrouchov, V. Pascucci, K. Potter, Prabhat, D. Pugmire, O. Reubel, A. Sanderson, C. Silva, D. Ushizima, G. Weber, B. Whitlock, K. Wu, "Occam's razor and petascale visual data analysis", *Journal of Physics: Conference Series*, vol. 180, 2009.

A. Knoll, Y. Hijazi, R. Westerteiger, M. Schott, C. Hansen, H. Hagen, "Volume Ray Casting with Peak Finding and Differential Sampling," *IEEE Transactions on Visualization and Computer Graphics*, Volume 15, Number 6, 2009, pp. 1571-1578.

Y. Wan, H. Otsuna, C.-B. Chien, and C. Hansen, "An Interactive Visualization Tool for Multi-channel Confocal Microscopy Data in Neurobiology Research," *IEEE Transactions on Visualization and Computer Graphics*, Volume 15, Number 6, 2009, pp. 1489-1496.

M. Schott, V. Pegorara, C. Hansen, K. Boulanger, K. Bouatouch, "A Directional Occlusion Shading Model for Interactive Direct Volume Rendering," *Computer Graphics Forum Journal*, Volume 28, Number 3, 2009, pp. 855-862.

A. Knoll, Y. Hijazi, A. Kensler, M. Schott, C. Hansen, and H. Hagen, "Fast Ray Tracing of Arbitrary Implicit Surfaces with Interval and Affine Arithmetic," *Computer Graphics Forum Journal*, Volume 28, Number 1, 2009, pp. 26-40.

A. Knoll, I. Wald and C. Hansen, "Coherent Multiresolution Isosurface Ray Tracing," *The Visual Computer*, Volume 25, Number 3, 2009, pp. 209-225.

Refereed Conference and Workshops

A. Knoll, Y. Hijazi, R. Westerteiger, M. Schott, C.D. Hansen, H. Hagen. "Volume Ray Tracing with Root-Finding and Differential Sampling," *In IEEE Transactions on Visualization and Computer Graphics, Proceedings of the 2009 IEEE Visualization Conference*, pp. 1571-1578. (Sept/Oct, 2009).

C.D. Hansen, C.R. Johnson, V. Pascucci, C.T. Silva. "Visualization for Data-Intensive Science," *In The Fourth Paradigm of Scientific Discovery*, Edited by Dan Fay, Kristin Tolle and Tony Hey, Microsoft Research, 2009. pp. 153-163.

Y. Wan, C. Hansen, "Fast Volumetric Data Exploration with Importance-Based Accumulated Transparency Modulation," *IEEE/EG Symposium on Volume Graphics 2010*, pages 61-68, Norrkoping, Sweden, 2010.

C. Brownlee, V. Pegoraro, S. Shankar, P. McCormick, C. Hansen, "Physically-Based Interactive Schlieren Flow Visualization," *IEEE Pacific Vis 2010*, pages 145-152, Taipei, Taiwan, 2010.

Books

C. Hansen, C. R. Johnson, V. Pascucci, C. T. Silva, "Visualization for Data-Intensive Science", *The Fourth Paradigm: Data-Intensive Scientific Discovery*, Microsoft Research, Edited by Tony Hey, Stewart Tansley, and Kristin Tolle, ISBN: 978-0-9825442-0-4, pages 153-164, 2009.

C. Garth, G.-S. Li, X. Tricoche, C. D. Hansen and H. Hagen, "Visualization of Coherent Structures in Transient Flows," *Topology-Based Methods in Visualization II*, Springer, Mathematics and Visualization Series, ISBN: 978-3-540-88605-1, pages 1-13, 2009.

Invited Talks & Presentations

"Parallel Visualization: Has It Come Of Age?," Keynote, Eurographics Parallel Graphics and Visualization, Norrkoping, May 2010



“Interactive Texture-based Flow Visualization”, Distinguished Lecture, Fraunhofer Institute for Graphics and Interaction”, Darmstadt, June 2009

“Biomedical Computing and Visualization at SCI”, University of Kaiserslautern, May 2010

Introduction to Scientific Visualization, KAUST Winter Enrichment Program, 2010

“VACET: Visualization and Analytics Center for Enabling Technologies”, International Supercomputing Conference, Hamburg, June 2009

“Interactive Texture-based Flow Visualization”, University of Kaiserslautern, June 2009

“Multi-Field Volume Visualization”, IAMCS Spring Symposium, May 2009

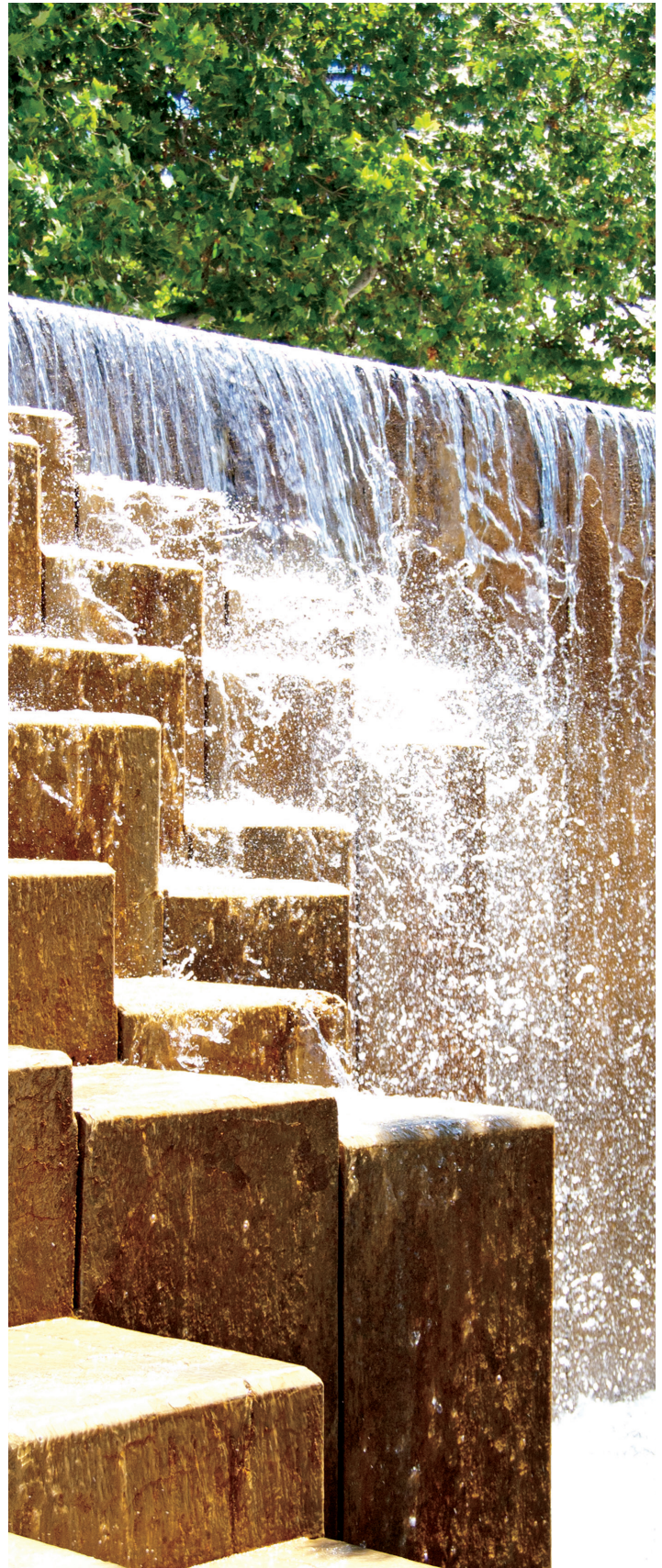
“Large-scale Scientific Visualization”, IAMCS Colloquium, TAMU, May 2009

Professional Participation

- Conferenc Co-Chair: Eurographics and IEEE-CS, Symposium on Volume Graphics 2010
- Program Committee: Eurographics 2011
- Program Committee: Pacific Vis 2010
- Program Committee: VMV 2010
- Program Committee: Pacific Vis 2009
- Program Committee: VMV 2009
- Program Committee: Pacific Vis, 2009
- Program Committee: ACM Super Computing , 2009
- Program Committee: TopoVis: Topological Methods for Visualization, 2009
- Program Committee: ACM I3D, 2009
- Scientific Advisory Board: RIVIC, Wales 2009, 2010
- External Advisory Board: Computer Integrated Systems for Microscopy and Manipulation, UNC 2009, 2010
- Advisory Board, RENC1 2009
- Advisory Board, LLNL Computation Division, 2009
- DOE Panel Review 2009
- NSF Panel Review 2009

Honors & Awards

Best Paper Award “Physically-Based Interactive Schlieren Flow Visualization,” IEEE Pacific Visualization 2010, March 2010



University of Utah Campus



Tom Henderson

Professor

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tch@cs.utah.edu

Thomas C. Henderson received his B.S. in Math from Louisiana State University in 1973 and his Ph.D. in Computer Science from the University of Texas at Austin in 1979. He is currently a full Professor in the School of Computing at the University of Utah. He has been at Utah since 1982, and was a visiting professor at DLR in Germany in 1980, and at INRIA in France in 1981 and 1987, and at the University of Karlsruhe, Germany in 2003. Prof. Henderson was chairman of the Department of Computer Science at Utah from 1991-1997, and was the founding Director of the School of Computing from 2000-2003.

Prof. Henderson is the author of *Discrete Relaxation Techniques* (University of Oxford Press), and editor of *Traditional and Non-Traditional Robotic Sensors* (Springer-Verlag); he serves as Co-Editor-in-Chief of the *Journal of Robotics and Autonomous Systems* and was an Associate Editor for the *IEEE Transactions on Pattern Analysis and Machine Intelligence*. His research interests include autonomous agents, robotics and computer vision, and his ultimate goal is to help realize functional androids. He has produced over 200 scholarly publications, and has been principal investigator on over \$8M in research funding. Prof. Henderson is a Fellow of the IEEE, and received the Governor's Medal for Science and Technology in 2000. He enjoys good dinners with friends, reading, playing basketball and hiking.

Professor Henderson's primary areas of research are autonomous intelligent systems, smart sensor networks, parallel programming, and digital image/map analysis.

Publications

Refereed Journals

X. Xue and T. C. Henderson, "Feature Fusion for Basic Behavior Unit Segmentation from Video Sequences," *Robotics and Autonomous Systems*, Vol. 57, No. 3, pp. 239-248, March 2009

T. C. Henderson, T. Linton, S. Potupchik and A. Ostanin, "Automatic Segmentation of Semantic Classes in Raster Map Images," *IAPR Workshop on Graphics Recognition*, La Rochelle, France, pp. 253-262, July 22-23, 2009

T. C. Henderson and T. Linton, "Raster Map Image Analysis," *IEEE International Conference on Document Analysis and Recognition*, Barcelona, Spain, pp. 376-380, July 26-29, 2009

Refereed Conference and Workshops

T. C. Henderson, X. Fan, A. Alford, E. Grant and E. Cohen, "Innate Theories as a Basis for Autonomous Mental Development," *IEEE Workshop on Autonomous Mental Development in Intelligent Systems*, St. Louis, MO, 11 October, 2009.

"Target Localization in Unknown Environments using Static Wireless Sensors and

Mobile Robots," *IEEE Conference on Multisensor Fusion and Integration for Intelligent Sensors*, Salt Lake City, UT, 5-7 September, 2010.

Book

T.C. Henderson, "Computational Sensor Networks," Springer, 2009. ISBN: 978-0-387-09642-1

Book Chapter

F. Sawo, T. C. Henderson, C. Sikorski, and U. D. Hanebeck, "Passive Localization Methods exploiting Models of Distributed Natural Phenomena," *Lecture Notes in Electrical Engineering* (Collection of best papers from MFI 2008), Springer, 2009.

Invited Talks & Presentations

"Computational and Cognitive Sensor Networks," *Sensor Networks and Applications*, San Francisco, CA, November 2009 (Keynote talk)

"Innate Theories as a Basis for Autonomous Mental Development," *IEEE Workshop on Autonomous Mental Development*, October 2009

"Plato Vindicated: Learning is Remembering," *Humanoids at Home Symposium*, Karlsruhe, Germany, October 2009

"Computational Sensor Networks," *NSF-ARO-ONR Workshop on Distributed Video Sensor Networks*, Riverside, CA, May 2009

"Educational Opportunities in Video Sensor Networks," *NSF-ARO-ONR Workshop on Distributed Video Sensor Networks*, Riverside, CA, May 2009

"Cloud Robotics," *Schloss Dagstuhl*, 4-8 October, Wadern, Germany, 2010

"Cognitive Sensor Networks," *Tutorial, Multisensor Fusion and Integration for Intelligent Systems*, Salt Lake City, UT, 4 September, 2010

"The Robotics Research Roadmap and Initiative," *IEEE Conference on Intelligent Robots and Systems*, Taipei, Taiwan, 20 October 2010

Professional Participation

- Regional Program Chair, *IEEE Conference on Intelligent Robots and Systems*, Taipei, Taiwan, 18-22 October 2010

- General Chair, *IEEE Conference on Multisensor Fusion and Integration for Intelligent Systems*, Salt Lake City, UT, 5-7 September 2010



Lee Hollaar
Professor

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Lee A. Hollaar received his B.S. Electrical Engineering from Illinois Institute of Technology in 1969, his M.S. and Ph.D. in Computer Science at the University of Illinois in 1974 & 1975 and was a Non-matriculated student at the University of Utah College of Law, 1989-1993. During his 1996-97 sabbatical, he was a Committee Fellow at the Senate Judiciary Committee, where he worked on patent reform legislation, database protection, and what eventually became the Digital Millennium Copyright Act. He was also a visiting scholar with Circuit Judge Randall R. Rader at the Court of Appeals for the Federal Circuit.

His past research was on hardware and software tradeoffs in system design, particularly as they apply to systems handling large text databases. He is the co-inventor of a new method of rapidly searching text stored and was the primary architect for perhaps the first distributed, workstation-based information retrieval system. He also worked on avionics and navigation systems.

He was Director of Campus Networking during the development of the University's campus-wide data communications network, and remains interested in distributed systems and telephony. Prior to coming to Utah, he designed and supervised the construction of the first campus-wide data network at the University of Illinois at Urbana-Champaign.

Professor Hollaar's current research interests center on intellectual property and computer law. He is the author of "Legal Protection of Digital Information," which covers copyrights and patents for computer software and other digital works, published in 2002 by BNA Books and available on the Internet at no cost.

Publications

Brief of Professor Lee A. Hollaar and IEEE-USA as amici curiae to the Supreme Court of the United States in *Bilski v. Kappos*, September 1, 2009. (Lee wrote the brief, and IEEE-USA joined it.)



John Hollerbach
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John M. Hollerbach received his B.S. in Chemistry from the University of Michigan in 1968, his M.S. in Mathematics from the University of Michigan in 1969, his S.M. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology in 1975, and his Ph.D. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology in 1978.

Publications

Refereed Journals, Conference and Workshops

Grieve, T., Sun, Y., Hollerbach, J.M., and Mascaro, S.A., "3-D force control on the human fingerpad using a magnetic levitation device for fingernail image calibration," World Haptics Conference, Salt Lake City, UT, March 18-20, 2009, pp. 411-416.

Kulkarni, S., Fisher, C., Pardyjak, E., Minor, M., and Hollerbach, J.M., "Wind display device for locomotion interface in a virtual environment," World Haptics Conference, Salt Lake City, UT, March 18-20, 2009, pp. 184-189.

Sun, Y., Hollerbach, J.M., and Mascaro, S.A., "Estimation of finger force direction with computer vision," IEEE Trans. Robotics, 25, 2009, pp. 1356-1369.

Grieve, T., Lincoln, L., Sun, Y., Hollerbach, J.M., and Mascaro, S.A., "3D force prediction using fingernail imaging with automated calibration," Haptics Symposium, March 25-26, 2010, Waltham, MA, pp. 113-120.

Invited Talks & Presentations

September 10-11, 2010: "The Year(s) of the Robot," invited lecture, Mike Brady Symposium, University of Oxford, UK

June 18, 2010: "Finger force measurement by imaging the fingernail," keynote lecture, 7th International Conference in Control, Automation and Robotics (ICINCO 2010), Madeira, Portugal

October 4-6, 2009: "Medical robotics," invited presentation, Science and Technology for Society Forum, Kyoto, Japan

Professional Participation

- Editor-in-Chief, International Journal of Robotics Research, 2000-present
- Vice President for Technical Activities, IEEE Robotics and Automation Society, 2010-2011
- International Foundation of Robotics Research, USA Regional Officer, 2002-present



Students

photo credit: Yong Wan



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Chris Johnson directs the Scientific Computing and Imaging (SCI) Institute at the University of Utah where he is a Distinguished Professor of Computer Science and holds faculty appointments in the Departments of Physics and Bioengineering. His research interests are in the areas of scientific computing and scientific visualization. Dr. Johnson founded the SCI research group in 1992, which has since grown to become the SCI Institute employing over 175 faculty, staff and students. Professor Johnson serves on several international journal editorial boards, as well as on advisory boards to several national and international research centers. Professor Johnson has received several awards, including the NSF Presidential Faculty Fellow (PFF) award from President Clinton in 1995 and the Governor's Medal for Science and Technology in 1999. He is a Fellow of the American Institute for Medical and Biological Engineering and a Fellow of the American Association for the Advancement of Science, and in 2009 he was elected a Fellow of the [Society for Industrial and Applied Mathematics \(SIAM\)](#) and received the [Utah Cyber Pioneer Award](#). In 2010 Professor Johnson received the [Rosenblatt Award](#) from the University of Utah and the [IEEE Visualization Career Award](#).

Publications

Refereed Journals

E. W. Bethel, C. Johnson, S. Ahern, J. Bell, P.-T. Bremer, H. Childs, E. Cormier-Michel, M. Day, E. Deines, T. Fogal, C. Garth, C. G. R. Geddes, H. Hagen, B. Hamann, C. Hansen, J. Jacobsen, K. Joy, J. Kruger, J. Meredith, P. Messmer, G. Ostrouchov, V. Pascucci, K. Potter, Prabhat, D. Pugmire, O. Rubel, A. Sanderson, C. Silva, D. Ushizima, G. Weber, B. Whitlock, K. Wu "Occam's razor and petascale visual data analysis. *Journal of Physics: Conference Series*, Volume 180, Number 1, 012084, 2009.

R. S. MacLeod, J.G. Stinstra, S. Lew, R.T. Whitaker, D.J. Swenson, M.J. Cole, J. Krueger, D.H. Brooks, and C.R. Johnson. "Subject-specific, multiscale simulation of electrophysiology: the software pipeline for image based models and application examples. *Philosophical Transactions of the Royal Society A*, Jun. 13;367(1896):2293-310, 2009.

A.R. Sanderson, M.R. Meyer, R.M. Kirby, and C.R. Johnson. "A Framework for Exploring Numerical Solutions of Advection Reaction Diffusion Equations using a GPU Based Approach. *Journal of Computing and Visualization in Science*, Vol. 12, pp. 155-170, 2009.

H. Martinez, S. Prajapati, C. Estrada, F. Jimenez, I. Wu, A. Bahadur, A. Sanderson, C.R. Johnson, M. Shim, C. Keller, and S. Ahuja. "microCT-based virtual histology for visualization and morphometry of atherosclerosis in diabetic ApoE mutant mice. *Circulation*, 120:821-822, 2009.

J.F. Shepherd, C. R. Johnson, Hexahedral Mesh Generation for Biomedical Models

in SCIRun, *Engineering with Computers*, vol. 25, issue 1, pp. 97-114, 2009.

M. Callahan, M. J. Cole, J.F. Shepherd, J. Stinstra, C. R. Johnson, A Meshing Pipeline for Biomedical Models, *Engineering with Computers*, vol. 25, issue 1, pp. 115-130, 2009.

K. Potter, J.M. Kniss, R. Riesenfeld, C.R. Johnson. "Visualizing Summary Statistics and Uncertainty," In *Computer Graphics Forum, Proceedings of Eurovis 2010*, Vol. 29, No. 3, pp. 823--831. 2010.

A.A. Samsonov, J.V. Velikina, Y.K. Jung, E.G. Kholmovski, C.R. Johnson, and W.F. Block. POCS-enhanced correction of motion artifacts in parallel MRI. *Magnetic Resonance in Medicine*, Volume 63, Issue 4, pages 1104-1110, May 2010.

Refereed Conference and Workshops

D.F. Wang, R.M. Kirby, C.R. Johnson. "Resolution Strategies for the Finite-Element-Based Solution of the ECG Inverse Problem," In *IEEE Transactions on Biomedical Engineering*, Vol. 57, No. 2, pp. 220--237. February, 2010.

K. Potter, A. Wilson, P. Bremer, D. Williams, C. Doutraux, V. Pascucci, and C.R. Johnson. "Visualization of uncertainty and ensemble data: Exploration of climate modeling and weather forecast data with integrated VISUS-CDAT systems. Proceedings of the 2009 IEEE International Conference on Data Mining Workshop on Knowledge Discovery from Climate Data: Prediction, Extremes, and Impacts, pp. 233-240, 2009.

Book Chapters

C. Hansen, C.R. Johnson, V. Pascucci, and C. Silva. "Visualization for Data-Intensive Science. In *The Fourth Paradigm: Data-Intensive Science*, S. Tansley, T. Hey, and K. Tolle, eds. pp. 153-164, 2009.

Invited Talks & Presentation

Biomedical Visualization, Oxford University, December 2010

Visualizing Uncertainty, Future Directions in Uncertainty Quantification, Santa Fe, November 2010

Visual Computing: Making Sense of a Complex World, Bucknell University, Lewisburg, October 2010 (Emerging Minds Series)

Image-Based Biomedical Modeling, Simulation, and Visualization, IEEE Cluster 2010, Crete, Greece, September 2010 (Keynote Speaker)

Extreme-Scale Biomedical Visualization, ICIS Workshop: Future of the Field,

Snowbird, July 2010

Image-Based Biomedical Modeling, Simulation, and Visualization, Wright State University, Dayton, May 2010 (2010 Mazumdar Lecture in Applied Mathematics)

Image-Based Biomedical Modeling, Simulation, and Visualization, Mathematical Biosciences Institute, Ohio State University, May 2010

Biomedical Modeling, Simulation, and Visualization Software Tools}, 2010 Association for Clinical Research Training/ Society for Clinical and Translational Science (ACRT/ SCTS) Joint Annual Meeting, Washington, DC, April 2010

Image-Based Biomedical Modeling, Simulation, and Visualization, NIH NCIBI Annual Meeting, Ann Arbor, April 2010 (Keynote Speaker)

Image-Based Biomedical Modeling, Simulation, and Visualization, IEEE Pacific Visualization 2010, Taipei, Taiwan, March 2010 (Keynote Speaker)

Biomedical Applications Confront Large Data in the 21st Century, 2010 AAAS Annual Meeting, San Diego, February 2010

Image-Based Biomedical Modeling and Simulation}, Salt Lake City, September 2009 International Meshing Roundtable (Plenary Speaker)

Large-Scale Visual Data Analysis}, Pacific Northwest National Laboratory, July 2009 (Frontiers in Computational and Information Sciences Lecture Series)

Computing the Future of Biomedicine}, University of Chicago, April 2009 (Distinguished Lecture)

Finite-Element Discretization Strategies for the Electrocardiographic (ECG) Inverse Problem, Inverse Days, Luosto, Finland, December 2009

Biomedical Visualization, Computers in Cardiology, Park City, September 2009

Biomedical Visualization, World Congress on Medical Physics and Biomedical Engineering, Munich, September 2009

Image-Based Biological Computing, DOE Workshop on Biological Computing at Extreme Scale, Chicago, August 2009

Computing the Future, US Library of Congress, Washington, DC, March 2009

Professional Participation

- Journal of Uncertainty, Editorial Board
- Journal of Computational Science, Editorial Board
- DOE Office of Advanced Scientific Computing Research Communications Project Editorial Board
- Visualization and Mathematics, Book Series, Springer-Verlag
- Computing and Visualization in Science, Editorial Board

Advisory Board and National Committees

- NSF Office of Cyberinfrastructure Task Force on Software Infrastructure
- NSF Office of Cyberinfrastructure Task Force on Grand Challenge Communities
- NSF-CRA Computing Community Consortium (CCC)
- Computing Research Association Education Committee
- European Union Virtual Physiological Human Network of Excellence
- Fundamental and Computational Science Directorate Review Committee, Pacific Northwest National Laboratory
- Mathematics Awareness Advisory Committee. Joint Policy Board for Mathematics (SIAM, AMS, ASA, MAA)
- NIH National Center for Biomedical Computation, Stanford University, Scientific Advisory Board
- Finnish Centre of Excellence in Inverse Problems, Scientific Advisory Board
- Bavarian Graduate School of Computational Engineering International Advisory Board
- NIH National Alliance for Medical Image Computing, Chair, Advisory Board
- NCMIR: National Center for Microscopy and Imaging Research, External Advisory Board

Program Committees

- Selection Committee, SIAM/ACM Prize in Computational Science, 2010
- Program Committee, Parallel Processing for Imaging Applications, 2010
- Program Committee, Workshop on Novel Computing for Life Sciences, 2010
- Working Group Co-Chair, DOE Workshop on Scientific Opportunities in Modeling and Simulation at the Extreme Scale for Biological Sciences, 2009

Honors & Awards

- 2009 Utah Cyber Pioneer Award
- 2009 Elected Fellow, Society for Industrial and Applied Mathematics (SIAM)
- 2010 IEEE Visualization Career Award
- 2010 Rosenblatt Award - The University of Utah



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Sneha Kumar Kaseram heads the Advanced Networked Systems Research (ANSR) Group at the University of Utah. His research interests include networks and systems - technologies, protocols and applications encompassing mobile and pervasive systems and wireless networks, network security and reliability, overload and congestion control, multicast communication, Internet pricing, Internet measurements and inferencing.

Publications

Refereed Journals

N. Patwari and S. K. Kaseram, "Temporal Link Signature Measurements for Location Distinction," accepted to appear in IEEE Transactions on Mobile Computing. PrePrint available at the IEEE Digital Library. published online.

S. Jana and Sneha K. Kaseram, "On Fast and Accurate Detection of Unauthorized Access Points Using Clock Skews," in IEEE Transactions on Mobile Computing, vol. 9, no. 3, pages 449-462, March 2010.

N. Patwari, J. Croft, S. Jana, and Sneha K. Kaseram, "High-Rate Uncorrelated Bit Extraction for Shared Secret Key Generation from Channel Measurements," in IEEE Transactions on Mobile Computing, vol. 9, no. 1, pages 17-30, January 2010.

Refereed Conference and Workshops

S. K. Kaseram, "Robust Networks Overload Control During Disasters," in IEEE Workshop on Telecommunications Infrastructure Protection and Security (TIPS), December 2009.

J.C. Park, S. K. Kaseram, and N. Patwari, "Cross Layer Multirate Adaptation Using Physical Capture," in Proceedings of IEEE Global Communications Conference (GLOBECOM), December 2009. ISBN: 978-1-4244-4148-8

S. Jana, S. Premnath, M. Clark, S. K. Kaseram, N. Patwari, and S. Krishnamurthy, "On the Effectiveness of Secret Key Extraction Using Wireless Signal Strength in Real Environments," in Proceedings of ACM Sigmobile 15th International Conference on Mobile Computing and Networking (MOBICOM), September 2009. pp. 321-332.

D. Maas, N. Patwari, J. Zhang, S. K. Kaseram, and M. Jensen, "Location Distinction in a MIMO Channel," in Virginia Tech Symposium on Wireless Personal Communications, June 2009.

J.C. Park and S. K. Kaseram, "Reduced Packet Probing Multi-rate Adaptation for Multi-hop Ad Hoc Wireless Networks," in the Proceedings of IEEE Symposium on World of Wireless, Mobile and Multimedia Networks (WoWMoM), June 2009.

M. Probst, J.C. Park, R. Abraham, S. K. Kaseram, "SocialSwarm: Exploiting Distance

in Social Networks for Collaborative Flash File Distribution," in Proceedings of IEEE International Conference on Network Protocols (ICNP), October 2010.

E. Gelal, K. Pelechris, I. Broustis, S. Krishnamurthy, S. Mohammed, A. Chokalingam, and S. K. Kaseram, "On the Impact of MIMO Diversity on Higher Layer Performance," 30th International Conference on Distributed Computing Systems, June 2010. pp. 764-773.

J. Croft, N. Patwari, and S. K. Kaseram, "Robust Uncorrelated Bit Extraction Methodologies for Wireless Sensors," 9th ACM/IEEE International Conference on Information Processing in Sensor Networks, April 2010. pp. 70-81.

J. Zhang, S. K. Kaseram, and N. Patwari, "Mobility Assisted Secret Key Generation Using Wireless Link Signatures," IEEE 29th Conference on Computer Communications (INFOCOM) Mini-conference, March 2010. pp. 261-265.

Patents

S. Jana and S. K. Kaseram, "Method and System for Detecting Unauthorized Wireless Access Points Using Clock Skews," PCT, filed in September 2009.

S. K. Kaseram and N. Patwari, "Method and System for Secret Key Exchange Using Wireless Link Characteristics and Random Device Movement," U.S. Patent, filed in September 2009.

N. Patwari, J. Croft, S. Jana, and S. K. Kaseram, "Method and System for High Rate Uncorrelated Shared Secret Bit Extraction from Wireless Link Characteristics," U.S. Patent, filed in September 2009.

Invited Talks & Presentations

"Enhancing Wireless Network Security Using Unique Device and Link Characteristics," in ARL/ONR MURI Review meeting, June 2009.

"Enhancing Wireless Network Security Using Unique Device and Link Characteristics," Brigham Young University Colloquium, February 2010.

"Advances in Wireless Network Security Using Unique Device and Link Characteristics," in ARL/ONR MURI Review meeting, August 2010.

Professional Participation

Associate Editor

- IEEE/ACM Transactions on Networking (2009 -- present)
- ACM/Springer Wireless Networks Journal (2007 -- present)
- Computer Networks Journal (COMNET) (2005 - 2010)
- ACM Mobile Computing and Communications Review (MC²R), Associate Editor-in-Chief (2008 - 2009)



Conference / Workshop Organization

- Technical Program Committee Co-Chair – IEEE International Conference on Networks Protocols (ICNP), 2011.
- Technical Program Committee Co-Chair – IEEE Conference on Sensor, Mesh, and Ad Hoc Communications, and Networks (SECON), 2011
- Technical Program Committee Area Chair – IEEE International Conference on Network Protocols, 2010
- Student Poster Co-Chair - IEEE International Conference on Network Protocols, 2010

Technical Program Committee Member

- ACM International Conference on Measurement and Modeling of Computer Systems (SIGMETRICS), 2010
- IEEE Conference on Sensor, Mesh, and Ad Hoc Communications, and Networks (SECON), 2010
- IEEE Conference on Computer Communications (INFOCOM), 2010
- ACM Sigmobility International Conference on Mobile Computing and Networking (MOBICOM), 2010
- IEEE International Conference on Network Protocols (ICNP), 2010
- Second International Conference on Communication Systems and Networks (COMSNETS), 2010
- ACM Sigmobility International Conference on Mobile Computing and Networking (MOBICOM), 2009
- IEEE International Conference on Network Protocols (ICNP), 2009
- IEEE Conference on Sensor, Mesh, and Ad Hoc Communications, and Networks (SECON), 2009
- IEEE Conference on Computer Communications (INFOCOM), 2009
- IEEE International Conference on Pervasive Computing and Communications (PERCOM), 2009
- IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks, 2009.
- First International Conference on Communication Systems and Networks (COMSNETS), 2009.

Review Panels

- National Science Foundation Review Panel, November 2009.
- National Science Foundation Review Panel, October 2009.
- Department of Energy Review Panel, March 2009.
- National Science Foundation Review Panel, February 2009.

Honors & Awards

S. Premnath, Sneha K. Kasera, and N. Patwari, "Secret Key Extraction in MIMO-Like Sensor Networks Using Wireless Signal Strength," Poster paper, in the 15th ACM Sigmobility International Conference on Mobile Computing and Networking (MOBICOM), September 2009. Won the third prize in the Student Research Competition, also selected as a finalist for ACM-wide Student Research Competition.



Graduate Poster Session



Bob Kessler

Professor

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Robert (Bob) R. Kessler has been on the faculty of the University of Utah since 1983 and is currently a professor and associate director of the School of Computing. He earned his B.S., M.S., and Ph.D. in 1974, 1977, and 1981 respectively, all from the University of Utah. His early work was centered on the portable implementation of the Lisp programming language and then distributed and parallel implementations of Lisp. In the early 90's, he founded the Center for Software Science, a state of Utah Center of Excellence, which was a research group working in nearly all aspects of system software for sequential and parallel/distributed computers. In the late 90's Professor Kessler served as chairman of the Department of Computer Science. At about that same time, his research interests expanded into software engineering and he also dabbled in agent technologies. His most recent interests are in undergraduate education and tackling the challenges of declining computer science enrollment by the introduction of computer gaming into early CS classes. He has authored two books and over fifty journal and conference publications. Professor Kessler has received over \$6.5M in external research funding from government and industrial sources and \$10M in equipment grants. He has founded two startup companies and has been on the board of directors of several others. Professionally he served several years as an officer of the ACM SIGPLAN organization and was the co-editor-in-chief of the International Journal of Lisp and Symbolic Computation for seven years. He is an award winning teacher having received the College of Engineering Outstanding Teaching Award in 2000 and the University of Utah's highest teaching honor, the Distinguished Teaching Award in 2001. In 2007, he lead the founding of the undergraduate Entertainment Arts and Engineering emphasis and in 2010 the Entertainment Arts and Engineering: Master Games Studio master's program.

Publications

M. van Langeveld and R. Kessler, "Two in the Middle: Digital Character Production and Machinima Courses," SIGCSE 2009, pp. 463-467.

R. Kessler, M. van Langeveld, and R. Altizer, "Entertainment Arts and Engineering (or How to Fast Track A New Interdisciplinary Program)," SIGCSE 2009, pp. 534-538.

M. van Langeveld and R. Kessler, "Educational Impact of Digital Visualization and Auditing Tools On a Digital Character Production Course," ICFDG 2009, pp. 316-323.

G. Draper, R. Kessler and R. Riesenfeld, "A History of Computing Course with a Technical Focus," SIGCSE 2009, pp. 67-71.

M. van Langeveld and R. Kessler, "Digital Visualization Tools Improve Teaching 3D Character Modeling," SIGCSE 2010, pp. 82-86.



Mike Kirby

Associate Professor

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Robert M. ("Mike") Kirby received his B.S. in Applied Mathematics and Computer and Information Sciences from Florida State University in 1997, his M.S. in Applied Mathematics from Brown University in 1999 and his M.S. in Computer Science from Brown University in 2001, his Doctor of Philosophy in Applied Mathematics from Brown University in 2003.

Professor Kirby's research focus is on large-scale scientific computing and visualization, with an emphasis on the scientific cycle of mathematical modeling, computation, visualization, evaluation, and understanding. His primary research interests are: Computational Science and Engineering, High-Order Methods: Algorithm Development and Applications, Scientific Visualization, Concurrent Programming: Verification and Applications, and High Performance Computing.

Publications

Refereed Journals

I. Melatti, R. Palmer, G. Sawaya, Y. Yang, R.M. Kirby and G. Gopalakrishnan, "Parallel and distributed model checking in Eddy", International Journal for Software Tools for Technology Transfer, Vol. 11, Number 1, pages 13-25, 2009.

A. R. Sanderson, M. D. Meyer, R. M. Kirby and C. R. Johnson, "A Framework for Exploring Numerical Solutions of Advection-Reaction-Diffusion Equations Using a GPU-Based Approach", Computing and Visualization in Science, Vol. 12, pages 155-170, 2009.

D. Walfisch, J. K. Ryan, R. M. Kirby and R. Haimes, "One-Sided Smoothness-Increasing Accuracy-Conserving Filtering for Enhanced Streamline Integration through Discontinuous Fields", Journal of Scientific Computing, Vol. 38, Number 2, pages 164-184, 2009.

T. Martin, E. Cohen and R. M. Kirby, "Volumetric Parameterization and Trivariate B-spline Fitting using Harmonic Functions", Computer Aided Geometric Design, Vol. 26, Issue 6, pages 648-664, 2009.

J. S. Preston, T. Tasdizen, C. M. Terry, A. K. Cheung and R. M. Kirby, "Using the Stochastic Collocation Method for the Uncertainty Quantification of Drug Concentration Due to Depot Shape Variability", IEEE Transactions on Biomedical Engineering, Vol. 56, Number 3, pages 609-619, 2009.

T. Etienne, C. Scheidegger, L.G. Nonato, R.M. Kirby and C.T. Silva, "Verifiable Visualization for Isosurface Extraction", IEEE Transactions on Visualization and Computer Graphics (IEEE Visualization Issue), Vol 15., Number 6, pages 1227-1234, 2009.

J. D. Frazier, P. K. Jimack and R. M. Kirby, "On the Use of Adjoint-Based Sensitivity

Estimates to Control Local Mesh Refinement”, *Communications on Computational Physics*, Vol. 7, Number 3, pages 631-638, 2010.

E. Cohen, T. Martin, R.M. Kirby, T. Lyche and R.F. Riesenfeld, “Analysis-aware Modeling: Understanding Quality Considerations in Modeling for Isogeometric Analysis”, *Computer Methods in Applied Mechanics and Engineering*, Vol. 199, Issues 5-8, pages 334-356, 2010.

M. Steffen, R. M. Kirby and M. Berzins, “Decoupling and Balancing of Space and Time Errors in the Material Point Method (MPM)”, *International Journal for Numerical Methods in Engineering*, Vol. 82, pages 1207-1243, 2010.

S. Pervez, G. Gopalakrishnan, R. M. Kirby, R. Thakur and W. Gropp, “Formal methods applied to high performance computing software design: a case study of MPI one-sided communication based locking”, *Software: Practice and Experience*, Vol. 40, Issue 1, pages 23-43, 2010.

D. Wang, R. M. Kirby and C. R. Johnson, “Resolution Strategies for the Finite Element Based Solution of the Electrocardiographic Inverse Problem”, *IEEE Transactions on Biomedical Engineering*, Vol. 57, Issue 2, pages 220-237, 2010.

H. Mirzaee, J. K. Ryan and R. M. Kirby, “Quantification of Errors Introduced in the Numerical Approximation and Implementation of Smoothness-Increasing Accuracy Conserving (SIAC) Filtering of Discontinuous Galerkin (DG) Fields”, *Journal of Scientific Computing*, Accepted for Publication, Vol. 45, pages 447-470, 2010.

G. Li, R. Palmer, M. DeLisi, G. Gopalakrishnan and R. M. Kirby, “Formal Specification of MPI 2.0: Case Study in Specifying a Practical Concurrent Programming API”, *Science of Computer Programming*, Accepted for Publication, 2010.

Y. Yang, X. Chen, G. Gopalakrishnan and R. M. Kirby, “Distributed Dynamic Partial Order Reduction”, *International Journal on Software Tools for Technology Transfer*, Vol. 12, Number 2, pages 113-122, 2010.

P. E. J. Vos, S. J. Sherwin and R. M. Kirby, “h-p Efficiently: Implementing Finite and Spectral/hp Element Methods to Achieve Optimal Performance for Low- and High-Order Discretisations”, *Journal of Computational Physics*, Vol. 229, Issue 13, pages 5161-5181, 2010.

Refereed Conference and Workshops

A. Vo, S. Vakkalanka, M. Delisi, G. Gopalakrishnan, R. M. Kirby and R. Thakur, “Formal Verification of Practical MPI Programs”, *Proceedings of 14th ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPoPP)*, Raleigh, NC, February 14-18, 2009. pp. 261-270.

S.E. Geneser, R.M. Kirby, B. Wang, B. Salter and S. Joshi, “Incorporating Patient Breathing Variability into a Stochastic Model of Dose Deposition for Stereotactic Body Radiation Therapy”, *Proceedings of Information Processing in Medical Imaging 2009*, Williamsburg, VA, *Lecture Notes in Computer Science (LNCS) 5636*, Pages 688-700, July 5-10, 2009. pp. 688-700.

A. Vo, S. Vakkalanka, J. Williams, G. Gopalakrishnan, R. M. Kirby and R. Thakur, “Sound and Efficient Dynamic Verification of MPI Programs with Probe Non-Determinism”, *Proceedings of EuroPVM-MPI 2009*, Espoo, Finland, September 7-10, 2009. pp. 271-281.

S. Ananthakrishnan, M. DeLisi, S. Vakkalanka, A. Vo, G. Gopalakrishnan, R. M. Kirby and R. Thakur, “How Formal Dynamic Verification Tools Facilitate Novel Currency Visualizations”, *Proceedings of EuroPVM-MPI 2009*, Espoo, Finland, September 7-10, 2009. pp. 261-270.

S. Vakkalanka, A. Vo, G. Gopalakrishnan and R. M. Kirby, “Reduced Execution Semantics of MPI: From Theory to Practice”, *Proceedings of the 16th International Symposium on Formal Methods 2009 (FM2009)*, Eindhoven, the Netherlands, November 2-6, 2009. pp. 724-740.

S. Vakkalanka, A. Vo, G. Gopalakrishnan and R. M. Kirby, “Precise Dynamic Analysis for Slack Elasticity: Adding Buffering Without Adding Bugs”, *Proceedings of EuroMPI 2010*, Stuttgart, Germany, September 12-15, 2010. pp. 152-159.

Professional Participation

- Associate Editor of *Mathematics and Computers in Simulation*, 2007 - 2009

Have reviewed for the following journals:

- *Computer Methods in Applied Mechanics and Engineering*
- *IEEE Transactions on Visualization and Computer Graphics*
- *IEEE Transactions on Parallel and Distributed Systems*
- *Journal of Applied Numerical Mathematics*
- *Journal of Computational Physics*
- *Journal of Fluids Engineering*
- *Journal of Scientific Computing*
- *SIAM Journal on Scientific Computing*

Honors & Awards

Awarded Leverhulme Visiting Professorship, 2008-2009.



Matt Might
Assistant Professor
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Dr. Might joined the school as an assistant professor in the fall of 2008. Before joining the School of Computing, he received his Ph.D. from Georgia Tech and then worked for two start-ups, Diagis and yaplet.com. Dr. Might's research in the field of programming languages and compilers is focused on tackling the key challenges in modern software development: improving security and harnessing parallelism. Driven by the escalation of information security crisis, he is actively investigating and constructing software tools for programmers to use that can prove the absence of security flaws and find bugs in software systems; his work with Diagis involved commercializing such tools. In response to hardware manufacturers recent insistence on doubling cores instead of clock-speeds, he is also investigating software analyses and tools that can automatically parallelize sequential software across multiple processors and detect flaws in explicitly parallel software.

Publications

Refereed Conference and Workshops

M. Might and T. Prabh. "Interprocedural dependence analysis of higher-order programs via stack reachability." 2009 Workshop on Scheme and Functional Programming. (Scheme 2009). Boston, MA. August, 2009, pp. 75-85.

M. Might and P. Manolios. "A posteriori soundness for non-deterministic abstract interpretations," 10th International Conference on Verification, Model Checking and Abstract Interpretation (VMCAI 2009). Savannah, GA. January, 2009. pp. 260-274.

C. Earl, M. Might and D. Van Horn. "Pushdown control-flow analysis of higher-order programs: Precise, polyvariant and polynomial-time," 2010 Workshop on Scheme and Functional Programming. (Scheme 2010). Montreal, Quebec, Canada. August, 2010.

D. Van Horn and M. Might. "Abstracting Abstract Machines," Accepted to International Conference on Functional Programming 2010 (ICFP 2010). Baltimore, Maryland. September, 2010. pp. 51-62.

M. Might. "Abstract interpreters for free," Static Analysis Symposium 2010 (SAS 2010). Perpignan, France. September, 2010. pp. 407-421.

M. Might, Y. Smaragdakis and D. Van Horn. "Resolving and exploiting the k-CFA paradox: Illuminating functional vs. object-oriented program analysis." Programming Language Design and Implementation 2010 (PLDI 2010). Toronto, Canada. June, 2010. pp. 305-315.

M. Might. "Shape analysis in the absence of pointers and structure." 11th International Conference on Verification, Model Checking and Abstract Interpretation (VMCAI 2010). Madrid, Spain. January, 2010. pp. 263-278.

Invited Talks & Presentation

"Static analysis of modern software systems: Taming control-flow." Brigham Young University. Provo, Utah. September 10 2009.

"Control-flow analysis of higher-order programs." NSF/ACM-sponsored Ph.D. Summer School on Theory and Practice of Language Implementation. Eugene, Oregon. July 23 2009.

"Control-flow analysis of order k (k-CFA)." NSF/ACM-sponsored Ph.D. Summer School on Theory and Practice of Language Implementation. Eugene, Oregon. July 24 2009.

"Efficient control-flow analysis and beyond." NSF/ACM-sponsored Ph.D. Summer School on Theory and Practice of Language Implementation. Eugene, Oregon. July 27 2009.

"Push-down control-flow analysis of higher-order programs." International Conference on Functional Programming Program Committee Workshop. Portland, Oregon. 30 April 2009.

"An Illustrated Guide to Hacking." The Leonardo. Salt Lake City, Utah. December 7, 2010.

"Static analysis in small steps." Purdue University. Lafayette, Indiana. October 5, 2010.

Professional Participation

- SAS 2010. PC Member. 14-16 September 2010. Perpignan, France
- PADTAD 2010. PC member. 13 July 2010
- Oregon Ph.D. Summer School 2009. Lecturer. 23-31 July 2009
- Scheme Workshop 2009. PC member. 22 August 2009
- PADTAD 2009. PC member. 19-20 July 2009
- ICFP 2009. PC member. 31 Aug - 2 Sep 2009



Valerio Pascucci

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Valerio Pascucci is an Associate Professor of Computer Science at the Scientific Computing Institute and School of Computing at the University of Utah. Previously, Valerio was a Group Leader and Project Leader in the Center for Applied Scientific Computing at the Lawrence Livermore National Laboratory, and Adjunct Professor Computer Science at the University of California Davis. Prior to his CASC tenure, he was a senior research associate at the University of Texas at Austin, Center for Computational Visualization, CS and TICAM Departments. Valerio earned a Ph.D. in computer science at Purdue University in May 2000, and a EE Laurea (Master), at the University "La Sapienza" in Roma, Italy, in December 1993, as a member of the Geometric Computing Group.

Publications

Refereed Journals

E.W. Bethel, C.R. Johnson, S. Ahern, J. Bell, P.-T. Bremer, H. Childs, E. Cormier-Michel, M. Day, E. Deines, P.T. Fogal, C. Garth, C.G.R. Geddes, H. Hagen, B. Hamann, C.D. Hansen, J. Jacobsen, K.I. Joy, J. Kreuger, J. Meredith, P. Messmer, G. Ostrouchov, V. Pascucci, K. Potter, Prabhat, D. Pugmire, O. Reubel, A.R. Sanderson, C.T. Silva, D. Ushizima, G.H. Weber, B. Whitlock, K. Wu. "Occam's Razor and Petascale Visual Data Analysis," In Proceedings of SciDAC 2009, Journal of Physics: Conference Series, Vol. 180, No. 012084, 2009.

A. Gyulassy, L. G. Nonato, P.-T. Bremer, C. Silva, and V. Pascucci. "Robust topology-based multiscale analysis of scientific data," IEEE Journal on Computing in Science and Engineering, 11(5):88{95, September/October 2009.

S. Dillard, V. Natarajan, G. Weber, V. Pascucci, and B. Hamann. "Topology-guided tessellation of quadratic elements," International Journal of Computational Geometry and Applications (IJCGA), 19(2):195{211, 2009.

M. Day, J. Bell, P.-T. Bremer, V. Pascucci, V. Beckner, and M. Lijewski. Turbulence effects on cellular burning structures in lean premixed hydrogen flames. *Combustion and Flame*, 156(5):1035{1045, May 2009.

K. Potter, A. Wilson, P.-T. Bremer, D. Williams, C. Doutriaux, V. Pascucci, C.R. Johnson. "Visualization of Uncertainty and Ensemble Data: Exploration of Climate Modeling and Weather Forecast Data with Integrated VISUS-CDAT Systems," In Proceedings of SciDAC 2009, Journal of Physics: Conference Series, Vol. 180, No. 012089, pp. (published online). 2009.

S. Gerber, P.-T. Bremer, V. Pascucci, R.T. Whitaker. "Visual Exploration of High Dimensional Scalar Functions," In Proceedings of Visualization 2010, IEEE Transactions on Visualization and Computer Graphics, Vol. 16(6), pp. 1271-1280, 2010.

M. Berger, L.G. Nonato, V. Pascucci, C.T. Silva. "Fiedler Trees for Multiscale Surface Analysis," In *Computers & Graphics*, London, UK, No. Special Issue of Shape Modeling Intl. (SMI), Vol. 34(3), pp. 272-281, 2010.

B. Summa, G. Scorzelli, M. Jiang, P.-T. Bremer, and V. Pascucci. "Interactive editing of massive imagery made simple: Turning Atlanta into Atlantis," *ACM Transactions on Graphics*, 29(5), October 2010.

P.-T. Bremer, and G. Weber, and V. Pascucci, and M. Day, and J. Bell. "Analyzing and Tracking Burning Structures in Lean Premixed Hydrogen Flames," *IEEE Transactions on Visualization and Computer Graphics*, 16(2), March, 2010.

P.-T. Bremer, G. Weber, J. Tierny, V. Pascucci, M. Day and J. Bell. "Interactive Exploration and Analysis of Large Scale Simulations Using Topology-based Data Segmentation," *IEEE Transactions on Visualization and Computer Graphics*, 99, 2010.

Refereed Conference and Workshops

J. Tierny, A. Gyulassy, E. Simon, V. Pascucci. "Loop Surgery for Volumetric Meshes: Reeb Graphs Reduced to Contour Trees," In *IEEE Transactions on Visualization and Computer Graphics*, Proceedings of the 2009 IEEE Visualization Conference, pp. 1177-1184, Sept./Oct, 2009.

P.-T. Bremer, G. Weber, J. Tierny, V. Pascucci, M. Day, and J. Bell. "A topological framework for the interactive exploration of large scale turbulent combustion," In Proceedings of the 5th IEEE International Conference on e-Science, pages 247{254. IEEE, December 2009.

E. Santos, J. Freire, C. Silva, A. Khan, J. Tierny, B. Grimm, L. Lins, V. Pascucci, S. A. Klasky, R. D. Barreto, and N. Podhorszki. "Enabling advanced visualization tools in a simulation monitoring system," In Proceedings of the 5th IEEE International Conference on e-Science, pages 358-365. IEEE, December 2009.

H. T. Vo, J. Comba, B. Summa, C. T. Silva, and V. Pascucci. "Streaming-enabled parallel data flow architecture for multicore systems," In *EuroVis 2010*. pp.1073-1080.

Books Chapters

C.D. Hansen, C.R. Johnson, V. Pascucci, C.T. Silva. "Visualization for Data-Intensive Science," In *The Fourth Paradigm of Scientific Discovery*, Edited by Dan Fay, Kristin Tolle and Tony Hey, Microsoft Research, pp. 153-163, 2009.

V. Pascucci, K. Cole-McLaughlin, and G. Scorzelli. "The TOPORRERY: computation and presentation of multiresolution topology," In T. Moller, B. Hamann, and R. Russell, editors, *Mathematical Foundations of Scientific Visualization, Computer Graphics, and Massive Data Exploration*, Mathematics and Visualization. Springer, 2009. pp. 19-40.

A. Mascarenhas, R. Grout, P.-T. Bremer, V. Pascucci, E. Hawkes, and J. Chen. "Topological feature extraction for comparison of length scales in terascale com-

Valerio Pascucci continued on page 64

bustion simulation data," In Topological Methods in Data Analysis and Visualization: Theory, Algorithms, and Applications. Springer, 2010. pp. 229-240.

G. Weber, P.-T. Bremer, M. Day, J. Bell, and V. Pascucci. "Feature tracking using reeb graphs," In Topological Methods in Data Analysis and Visualization: Theory, Algorithms, and Applications. Springer, 2010. pp. 244-253.

A. Gyulassy, P.-T. Bremer, B. Hamann, and V. Pascucci. "Practical considerations in Morse-Smale complex computation," In Topological Methods in Data Analysis and Visualization: Theory, Algorithms, and Applications. Springer, 2010. pp. 67-78.

Books

V. Pascucci, X. Tricoche, H. Hagen, and J. Tierny, editors. "Topological Methods in Data Analysis and Visualization: Theory, Algorithms, and Applications, Mathematics + Visualization" Springer, 2010. ISBN: 978-3-642-15013-5

Invited Talks & Presentations

IX Congress of the Peruvian Society of Computing, October 14, 2010

23rd SIBGRAPI Conference on Graphics, Patterns and Images, August 31, 2010

CSRI workshop on workshop on combinatorial algebraic topology, August 30, 2009 in Santa Fe, NM

CScADS 2009, July 20, 2009 in Lake Tahoe, CA

University of Utah Campus Cyberinfrastructure Day, March 11, 2009

Joint AMS-MAA Mathematics Meetings Tuesday January 6, 2009

University of San Paulo, August 27, 2010, San Paulo, Brazil

American-Chinese Cyberinfrastructure and E-Science workShop (ACCESS) 2010, National Center of Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign (UIUC), August 9, 2010

SciDAC conference, July 14, 2010, Chattanooga, TN

Pacific Northwest National Laboratory, March 12, 2010, Richland, WA

Professional Participation

Conference Chair:

- Co-Chair of the ACM Symposium on Computational Geometry 2010
- Program Co-Chair and Organizer of TopoInVis 2009, International Workshop on Topological Methods in Data Analysis and Visualization
- SciDAC 2009 Organizing Committee and Co-Chair of Visualization Competition

Program Committee Member:

- 2011 ACM/IEEE conference on Supercomputing (SC2011)
- 2011 SIAM/ACM Joint Conference on Geometric and Physical Modeling (GD/SPM11)
- 2011 Workshop on Emerging Computational Methods for the Life Sciences (at HPDC 2011)
- Eurographics 2011
- 2011 SIBGRAPI Conference on Graphics, Patterns and Images
- IEEE Visualization 2010 Conference (Vis 2010)
- 2010 ACM/IEEE conference on Supercomputing (SC2010)
- 2010 SIBGRAPI Conference on Graphics, Patterns and Images
- 6th International Symposium on Visual Computing ISVC10
- 2010 Workshop on Emerging Computational Methods for the Life Sciences (at HPDC 2010)
- IASTED International Conference on Computer Graphics and Imaging (CGIM 2010)
- SIBGRAPI 2009
- SciDAC 2009 Program Committee
- Eurographics 2009
- Eurovis 2009
- 5th International Symposium on Visual Computing ISVC09

Honors & Awards

Supercomputing 2009, finalist for the Bandwidth Challenge, November 2009



Students during EAE Demo Day

photo credit: Yong Wan



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John Regehr received his B.S. in Mathematics and Computer Science from Kansas State University in 1995, his Master of Computer Science from the University of Virginia in 1997, and his Ph.D. in Computer Science from the University of Virginia in 2001.

Publications

Refereed Conference and Workshops

Y. Chen, O. Gnawali, M. Kazandjieva, P. Levis, and J. Regehr. "Surviving Sensor Network Software Faults," In Proceedings of the 22nd ACM Symposium on Operating Systems Principles (SOSP 2009), Big Sky, MT, USA, October 2009. pp. 235-246.

X. Yang, N. Cooperider, and J. Regehr. "Eliminating the Call Stack to Save RAM," In Proceedings of the ACM Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES 2009), Dublin, Ireland, June 2009. pp. 60-69.

J. Raffkind, A. Wick, J. Regehr, and M. Flatt. "Precise Garbage Collection for C," In Proceedings of the 2009 International Symposium on Memory Management (ISMM), Dublin, Ireland, June 2009. pp. 39-48.

P. Li and J. Regehr. "T-Check: Bug Finding for Sensor Networks," In Proceedings of the International Conference on Information Processing in Sensor Networks (IPSN), SPOTS track, Stockholm, Sweden, April 2010. pp. 174-185.

J. Duan and J. Regehr. "Correctness Proofs for Device Drivers in Embedded Systems," In Proceedings of the 5th International Workshop on Systems Software Verification (SSV), Vancouver, Canada, October 2010.

Invited Talks & Presentations

"Safety Analysis for Wireless Embedded Networks." Series of three lectures given at RWTH Aachen, February 17-19 2009.

"Safe TinyOS." Part of a three-hour tutorial on TinyOS given at IPSN 2009 with other members of the TinyOS Core Working Group. April 16 2009.

"Exposing Difficult Compilers Bugs With Random Testing." Talk at the GCC Summit, Ottawa Canada, October 2010.

Professional Participation

- Associate editor, ACM Transactions on Sensor Networks, October 2010-present

Program Committee Chair

- IEEE 2010 Real-Time Systems Symposium (RTSS), track on sensor networks
- ACM SIGPLAN/SIGBED 2008 Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES)
- IEEE 2006 Real-Time Technology and Applications Symposium (RTAS), track on "Development, Verification, and Debugging Tools for Real-Time and Embedded Systems"

Program Committee Member

- USENIX Annual Technical Conference 2010
- European Conference on Computer Systems (EuroSys) 2010
- International Workshop on Java Technologies for Real-time and Embedded Systems (JTRES) 2010
- ACM Conference on Embedded Networked Sensor Systems (SenSys) 2009
- Design Automation Conference (DAC) 2009
- Real-Time and Embedded Technology and Applications Symposium (RTAS) 2009
- Real-Time Systems Symposium (RTSS) 2009



Rich Riesenfeld

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Having previously served as a two term Chair of Computer Science, Riesenfeld has sustained a large, multi-disciplinary research effort for more than three decades in Geometric Modeling, Manufacturing, and Design. He has published extensively and headed many large funding contracts from various sources like NSF, DARPA, ONR, ARO, in addition to private industrial supporters. From 1998 until it ended in July 2002, he served as Director of the NSF Science and Technology Center for Computer Graphics and Scientific Visualization, a research consortium including Brown University, California Institute of Technology, Cornell University, the University of North Carolina, and University of Utah. He has held faculty appointments in five different academic areas including mechanical engineering, electrical engineering, mathematics, and civil engineering in addition to computer science. The B-spline methods of design, proposed in his doctoral thesis, is now used as a worldwide standard for computer aided design of freeform curves and surfaces. Since then he has co-authored several seminal papers, including those on the well known "Oslo Algorithms," on surface subdivision methods, and presenting exact formulations for radiosity calculations. In addition, his co-authored papers in approximation theory include widely referenced work on discrete box splines and cone splines.

In 2001 he co-authored a reference and advanced textbook entitled "Geometric Modeling with Splines," that closely ties spline theory and geometric algorithms. The multidisciplinary Geometric Design and Computation Research Group which he co-heads has been investigating a broad spectrum of research problems in computer graphics, geometric modeling, remote collaborative design, and manufacturing within an integrated experimental testbed environment. He heads both the Computer Graphics Laboratory and the Advanced Manufacturing Laboratory at the University of Utah. In 2005 Riesenfeld received the International Gregory Award for lifetime contributions to Computer Aided Geometric Design.

Publications

Refereed Journals

K. Potter, A. Gooch, B. Gooch, P. Willemsen, J. Kniss, R. F. Riesenfeld and P. Shirley, "Resolution Independent NPR-Style 3D Line Textures," *Computer Graphics Forum*, Vol. 28, No. 1, 2009, pp. 52-62.

G. Draper, Y. Livnat, R. Riesenfeld. "A Survey of Radial Methods for Information Visualization: Analysis and Patterns." *IEEE Transactions on Visualization and Computer Graphics*. v. 15, n. 5, pp. 549-776, 2009.

K. Potter, J.M. Kniss, R. Riesenfeld, and C.R. Johnson. "Visualizing Summary Statistics and Uncertainty," *In Computer Graphics Forum (Proceedings of Eurovis 2010)*, Vol. 29, No. 3, pp. 823--831, 2010.

E. Cohen, T. Martin, M. Kirby, T. Lyche, and R. Riesenfeld, "Analysis-aware Modeling: Understanding Quality Considerations in Modeling for Isogeometric Analysis," *Computer Methods in Applied Mechanics and Engineering*, v. 199, issues 5-8, p. 334-356, Jan. 2010.

E. Cohen, T. Lyche, and R. Riesenfeld, "MCAD:Key Historical Developments," *Computer Methods in Applied Mechanics and Engineering*, v 199, issues 5-8, Jan. 2010, pp. 224-228.

G. M Draper, B. Liu, and R. F. Riesenfeld, "Integrating Statistical Visualization Research into the Political Science Classroom," *Proceedings of Information Systems Educators Conference (ISECON) 2010*, v. 27, n1342, October 2010, 11 pages.

X. Chen, R. F. Riesenfeld, and E. Cohen, "An Algorithm for Direct B-spline Multiplication," *IEEE Transactions on Automation Science and Engineering*, pp. 433-442, v. 6, n. 3 (Jul. 2009).

Refereed Conference and Workshops

D. E. Johnson, R. Riesenfeld, E. Cohen, and S. Drake, "Interactive Functional Reparameterization of Geometric Models," *Proceedings of the 2009 International Design Engineering Technical Conference & Design Automatic Conference*, 2009.

G. Draper, R. Kessler, R. Riesenfeld. A History of Computing Course with a Technical Focus. *Proceedings of the 40th ACM Technical Symposium on Computer Science Education (SIGCSE 2009)*, pp. 458-462, 2009.

Honors & Awards

2009 Bezier Award for Solid, Geometric and Physical Modeling and Applications, from the Solid Modeling Association



Ellen Riloff

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Professor Riloff's primary research area is natural language processing (NLP), although she also has interests in information retrieval, machine learning, and artificial intelligence in general. Recent research projects have tackled the problems of information extraction, semantic tagging and lexicon induction, coreference resolution, and subjectivity analysis. A major emphasis of Prof. Riloff's research involves automatically acquiring the knowledge needed for conceptual natural language processing, and the development of bootstrapping methods that can learn from unannotated text with minimal human supervision.

Publications

Refereed Conference and Workshops

V. Stoyanov, N. Gilbert, C. Cardie, and E. Riloff, "Conundrums in Noun Phrase Coreference Resolution: Making Sense of the State-of-the-Art," Proceedings of the Joint Conference of the 47th Annual Meeting of the Association for Computational Linguistics and the 4th International Joint Conference on Natural Language Processing of the Asian Federation of Natural Language Processing (ACL-IJCNLP 2009) pp. 656-664.

S. Patwardhan, and E. Riloff, "A Unified Model of Phrasal and Sentential Evidence for Information Extraction," Proceedings of the 2009 Conference on Empirical Methods in Natural Language Processing (EMNLP-09) pp. 151-160.

E. Hovy, and Z. Kozareva, and E. Riloff, "Toward Completeness in Concept Extraction and Classification," Proceedings of the 2009 Conference on Empirical Methods in Natural Language Processing (EMNLP-09) pp. 948-957.

Z. Kozareva, E. Hovy, and E. Riloff, "Learning and Evaluating the Content and Structure of a Term Taxonomy," AAAI-09 Spring Symposium on Learning by Reading and Learning to Read. pp. 1-8.

S. Igo, and E. Riloff, "Corpus-based Semantic Lexicon Induction with Web-based Corroboration," NAACL-09 Workshop on Unsupervised and Minimally Supervised Learning of Lexical Semantics. pp. 18-26.

R. Huang, and E. Riloff, "Inducing Domain-specific Semantic Class Taggers from (Almost) Nothing," Proceedings of The 48th Annual Meeting of the Association for Computational Linguistics pp. 275-285. (ACL 2010)

A. Goyal, E. Riloff, H. Daume III, "Automatically Producing Plot Unit Representations for Narrative Text," Proceedings of the 2010 Conference on Empirical Methods in Natural Language Processing pp. 77-86. (EMNLP 2010)

A. Goyal, E. Riloff, H. Daume III, and N. Gilbert, "Toward Plot Units: Automatic Affect State Analysis," NAACL-HLT 2010 Workshop on Computational Approaches to Analysis and Generation of Emotion in Text. Pp. 17-25. 2010

V. Stoyanov, C. Cardie, N. Gilbert, E. Riloff, D. Buttler, and D. Hysom "Coreference Resolution with Reconcile", Proceedings of The 48th Annual Meeting of the Association for Computational Linguistics (ACL 2010), Short Paper. pp.156-161.

C. Ramakrishnan, W. Baumgartner Jr., J. Blake, Gully APC. Burns, K. Bretonnel Cohen H. Drabkin, J. Eppig, E. Hovy, C. Hsu, L. Hunter, T. Ingulfsen, H. Onda, S. Pokkunuri, E. Riloff, C. Roeder, and K. Verspoor "Building the Scientific Knowledge Mine (SciKnowMine): a community-driven framework for text mining tools in direct service to biocuration", LREC-10 Workshop on New Challenges for NLP Frameworks.

Book Chapter

J. Hobbs, and E. Riloff "Information Extraction", Handbook of Natural Language Processing, 2nd Edition, Editors: Nitin Indurkha and Fred J. Damerau, Chapman & Hall/CRC Press, Taylor & Francis Group. 2010 ISBN: 978-1420085921

Professional Participation

- *Editorial Board Member:* Computational Linguistics, 1/2007- 12/ 2009
- *Area Chair:* Association for Computational Linguistics (ACL), 2009

Program Committee Member:

- Association for Computational Linguistics (ACL) 2010
- Empirical Methods in Natural Language Processing (EMNLP) 2010
- Computational Natural Language Learning Conference (CoNLL) 2010
- International Conference on Semantic Computing (ICSC) 2010
- NAACL-HLT
- 2010 Workshop on Formalisms and Methodology for Learning by Reading
- NAACL-HLT 2010 Workshop on Semantic Search
- NAACL-HLT 2009 Student Research Workshop

Reviewer:

- Computational Linguistics (2010)
- Artificial Intelligence Journal (2010)
- Journal of Natural Language Engineering (2009),
- Journal of Applied Artificial Intelligence (2009)
- North American Association for Computational Linguistics Conference (NAACL) (2009, 2010)
- National Science Foundation External Reviewer (2009)
- National Science Foundation Panel Reviewer (2010).



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Professor Sikorski received his MS from the Department of Mathematics, Computer Science and Mechanics at the University of Warsaw, and his Ph.D. from the Department of Mathematics at the University of Utah.

Professor Sikorski's research interests are in the areas of scientific computation, computational complexity and numerical analysis, with special emphasis on Information Based Complexity. Of special interest are optimal algorithms for fixed points and nonlinear equations, optimal algorithms for signal reconstruction, forward and inverse problems in geophysics, combustion engineering, computational sensor networks, numerical verification and validation of nonlinear solvers as well as nonlinear optimization for inverse problems in urban modeling. Professor Sikorski was awarded First Degree Prize of the Secretary of Education of Poland (jointly with M. Kowalski and F. Stenger) for research leading to the publication of the monograph: *Selected Topics in Approximation and Computation* (1996). In 2001-2010 he received 7 Dean's letters for excellence in teaching as well as best paper award in 2008. He published 2 research monographs with Oxford Press, 1 textbook and numerous papers in wide spread areas from theory of scientific computation and numerical analysis, algorithmic design, through software and hardware design. He is the founding Director (2001) of the Master of Science program in Computational Engineering and Science (www.ces.utah.edu) at the University of Utah. He currently directs the MS CES program.

He held positions at universities in USA, Poland, Germany, and Italy. He chairs WG1.1 Research Group on Continuous Algorithms and Complexity/Foundations of Computer Science of the International Federation for Information Processing. He supervised 13 Ph.D. and 28 MS students. His students hold top positions in academia and industry.

Publications

Journals

B. Bialecki, B. R. Kearfott, K. A. Sikorski, M. Sugihara, *Journal of Complexity*, Vol 25 Issue 3, June 2009, pp. 233-236. Preface: Issue dedicated to Professor Frank Stenger

K. Sikorski, B. Addepalli, E. R. Pardyjak and M. Zhdanov, "Quasi- Monte Carlo, Monte Carlo, and regularized gradient optimization methods for source characterization of atmospheric releases, in *Algorithms and Complexity for Continuous Problems*" 2009, editors T. Muller-Gronbach, L. Plaskota and J. F. Traub, Dagstuhl Seminar Proceedings, ISSN = (1862-4405), Dagstuhl, Germany

K. Sikorski, "Computational Complexity of Fixed Points," *Journal of Fixed Points Theory and Applications*, Birkhauser Basel, Vol 6 No 2, Dec 2009, pp. 249- 283, (dedicated to S. Smale on his 80th birthday)

Edited, Special Issue of *Journal of Complexity* devoted to Frank Stenger's Festschrift, Vol 25, Issue 3, 2009, pp. 231-310.

F. Sawo, T. C. Henderson, C. Sikorski, and U. D. Hanebeck, "Passive Localization Methods exploiting Models of Distributed Natural Phenomena," *Lecture Notes in Electrical Engineering*, (Collection of best papers from MFI 2008), Springer Verlag,

Vol 35, 2009, pp. 375-392

S. Shellmann, and K. Sikorski, "A Note on Location and Algorithms for Fixed Points," *International Journal of Pure and Applied Mathematics*, vol. 65, No. 2, 2010, pp. 147-153.

Refereed Conference and Workshops

B. Addepalli, E. Pardyjak, K. Sikorski and M. Zhdanov, "Source characterization of atmospheric releases using stochastic search and regularized gradient optimization," *Inverse Problems in Science & Engineering*, paper ID GIPE-2010-0049, 2010.

Ch. Booniasiriwat, K. Sikorski and Ch-W, Tsay, "The Exterior Ellipsoid Algorithm for Fixed Points, *Mathematics of Computation*," 2010, (dedicated to the memory of Leo Khachiyan). pp. 952-961.

Book Chapter

Coauthored Book Chapter in: "Computational Sensor Networks," Thomas C. Henderson, Springer-Verlag, New York, NY, 2009.

Invited Talks & Presentations

"Computational Complexity of Fixed Points" University of Warsaw, Poland, 9/2009

"Optimal Algorithms for Fixed Points" UKSW University, Warsaw, Poland, 9/2009

"Quasi- Monte Carlo, Monte Carlo, and regularized gradient optimization methods for source characterization of atmospheric releases" Schloss Dagstuhl - Leibniz-Zentrum fuer Informatik, Germany, Dagstuhl, 9/2009

"Uncertainty quantification and verification: the MGS Method" University of Utah, Department of Chemical Engineering, 3/2010.

"Tools to Characterize the source of hazardous releases" National Conference on Advancing Tools and Solutions for Nuclear Material Detection, Salt Lake City, 2/2010

"Inverse source problems with QMC/MC methods" Dept. of Applied Mathematics and Statistics, University of Notre Dame, 5/ 2010

"Hybrid Algorithms for Fixed Points" Dept. of Applied Mathematics and Statistics, University of Notre Dame, 5/ 2010

Efficient Adaption of Simulated Annealing and Genetic Algorithms to Atmospheric Inverse-Source Problems, joint with B. Addepalli, session: "Role of chemical engineering in nuclear forensics", AIChE Annual Meeting, Salt Lake City, 11/2010

Professional Participation

Chair: WG1.1 Group on Continuous Algorithms and Complexity/Foundations of Computer Science of the International Federation for Information Processing

Discussion Session Chair: IFIP Group WG1.1, Dagstuhl, Germany 9/2009

Member: Scientific Program Committee, International Multiconference on Computer Science and Information Technology (IMCIST) organized by the Polish Information Processing Society in cooperation with the IEEE Computer Society (Poland Chapter), Council of European Professional Informatics Societies (CEPIS), the Systems Research Institute Polish Academy of Sciences, and the Institute of Computer Science Polish Academy of Sciences, Wisla, Poland, Oct. 2010 (www.imcsit.org).



Claudio Silva

Professor

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Claudio T. Silva received the B.S. degree in mathematics from the Federal University of Ceara, Brazil, in 1990, and the Ph.D. degree in computer science from the State University of New York at Stony Brook in 1996. He is a full professor of computer science and a faculty member of the Scientific Computing and Imaging (SCI) Institute at the University of Utah. Before joining Utah in 2003, he worked in industry (IBM and AT&T), government (Sandia and LLNL), and academia (Stony Brook and OGI). He coauthored more than 150 technical papers and eight U.S. patents, primarily in visualization, geometric computing, scientific data management, and related areas. He is an active member of the visualization, graphics, and geometric computing research communities, having served on more than 80 program committees. He is co-editor of the Visualization Corner of the IEEE Computing in Science and Engineering, and on the editorial board of Graphical Models and Computer and Graphics. Previously, he was on the editorial board of the IEEE Transactions on Visualization and Computer Graphics. He was papers co-chair for IEEE Visualization conference in 2005 and 2006, and general co-chair of IEEE Visualization 2010. He received IBM Faculty Awards in 2005, 2006, and 2007, and best paper awards at IEEE Visualization 2007 and IEEE Shape Modeling International 2008. He is a member of the ACM, Eurographics, and IEEE. His work is primarily funded by grants from the NSF, NIH, DOE, IBM, and ExxonMobil.

Publications

Refereed Journals

T. Etiene, C. Scheidegger, L. G. Nonato, R. M. Kirby, and C. Silva. "Verifiable Visualization for Isosurface Extraction," *IEEE Transactions on Visualization and Computer Graphics* (Proceedings of IEEE Visualization 2009). 15(6) pp. 1077-2626

E. Santos, L. Lins, J. Ahrens, J. Freire, and C. Silva. "VisMashup: Streamlining the Creation of Custom Visualization Applications," *IEEE Transactions on Visualization and Computer Graphics* (Proceedings of IEEE Visualization 2009). pp. 1539-1546.

J. Daniels, E. Cohen, and C. Silva. "Semi-Regular Quadrilateral Remeshing from Simplified Base Domains," *Computer Graphics Forum* (Proceedings of Symposium on Geometry Processing 2009), 28(5):1427-1435, 2009.

J. Daniels, E. Cohen, and C. Silva. "Localized Quadrilateral Coarsening," *Computer Graphics Forum* (Proceedings of Symposium on Geometry Processing 2009), 28(5):1436-1444, 2009.

A. Gyulassy, L. G. Nonato, P.-T. Bremer, C. Silva, and V. Pascucci. "Robust Topology-Based Multiscale Analysis of Scientific Data," *Computing in Science and Engineering*, 11(5):88-95, 2009.

L. Ha, J. Krueger, and C. Silva. "Fast 4-way parallel radix sorting on GPUs," *Computer Graphics Forum*, 28(8):2368-2378, 2009.

S. P. Callahan and C. Silva, "Image-Space Acceleration for Direct Volume Rendering of Unstructured Grids using Joint Bilateral Upsampling," *Journal of Graphics, GPU, & Game Tools*, 14(1):1-15, 2009.

H. Wang, C. E. Scheidegger, and C. Silva, "Bandwidth Selection and Reconstruction Quality in Point-Based Surfaces," *IEEE Transactions on Visualization and Computer Graphics*, 15(4):572-582, 2009.

C. Dietrich, J. Comba, L. Nedel, C. Scheidegger, J. Schreiner, and C. Silva. "Marching Cubes without Skinny Triangles," *Computing in Science and Engineering*, 11(2):82-87, 2009.

C. Dietrich, J. Comba, L. Nedel, C. Scheidegger, J. Schreiner, and C. Silva. "Improving Mesh Quality of Marching Cubes Using Edge Transformations," *IEEE Transactions on Visualization and Computer Graphics*, 15(1):150-159, 2009.

C. Silva, E. Anderson, E. Santos, and J. Freire, "Using VisTrails and Provenance for Teaching Scientific Visualization," *Eurographics 2010 Educator Program*, 2010). (Best paper award) DOI: 10.1111/j.1467-8659.2010.01830.x

C. Tuttle, L. G. Nonato, and C. Silva. "PedVis: A Structured, Space Efficient Technique for Pedigree Visualization," *IEEE Transactions on Visualization and Computer Graphics* (Proceedings of IEEE Information Visualization 2010). pp. 1063-1072.

F. V. Paulovich, L. G. Nonato, and C. Silva. "Two-Phase Mapping for Projecting Massive Data Sets," *IEEE Transactions on Visualization and Computer Graphics* (Proceedings of IEEE Visualization 2010). 16(6) pp. 1281-1290.

J. Daniels, E. W. Anderson, L. G. Nonato, and C. Silva. "Interactive Vector Field Feature Identification," *IEEE Transactions on Visualization and Computer Graphics* (Proceedings of IEEE Visualization 2010). 16(6) pp. 1560-1568.

E. Anderson, G. Preston, and C. Silva. "Using Python for Signal Processing and Visualization," *IEEE Computing in Science and Engineering* 12(4) pp 90-95 2010.

M. Berger, L. G. Nonato, V. Pascucci, and C. Silva, "Fiedler Trees for Multiscale Surface Analysis," *Computer & Graphics* (Proceedings of IEEE International Conference on Shape Modeling and Applications (SMI) 2010). 34(3) pp. 272-281.

H. Vo, B. Summa, D. Osmari, J. Comba, V. Pascucci, and C. Silva, "Streaming-Enabled Parallel Dataflow Architecture for Multicore Systems," *Computer Graphics Forum* (Proceedings of EuroVis 2010). pp. 1073-1082.

G. A. Preston, E. W. Anderson, E. Wassermann, T. Goldberg, and C. Silva, "Effects of 10Hz rTMS on the neural efficiency of working memory," *Journal of Cognitive Neuroscience*, 22(3):447-456, 2010.

Claudio Silva continued on page 70

L. K. Ha, J. Krueger, P. T. Fletcher, S. Joshi and C. Silva, "Fast Parallel Unbiased Diffeomorphic Atlas Construction on Multi-Graphics Processing Units," 9th Eurographics Workshop on Parallel Graphics and Visualization (EGPGV 2009), pp. 41-48.

E. Santos, J. Tierny, A. Khan, B. Grimm, L. Lins, J. Freire, V. Pascucci, C. Silva, S. Klasky, R. Barreto, N. Podhorszki, "Enabling Advanced Visualization Tools in a Simulation Monitoring System," IEEE International Conference on e-Science 2009, pp. 358-365, 2009.

E. Santos, D. Koop, H. Vo, E. Anderson, J. Freire, and C. Silva, "Using Workflow Medleys to Streamline Exploratory Tasks," pp. 292-301, Statistical and Scientific Database Management (SSDBM), 2009.

T. Ellkvist, D. Koop, J. Freire, C. Silva, and L. Stromback, "Using Mediation to Achieve Provenance Interoperability," IEEE International Conference on Scientific Workflows 2009. pp. 398-399.

M. Lizier, M. Siqueira, J. Daniels II, C. Silva, and L. G. Nonato. "Template-based Remeshing for Image Decomposition," SIBGRAPI 2010 - Brazilian Symposium on Computer Graphics and Image Processing, 2010. (Selected as one of the best papers, invited for journal submission.) pp. 1-8.

L. Ha, M. Prastawa, G. Gerig, J. H. Gilmore, C. T. Silva, S. Joshi, "Image Registration Driven by Combined Probabilistic and Geometric Descriptors," Proceedings of MIC-CAI 2010. pp. 602-609.

R. Tchoua, S. Klasky, N. Podhorszki, B. Grimm, A. Khan, E. Santos, C. Silva, P. Moullem, and M. Vouk. "Collaborative Monitoring and Analysis for Simulation Scientists," Proceedings of The 2010 International Symposium on Collaborative Technologies and Systems (CTS 2010). pp. 235-244.

D. Koop, C. Scheidegger, J. Freire, and C. Silva, "The Provenance of Workflow Upgrades," 3rd International Provenance and Annotation Workshop (IPAW) 2010. pp. 2-16.

D. Koop, E. Santos, B. Bauer, M. Troyer, J. Freire, and C. Silva, "Bridging Workflow and Data Provenance using Strong Links," Statistical and Scientific Database Management (SSDBM), 2010. pp. 397-415.

Invited Talks & Presentations

Geometry and Topology for Quadrilateral Mesh Processing and Verifiable Visualization

- Symposium on Computational Geometry (Plenary Talk), June 16th, 2010
- Federal University of Ceara, June 7th, 2010
- University of Chicago, April 8, 2010

High-Quality Isosurfaces and Surface Re(Meshing)

- Washington University, December 4th, 2009
- Brown University, April 7th, 2009
- Linkoping University, January 20th, 2009

VisTrails: Provenance and Data Exploration

- Harvard University, April 9th, 2009

Professional Participation

- Associate Editor, Graphical Models (GMOD) (2010--)
- Editorial Board, Computer and Graphics (2008--)
- Co-Editor, Visualization Corner, Computing in Science and Engineering magazine (2007--)
- General Co-chair, IEEE VisWeek 2010
- Conference chair, IEEE Visualization 2010
- Co-organizer, CSCW 2010 workshop on "The Changing Dynamics of Scientific Collaborations"
- Visualization area co-chair, 5th International Symposium on Visual Computing, 2009
- Co-organizer, CHI 2009 workshop on "The Changing Face of Digital Science: Workshop on New Practices in Scientific Collaborations."
- Reappointment committee for the Editor-in-Chief of IEEE/AIP Computing in Science and Engineering (2010).
- Search committee for the Editor-in-Chief of IEEE Computer Graphics and Applications (2009)
- 10th Eurographics Parallel Graphics and Visualisation (EGPGV) Symposium
- XXI Brazilian Symp on Computer Graphics and Image Processing (SIBGRAPI) 2010
- 2010 SIAM/ACM Joint Conference on Geometric and Physical Modeling
- EuroVis 2010
- International Meeting High Performance Computing for Computational Science (VECPAR'10)
- Symposium on Geometry Processing 2010
- IEEE International Conference on Shape Modeling and Applications (SMI) 2010
- Symposium on 3D Data Processing, Visualization, and Transmission (3DPVT) 2010
- First International Workshop on Semantic Web and Provenance Management 2009 (SWPM)
- XX Brazilian Symp on Computer Graphics and Image Processing (SIBGRAPI) 2009
- 1st International Workshop on Provenance in Practice 2009 (PPW09)
- Symposium on Geometry Processing 2009
- VizMining 2009 Workshop at the 2009 SIAM International Conference on Data Mining
- EuroVis 2009
- Eurographics 2009 Symposium on Parallel Graphics and Visualization (EGPGV'09)
- 2009 SIAM/ACM Joint Conference on Geometric and Physical Modeling
- IEEE International Conference on Shape Modeling and Applications (SMI) 2009

Honors & Awards

Best paper award, EUROGRAPHICS 2010 Educator Program.

Best poster award, 24th Brazilian Symposium On Databases (SBBD 2009)

"Computing and Rendering Point Set Surfaces" (article published in 2003) is the 2nd most cited paper in the 15-year history of the IEEE Transactions on Visualization and Computer Graphics with over 700 citations.

2009 Utah Innovation Awards, VisTrails Provenance Plugin for Autodesk Maya.



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William Thompson received his ScB., Physics, Brown University in Providence, RI in 1970, his M.S. in Computer Science at the University of Southern California in Los Angeles, California in 1972, and his Ph.D. in Computer Science at the University of Southern California in Los Angeles, California in 1975.

Prof. Thompson's current research lies at the intersection of computer graphics and visual perception, with the dual aims of making computer graphics more effective at conveying information and using computer graphics as an aid in investigating human perception. This is an intrinsically multi-disciplinary effort involving aspects of computer science, perceptual psychology, and computational vision. Prof. Thompson has also made contributions in the areas of visual motion perception and in the integration of vision and maps for navigation.

Publications

Refereed Journals

M. Bratkova, P. Shirley, and W.B. Thompson, "Artistic Rendering of Mountainous Terrain," *ACM Transactions on Graphics*, 28(4) Article 102, 2009.

S.A. Kuhl, W.B. Thompson, and S.H. Creem-Regehr, "HMD calibration and its effects on distance judgments," *ACM Transactions on Applied Perception*, 6(3) Article 19, 2009.

B.R. Kunz, L. Wouters, D. Smith, W.B. Thompson, and S.H. Creem-Regehr, "Revisiting the Effect of Quality of Graphics on Distance Judgments in Virtual Environments: A Comparison of Verbal Reports and Blind Walking," *Attention, Perception, & Psychophysics*, 71(6) pp. 1284-1293, 2009.

B.R. Kunz, and S.H. Creem-Regehr, and W.B. Thompson, "Evidence for Motor Simulation in Imagined Locomotion," *Journal of Experimental Psychology: Human Perception and Performance*, 35(5) pp. 1458-1477, 2009.

P. Willemsen, M.B. Colton, S.H. Creem-Regehr and W.B. Thompson, "The Effects of Head-Mounted Display Mechanical Properties and Field-of-View on Distance

Judgments in Virtual Environments," *ACM Transactions on Applied Perception*, 6(2) Article 8, 2009.

M. Bratkova, W.B. Thompson, and P. Shirley, "Automatic Views of Natural Scenes," *Proc. International Symposium on Computational Aesthetics in Graphics, Visualization, and Imaging*, pp. 1-8, May 2009.

Kunz, B. R., Creem-Regehr, S. H., & Thompson, W. B. "Visual capture influences body-based indications of visual extent," *Experimental Brain Research*, 207(3-4), 259-268, 2010.

B.J. Mohler, S.H. Creem-Regehr, W.B. Thompson, and H.H. Bulthoff, "The Effect of Viewing a Self-Avatar on Distance Judgments in an HMD-Based Virtual Environment," *Presence: Teleoperators and Virtual Environments*, 19(3) pp. 230-242, 2010.

M.R. Tarampi, S.H. Creem-Regehr, and W.B. Thompson, "Intact Spatial Updating with Severely Degraded Vision," *Attention, Perception, & Psychophysics*, 72(1) pp. 23-27, 2010.

Refereed Conference and Workshops

Geuss, M., Stefanucci, J., Creem-Regehr, S., & Thompson, W.B. "Can I Pass?: Using Affordances to Measure Perceived Size in Virtual Environments," *In Proc. Symposium on Applied Perception in Graphics and Visualization*. pp. 61-64, 2010.

Book Chapters

W.B. Thompson and P. Shirley, "Computer Graphics and Perception," in *Encyclopedia of Perception*, E.B. Goldstein, ed., Sage, 2009. ISBN: 9781412940818

W.B. Thompson, "Virtual Reality: Vision," in *Encyclopedia of Perception*, E.B. Goldstein, ed., Sage, 2009. ISBN: 9781412940818

Professional Participation

- Associate Editor, *ACM Transactions on Applied Perception*, 2003 – current
- Program Committee, *ACM SIGGRAPH Symposium on Applied Perception in Graphics and Visualization*, 2010, 2009, 2008, 2007, 2005, 2004



Suresh Venkatasubramanian

Assistant Professor

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Suresh Venkatasubramanian is interested in algorithms of all shapes and sizes. His current interests lie in computational geometry, massive data sets and statistics, and he enjoys working on problems on the boundary between theory and applications. He comes to the School from AT&T Labs -- Research, where he spent seven years working on a variety of problems in geometry, graphics and databases. He also learned that if your "massive data set" isn't at least a gigabyte, people in the Labs will laugh at you.

Suresh got his Ph.D at Stanford in 1999, working with Rajeev Motwani and Jean-Claude Latombe. At Stanford, he worked on geometric problems arising in the design of pharmaceutical drugs, which allowed him to get up close and personal with cocaine, albeit only on a computer screen. Prior to that, he inhabited the hallowed halls of the Indian Institute of Technology, Kanpur.

In the alternate universe where he has time for hobbies, he enjoys playing classical guitar, skiing, and compulsively redesigning his website. His personal credo is, 'Make the world safe for theory', and to this end writes The Geomblog (<http://geomblog.blogspot.com>), a blog about algorithms, geometry, and technology.

Publications

Refereed Conference and Workshops

N. Koudas, A. Saha, D. Srivastava, and S. Venkatasubramanian. "Metric functional Dependencies," In 25th International Conference on Data Engineering (ICDE), 2009, pp. 1275-1278.

T. Dasu, S. Krishnan, D. Lin, S. Venkatasubramanian, and K. Yi. "Change (detection) you can believe in: Finding distributional shifts in Data Streams," IDA '09 Proceedings of the 8th International Symposium on Intelligent Data Analysis: Advances in Intelligent Data Analysis VIII, 2009. ISBN: 978-3-642-03914-0.

B. Amadi, M. Hadjieleftheriou, T. Seidl, D. Srivastava, and S. Venkatasubramanian. "Type-based categorization of relational attributes." In Proc. 12th International Conference on Extending Database Technology (EDBT), 2009. ISBN: 978-1-60558-422-5.

S. Krishnan and S. Venkatasubramanian. "Approximate symmetry detection for 3D shapes with guaranteed error bounds," In IEEE Shape Modelling International (SMI), pp.44-51, 2009.

P. Raj, H. Daume, and S. Venkatasubramanian. "Streamed learning: One-pass SVMs," In Proc. 21st International Joint Conference on Artificial Intelligence (IJCAI), pp.1211-1216, 2009.

A. Goyal, S. Venkatasubramanian, and H. Daume. "Streaming for large scale NLP: Language modeling," In Proc. NAACL-HLT. pp.17-25, 2010.

P. Raj, A. Saha, H. Daume, and S. Venkatasubramanian. "Domain Adaptation Meets Active Learning," NAACL-HLT 2010, pp. 27-32.

A. Agarwal, J. Phillips, and S. Venkatasubramanian. "Universal Multi-Dimensional Scaling," 16th ACM SIGKDD Conference 2010, pp. 1149-1158.

A. Goyal, J. Jagarlamundi, H. Daume, and S. Venkatasubramanian. "Sketching Techniques for Large-Scale NLP," NAACL-HLT 2010, pp. 17-25.

Invited Talks & Presentations

NSF Workshop on Electronic Design Automation: Past, Present and Future

Tutorial: Information Theory for Data Management. 35th International Conference on Very Large Databases (VLDB) (with Divesh Srivastava)

Professional Participation

Editorial Boards

- International Journal of Computational Geometry and Applications (Associate Editor)

Program Committees

- 21st ACM-SIAM Symposium on Discrete Algorithms, 2010.
- Workshop on Massive Data Algorithmics, 2009.
- The 11th International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS 2009).
- IEEE International Conference on Data Mining, 2009.



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Ross T. Whitaker received his B.S. in Electrical Engineering and Computer Science/Engineering Physics at Princeton University in 1986 and his M.S. and PhD in Computer Science at the University of North Carolina in 1991 and 1993.

Professor Whitaker works in the Scientific Imaging and Computing Institute, and he runs the Image Processing Laboratory. He conducts research in image processing, computer vision, pattern recognition, and visualization. His approach to problems in these domains is usually based upon my background in differential geometry, differential equations, and signal processing.

Publications

Refereed Journals

J.R. Anderson, B.W. Jones, J.-H. Yang, M.V. Shaw, C.B. Watt, P. Koshevoy, J. Spaltenstein, E. Jurrus, Kannan U.V., R.T. Whitaker, D. Mastronarde, T. Tasdizen, R.E. Marc. "A Computational Framework for Ultrastructural Mapping of Neural Circuitry," In *PLoS Biology*, Vol. 7, No. 3, pp. e74. 2009.

E. Jurrus, M. Hardy, T. Tasdizen, P.T. Fletcher, P. Koshevoy, C.-B. Chien, W. Denk, R.T. Whitaker. "Axon Tracking in Serial Block-Face Scanning Electron Microscopy," In *Medical Image Analysis (MEDIA)*, Vol. 13, No. 1, Elsevier, pp. 180--188. February, 2009.

Y. Pan, R.T. Whitaker, A. Cheryauka, D. Ferguson. "Feasibility of GPU-Assisted Iterative Image Reconstruction for Mobile C-ARM CT," In *Proceedings of SPIE Medical Imaging 2009*, Vol. 7258, 2009. ISSN: 0277-786X

R.S. MacLeod, J.G. Stinstra, S. Lew, R.T. Whitaker, D.J. Swenson, M.J. Cole, J. Krueger, D.H. Brooks, C.R. Johnson. "Subject-specific, multiscale simulation of electrophysiology: a software pipeline for image-based models and application examples," In *Philosophical Transactions of The Royal Society A, Mathematical, Physical & Engineering Sciences*, Vol. 367, No. 1896, pp. 2293-2310. 2009.

R. Tao, P.T. Fletcher, R.T. Whitaker. "An Variational Image-Based Approach to the Correction of Susceptibility Artifacts in the Alignment of Diffusion Weighted and Structural MRI," In *Information Processing in Medical Imaging, Lecture Notes in Computer Science LNCS*, Vol. 5636, pp. 664-675. 2009.

M. Datar, J. Cates, P.T. Fletcher, S. Gouttard, G. Gerig, R.T. Whitaker. "Particle Based Shape Regression of Open Surfaces with Applications to Developmental Neuroimaging," In *Medical Image Computing and Computer-Assisted Intervention – MICCAI 2009, Lecture Notes in Computer Science LNCS*, Vol. 5762, pp. 167--174. 2009.

S. Gerber, T. Tasdizen, P.T. Fletcher, S. Joshi, R.T. Whitaker, the Alzheimers Disease Neuroimaging Initiative (ADNI). "Manifold modeling for brain population analysis," In *Medical Image Analysis, Special Issue on the 12th International Conference on*

Medical Image Computing and Computer Assisted Intervention (MICCAI) 2009, Vol. 14, No. 5, Note: Awarded MICCAI 2010, Best of the Journal Issue Award, pp. 643-653. 2010. ISSN: 1361-8415

E. Jurrus, A.R.C. Paiva, S. Watanabe, J.R. Anderson, B.W. Jones, R.T. Whitaker, E.M. Jorgensen, R.E. Marc, T. Tasdizen. "Detection of Neuron Membranes in Electron Microscopy Images Using a Serial Neural Network Architecture," In *Medical Image Analysis*, Vol. 14, No. 6, pp. 770-783. 2010. ISSN: 1361-8415

S. Gerber, T. Tasdizen, P.T. Fletcher, S. Joshi, R. Whitaker, "Manifold modeling for brain population analysis", *Medical Image Anal*, 14(5), pp. 643–653, 2010.

P.T. Fletcher, R. Whitaker, R. Tao, M.B. DuBray, A. Froehlich, C. Ravichandran, A.L. Alexander, E.D. Bigler, N. Lange, J.E. Lainhart, "Microstructural connectivity of the arcuate fasciculus in adolescents with high-functioning autism", *Neuroimage*, 51(3), pp. 1117–1125, 2010.

T. Tasdizen, P. Koshevoy, B.C. Grimm, J.R. Anderson, B.W. Jones, C.B. Watt, R.T. Whitaker, R.E. Marc, "Automatic mosaicking and volume assembly for high-throughput serial-section transmission electron microscopy", *J. Neuroscience Methods*, 193(1), pp. 132–144, 2010.

J.R. Anderson, S. Mohammed, B. Grimm, B.W. Jones, P. Koshevoy, T. Tasdizen, R. Whitaker, R.E. Marc, "The Viking viewer for connectomics: scalable multi-user annotation and summarization of large volume data sets", *J. Microscopy*, 241(1), pp. 13–28, 2010.

Refereed Conference and Workshops

E. Jurrus, A.R.C. Paiva, S. Watanabe, R. Whitaker, E.M. Jorgensen, T. Tasdizen. "Serial Neural Network Classifier for Membrane Detection using a Filter Bank," In *Proc. Workshop on Microscopic Image Analysis with Applications in Biology*, Bethesda, MD, 2009.

Y. Pan, W.-K. Jeong, R.T. Whitaker. "Markov Surfaces: A Probabilistic Framework for User-Assisted Three Dimensional Image Segmentation," In *Proceedings of MICCAI 2009 workshop on Probabilistic Models for Medical Image Analysis*, London, UK, pp. 57-68, 2009.

S. Gerber, T. Tasdizen, R.T. Whitaker. "Dimensionality Reduction and Principal Surfaces via Kernel Map Manifolds," In *Proceedings of the 2009 International Conference on Computer Vision (ICCV 2009)*, pp. 529-536, 2009.

S. Gerber, T. Tasdizen, S. Joshi, R.T. Whitaker. "On the Manifold Structure of the Space of Brain Images," In *Proceedings of the 2009 International Conference on*

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Ross Whitaker continued

Medical Image Computing and Computer Assisted Intervention (MICCAI 2009), No. 12 (pt. 1), pp. 305--312. 2009.

W.-K. Jeong, J. Beyer, M. Hadwiger, A. Vazquez, H. Pfister, R.T. Whitaker. "Scalable and Interactive Segmentation and Visualization of Neural Processes in EM Datasets," In IEEE Transactions on Visualization and Computer Graphics, Proceedings of the 2009 IEEE Visualization Conference, Vol. 15, No. 6, pp. 1505--1514. Sept/Oct, 2009.

J. Anderson, B. Jones, J. Yang, M. Shaw, C. Watt, P. Koshevoy, J. Spaltenstein, E. Jurrus, Kannan U.V., R.T. Whitaker, D. Mastronarde, T. Tasdizen, R. Marc. "Ultra Structural Mapping of Neural Circuitry: A Computational Framework," In IEEE International Symposium on Biomedical Engineering (ISBI 2009), pp. 1135-1137, 2009.

S. Gerber, P.-T. Bremer, V. Pascucci, R.T. Whitaker. "Visual Exploration of High Dimensional Scalar Functions," In Proceedings of Visualization 2010, IEEE Transactions on Visualization and Computer Graphics, pp. 1271-1280, 2010.

J.R. Bronson, J.A. Levine, R.T. Whitaker. "Particle Systems for Adaptive, Isotropic Meshing of CAD Models," In Proceedings of the 19th International Meshing Roundtable, Chattanooga, TN, Note: Awarded Best Paper, pp. 279-296, October, 2010.

Y. Pan, R.T. Whitaker, A. Cheryauka, D. Ferguson. "TV-regularized Iterative Image Reconstruction on a Mobile C-ARM CT," In Proceedings of SPIE Medical Imaging 2010, San Diego, CA, pp. 124-127, 2010.

Invited Talks & Presentations

Janelia Farms workshop on Computer Vision in Neuroscience (Nov. 14 – 17, 2010)

Banff International Research Station (BIRS) workshop on Sampling and Reconstruction (Nov. 28 – Dec. 3, 2010)

Professional Participation

- Workshops Chair, IEEE Int. Symposium on Biomedical Imaging, 2009, Boston.
- General coChair of IEEE VisWeek 2010
- Associate Editor of IEEE Transactions on Visualization and Graphics
- Medical Image Analysis and Computer Aided Intervention (MICCAI), 2005, 2007, 2009.
- IEEE Conference on Visualization, 2003, 2004, 2005, 2006, 2009.
- IEEE EuroVis 2009.

Honors & Awards

Medical Image Analysis / MICCAI Best Paper Award, 2010



Students

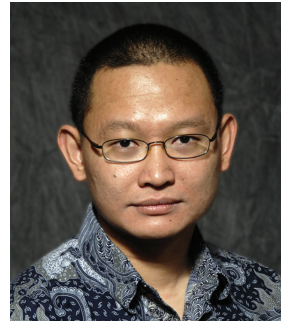
RESEARCH FACULTY



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Samuel Drake received his B.S. in Physics at Massachusetts Institute of Technology in 1965, and his M.S. and PhD in Mechanical Engineering at Massachusetts Institute of Technology in 1970 and 1977.

Professor Drake holds appointments as a research associate professor in Mechanical Engineering and at the School of Computing. His research interests include integrated process planning, computer aided manufacturing, design for manufacturing, design for assemblies and industrial robotics. Professor Drake is also in charge of running the Advanced Manufacturing Laboratory (AML), a lab which allows departmental research into computer vision, computer-aided geometric design, and geometric modeling to produce not only pictures, but solid objects as well.



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Marcel Prastawa received his B.S. in Computer Science and Mathematics from Purdue University in 2001, his M.S. in Computer Science from University of North Carolina at Chapel Hill in 2004, and his Doctor of Philosophy in Computer Science from University of North Carolina at Chapel Hill in 2007.

Marcel Prastawa's research focus is on the analysis of medical images that somehow differ from the norm, particularly those related to pathology or aging. His main research interest is in the application of statistical and physical models for analyzing and modeling normal growth processes or pathological processes. His general research areas are: image processing and analysis, computer vision, machine learning, and biological modeling.

Publications

Refereed Journals, Conference and Workshops

M. Prastawa, E. Bullitt, and G. Gerig. "Simulation of Brain Tumors in MR Images for Evaluation of Segmentation Efficacy," *Medical Image Analysis (MedIA)*. Volume 13, Number 2, April 2009, pages 297-311.

S. Gouttard, M. Prastawa, E. Bullitt, W. Lin, C. Goodlett and G. Gerig. "Constrained Data Decomposition and Regression for Analyzing Healthy Aging from Fiber Tract Diffusion Properties," *Medical Image Computing and Computer Assisted Intervention (MICCAI) 2009*, Lecture Notes in Computer Science (LNCS) 5761, pp. 321-328.

L. Ha, M. Prastawa, G. Gerig, J. H. Gilmore, C. T. Silva, and S. Joshi. "Image Registration Driven by Combined Probabilistic and Geometric Descriptors," *Medical Image Computing and Computer Assisted Intervention (MICCAI) 2010*, Lecture Notes in Computer Science (LNCS) 6362, pages 602-609.

M. Prastawa, N. Sadeghi, J. H. Gilmore, W. Lin, and G. Gerig. "A New Framework for Analyzing White Matter Maturation in Early Brain Development," *International Symposium on Biomedical Imaging (ISBI) 2010*. pp. 97-100.

N. Sadeghi, M. Prastawa, JH Gilmore, W. Lin, G. Gerig, "Towards Analysis of Growth Trajectory through Multi-modal Longitudinal MR Imaging," *SPIE Medical Imaging*, Vol. 7623, February 2010



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Robert Ricci received his B.S. in Computer science from the University of Utah in 2001, and his PhD in 2010. Prior to joining the faculty of the School of Computing as a Research Assistant Professor, he was a research staff member in the SoC for nine years. He is one of the leaders of the Flux Research Group, which has approximately two dozen faculty, staff, and students. Dr. Ricci's research is in the area of systems and networking, including testbeds for conducting experiments in those fields. He and the Flux Group have produced two testbeds, Emulab and ProtoGENI, that are heavily used by researchers and educators worldwide.

Publications

P. Sanaga, J. Duerig, R. Ricci and J. Lepreau. "Modeling and Emulation of Internet Paths" In Proc. of NSDI '09, Boston, Massachusetts, pp. 199-212 2009

C. Cutler, M. Hibler, E. Eide, and R. Ricci. "Trusted Disk Loading in the Emulab Network Testbed," In Proc. of CSET '10, Washington DC, August 2010. pp. 1-8

CLINICAL FACULTY



H. James de St. Germain
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H. James de St. Germain received his B.S. degree from New Mexico State University in 1991 and his PhD in Computer Science at the University of Utah in 2002. His doctorate work was on constraint hypothesis and optimization in the field of Reverse Engineering of mechanical parts. He has conducted further research into CAD/CAM user interface methods and modeling systems, including work toward a 3D stereo wall for virtual design of mechanical CAD models. In 2005, he joined the faculty at Utah and began extensive teaching of university undergraduates. His current interests include exploring more effective tools and techniques for teaching problem solving and programming skills. Dr. de St. Germain is the current Director of Undergraduate Studies for the School of Computing.



Erin Parker
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Erin Parker received B.S. degrees in Computer Science and Mathematics at the College of William and Mary in 1999. She received an M.S. in Computer Science in 2001 followed by a Ph.D. in Computer Science in 2004 from the University of North Carolina at Chapel Hill. After moving to Utah in late 2004, Erin became an Adjunct Assistant Professor in the School of Computing, teaching variety of courses in systems and introductory computer science. Erin recently became a Clinical Assistant Professor and is excited to continue teaching, as well as, working on undergraduate and diversity issues.



Peter Jensen
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Peter A. Jensen received his B.S. and Ph.D. degrees from the University of Utah in 1995 and 2007 respectively. Dr. Jensen began teaching at Utah in 1998 and he received the School of Computing outstanding teaching award in 2007. His research interests include automated fault localization for tutoring systems, efficiency in teaching, and Boolean techniques for factoring large integers. Dr. Jensen has been professionally involved in education and computer science since 1986. His professional background includes development of educational software and hardware for elementary schools, interactive kiosks, data compression techniques, and high-volume financial transaction processing. Most recently, he helped create an educational display for Clark Planetarium in Salt Lake City. Dr. Jensen is currently a clinical assistant professor in the School of Computing.



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Joe Zachary is a graduate of the Massachusetts Institute of Technology, where he earned a B.S. in Computer Science and Engineering in 1979, an M.S. in Computer Science in 1983, and a Ph.D. in Computer Science in 1987. He has been on the faculty of the School of Computing since 1987.

Prof. Zachary specializes in teaching undergraduates, and has been recognized for outstanding teaching throughout his career. He received the IEEE Computer Society Computer Science and Engineering Undergraduate Teaching Award in 1999, the University of Utah Distinguished Teaching Award in 1997, the Department of Energy Undergraduate Computational Science Education Award in 1996, the University of Presidential Teaching Scholar Award in 1995, and the College of Engineering Outstanding Teaching Award in 1990.

Prof. Zachary's research interests center on the applications of computers to computer science education. He is the author of two versions of the textbook *Introduction to Scientific Programming*, the creator of five innovative online courses over the last fifteen years, and the author of a variety of computer-based educational tools for teaching introductory programming.



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Mark Christensen van Langeveld received his B.S. degree from Brigham Young University in 1985, his M.A. in Design at the University of California Los Angeles in 1990, his M.B.A from Northwestern University in 1999, his M.S.E in Computer Graphics and Game Technology at the University of Pennsylvania in 2005, and his Ph.D. in Computing at the University of Utah in 2009. His dissertation was on "The Educational Impact of Digital Visualization Tools on Digital Character Production Computer Science Courses" and his doctoral work was on Entertainment Arts and Engineering Interdisciplinary Education. His industry experience included designing and directing interactive music videos for Sting and Peter Gabriel, working on several AAA video games in varied rolls, and designing and directing the first major interactive TV (I-TV) show at Microsoft that was called Vine Street. He has been teaching at the University of Utah since 2007. He is currently the director of the Entertainment Arts and Engineering Master Games Studio program.

AUXILIARY FACULTY

Craig Caldwell
 USTAR Professor, Digital Media

Chris Myers
 Adjunct Professor

Peter Shirley
 Adjunct Professor

John Carter
 Adjunct Associate Professor

Steve Parker
 Adjunct Associate Professor

Kenneth Stevens
 Adjunct Professor

Hal Daume
 Adjunct Assistant Professor

Neal Patwari
 Adjunct Assistant Professor

Tolga Tasdizen
 Adjunct Assistant Professor

Sarah Creem-Regehr
 Adjunct Associate Professor

William Provancher
 Adjunct Assistant Professor

Xavier Tricoche
 Adjunct Research Assistant Professor

Paul Hudak
 Adjunct Professor

Olivia Sheng
 Adjunct Professor

Ingo Wald
 Adjunct Research Assistant Professor

Stephen Jacobsen
 Research Professor

EMERITUS FACULTY

David Hanscom
 Professor Emeritus

Robert Johnson
 Professor Emeritus

Frank Stenger
 Professor Emeritus

Gary Lindstrom
 Professor Emeritus

Kenneth Smith
 Professor Emeritus

LIVING IN UTAH

The University of Utah is located in Salt Lake City, situated at the foot of the Wasatch Mountains. Salt Lake City is the hub of a large metropolitan area including a major international airport and a population of approximately a million people. The local high technology base is growing steadily.

Salt Lake City offers a wide variety of athletics, cultural events and popular entertainment. Fine dining is abundant, along with many affordable eating and drinking establishments frequented by students. Excellent cultural facilities are available in the city and through out the rest of the state, including The Utah Symphony, Ballet West, and a large number of theater companies. The Sundance Film Festival takes place annual in Park City, a half hour's drive from campus.

The canyon country of southern Utah is unique. The area includes five National Parks and the largest contiguous area of wilderness in the U.S. outside of Alaska. National Forests and Wilderness Areas are scattered throughout the state.

The state of Utah has unsurpassed opportunities for outdoor recreation, many only a few minutes away from the campus. It has the world's best skiing only thirty minutes from campus, along with excellent biking camping and mountain and desert hiking.

National Parks

Arches National Park
Bryce Canyon National Park
Canyonlands National Park
Capitol Reef National Park
Zion National Park

Skiing // Snowboarding

Salt Lake Resorts

- Alta
- Brighton
- Snowbird
- Solitude

Park City Resorts

- Deer Valley
- Park City
- The Canyons
- Sundance

Northern Resorts

- Beaver Mountain
- Powder Mountain
- Snowbasin
- Wolf Mountain

Southern Resorts

- Brian Head
- Eagle Point



1 - Salt Lake City (photo courtesy Utah Office of Tourism) 2 - Skiing Wasatch Mountains (photo courtesy Howie Garber) 3 - Bryce Canyon (photo courtesy Utah Office of Tourism) 4 - Deer Valley Music Festival (photo courtesy Utah Office of Tourism) 5 - Wasatch Mountain (photo courtesy Utah Office of Tourism)



Aerial view of University of Utah Campus



