THE UNIVERSITY OF UTAH

The Utah Teapot

Newsletter for Alumni and Friends of the
SCHOOL OF COMPUTING

IN THIS ISSUE

The teapot was one of the first free-form models used in computer graphics. Since it was created at the University of Utah (by Martin Newell) in 1975, the teapot has become a favorite computer graphics benchmark. The teapot symbolizes Utah's distinguished leadership in computer graphics.

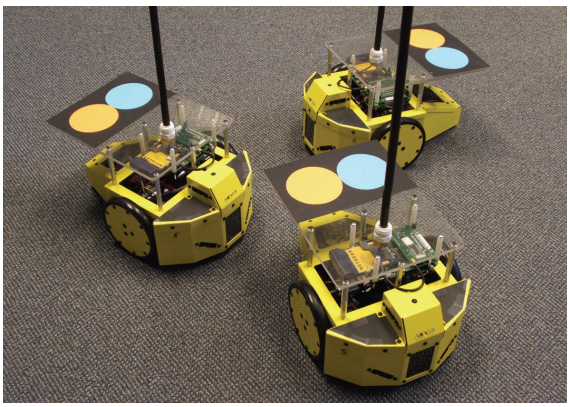
Pete Shirley Wins University Teaching Award

Dean Brown and Pete Shirley

Pete Shirley was awarded the University of Utah Distinguished Teaching Award during College of Engineering Convocation on May 6th. "Pete is deeply committed to teaching as evidenced by the many extra courses he has taught in addition to his normally assigned duties. He has received 6 Dean's Teaching Commendations, the College of Engineering Dean's Teacher Award and the University of Utah Student's Choice Award. He designed the School of Computing's BS/MS program and BS honors program. This year, the second edition of his popular undergraduate computer graphics textbook appears. With this award, we acknowledge Pete Shirley as one of the best teachers at the University of Utah," said Dean Richard Brown during the presentation.

Real Mobility, Real Wireless: A New Kind of Testbed

by David Johnson and Jay Lepreau



Three of the robots in the mobile testbed. Each robot has a PDA-like computer, WiFi card, sensor node, waist-high antenna riser, and a distinctive marker for the vision system.

In the last ten years we have witnessed an explosion of wireless devices. In daily life people use two billion mobile cell phones. Wireless PDAs are used as interfaces to e-mail, the Internet, and to nearby devices. In research, we use tiny new devices called "motes" that consist of an 8-bit computer, environmental sensors, and a radio. Hundreds or thousands of these will be densely deployed to perform tasks like remote habitat monitoring or sniper detection.

But—building reliable, speedy network protocols and applications for these devices is hard! Noisy radio environments, device mobility, and tiny computers greatly worsen the normal problems. How can you show that your latest, greatest routing protocol can deal effectively with radio interference and mobility? You

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The Purcells

It was during freshman year at the University of Utah that Tim and Jessica Purcell first met. After taking a math class together their first quarter, they ran into one another again during Introduction to Computing taught by Dave Hanscom. "Jessica was the only person I recognized of the hundred plus in the class, so I went over and introduced myself ". said Tim. Over the next four years Tim and Jessica took many classes together and became very good friends. After completing their studies at the U, they both went on to pursue further education and eventually were married.

The two have since moved Austin, Texas where Tim works for Nvidia in the graphics architecture group and Jessica is a mathematics instructor at the University of Texas at Austin.

Utah Teapot: When did you graduate?

Tim Purcell: I graduated in June of 1998.

Jessica Purcell: I went on to pursue a degree in mathematics and graduated in 1998.

UT: Why did you chose the U of U?

TP: What it came down to was a full ride scholarship to the U or be put on the waiting list at MIT.

JP: For me it was inexpensive tuition. But, neither of us realized at the time how excellent the U was. We really lucked out!

UT: After completing your degrees what did you do?

TP: After leaving the U, I went on to Stanford where I completed my MS and PhD degrees in computer science. I was interested in computer graphics (especially ray tracing) computer architecture, and in combining the two. I was fortunate to work with Pat Hanrahan as my advisor, who actually let me work on what I wanted for my

Tim, Jessica and Jonathan Purcell

thesis. While doing my thesis work, I got to know several people at Nvidia, and was given fellowships for my last two years of grad school. I decided to take an industry job after grad school in the hopes of coordinating more easily with Jessica's post-doc.

JP: I went on to complete my MS degree in math at University of Michigan and then onto Stanford where I finished my PhD. After which I went to the University of Texas at Austin to do work as a post-doc. Tim and I were lucky to find schools and job locations that worked for both of us. It's pretty rough being in a relationship with someone smart who wants his own job and won't just tag along after me.

UT: Was your career path what you expected?

TP: No. I started out as an undergrad wanting to do chemistry. Then moved on to taking graphics classes, with the desire to work at Pixar. Somehow I ended up in graduate school where I studied computer architecture and graphics, and now utilize that knowledge at Nvidia.

JP: Yes, I knew that I wanted to complete my PhD and teach.

UT: Do any memorable classes or experiences stand out will you were here at the U?

TP: I remember taking a hardware class from Erik Brunvand and then having the opportunity to TA the class the next two years, after which I decided I wanted to be a hardware guy. Then I took a graphics class from Pete Shirley where I changed from wanting to be a hardware guy to wanting to be a graphics guy. I guess I do a little of both in my current position.

JP: I worked with Ellen Riloff as an undergraduate research assistant, which was a really great experience. I received first hand knowledge of how research is really done.

I also loved Elaine Cohen's CAGD class because of all the interesting geometry. After that I decided geometry was my true calling in life.

UT: What are you doing now?

TP: I am helping to design next-generation GPUs. I am receiving hands on experience of what designing a very complex processor is like, and still getting to do a bit of graphics work.

JP: During the school year I teach one class per semester and work on my research the rest of the time. My field of expertise is geometric topology.

When not engaged in their careers the Purcells enjoy spending time with their little boy Jonathan, playing video games, and working on their new home.

If you are interested in contacting the Purcells send email to tpurcell@gmail.com or jessica.purcell@gmail.com.

Organick Memorial Lecture Series Update

Vinton Cerf, one of the Founding Fathers of the internet presented the 19th Annual Organick Lecture Series in April. Cerf, Senior Vice President of Technology Strategy, MCI Inc., gave two lectures on computer science and the Internet.

"This year's Organick lecture series was outstanding in several respects -- the credentials of the speaker, including being co-winner of this year's Turing Award, his lively and stimulating lectures, and his genuine renown as being a "Father of the Internet". With respect to the last accolade, he reports that his son is still wondering: "Does that make me a brother of the Internet?" said series organizer Gary Lindstrom.

Dr. Cerf sporting a U of U cap

Martin Berzins Appointed as New Director of SoC

After three years as Associate Director, Martin Berzins was asked to take over as director of the School of Computing effective July 1st. Berzins replaced Chris Johnson who served two years in the position.

As part of the new change, Berzins appointed three Associate Directors, Al Davis, John Carter and Pete Shirley to help with facility, outreach and educational duties.

"As the new Director of the School of Computing, I have set my priorities on both ensuring that existing strengths are maintained and that potentially new core and multi-disciplinary activities are initiated including, possible new joint graduate degrees with the Business School and Medical Informatics.

With the help of John Carter, I hope to strengthen outreach to local and national industry. I'm hopeful that new hires in areas such as AI, Theory, Systems and the software side of Scientific Computing will greatly strengthen the School," said Berzins.

Berzins continued by stating, "At a time of financial difficulty at both college and national levels I will work to ensure that the school is using its resources wisely and with maximum possible impact.

Utah has a great tradition of excellence in Computer Science in its broadest sense, I intend to do my best to continue to expand that tradition."

Contact Martin Berzins at director@cs.utah.edu

Tempest in a Teapot

Farewell

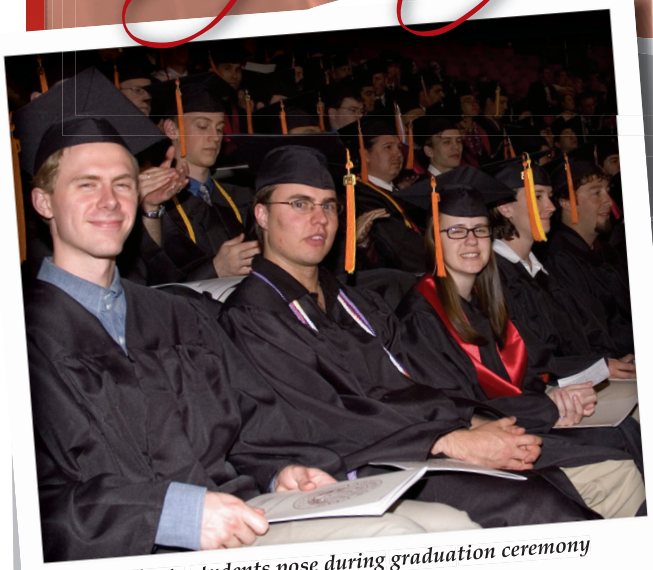
by Chris Johnson
School of Computing

On July 1, 2005, I returned as the full time Director of the Scientific Computing and Imaging (SCI) Institute and we welcomed Martin Berzins as the third Director of the School of Computing and tenth head of the computer science effort at the University of Utah since 1965. During my time as Director of the School of Computing, my goals have been to foster efforts that realized the School's significant potential for excellence and impact in Computing. Specifically, I focused my efforts on expanding our research efforts, recruiting top graduate students and expanding our graduate program, on excellence in graduate and undergraduate education, and on getting the word out about the great ongoing research and education within the School of Computing at Utah!

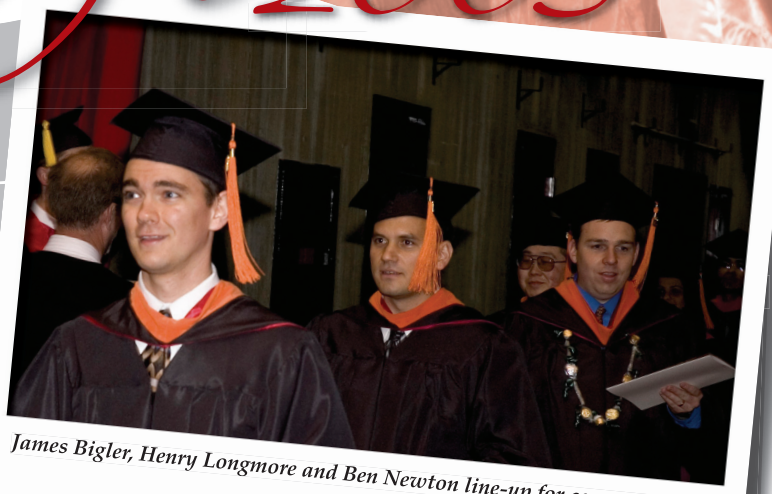
We have made significant strides in realizing these goals. However, given the current budget climate for federal granting agencies such as the National Science Foundation, there are significant challenges ahead. Fortunately, with Martin Berzins as the new Director of the School of Computing, we will have experienced leadership taking us forward. Martin served as an Associate Director of the School of Computing during my term as Director and he has previously served as a Research Dean at the University of Leeds, UK. I wish Martin the best of success as he takes over the School's leadership and look forward to continued progress in making the School of Computing the best it can be. I thank you all for your support during my time as Director and look forward to your continued involvement with the School of Computing.

Contact Chris Johnson at crj@cs.utah.edu

Graduation 2005



Undergraduate students pose during graduation ceremony



James Bigler, Henry Longmore and Ben Newton line-up for ceremony

John Carter, Dave Hanscom and Erik Brunvand

"Photo-op"

spring/fall TGIF

Martin announces teaching and TA awards

Ali Ibrahim and Liz Jurrus pose for camera

Kristin Potter

David Johnson and daughter, Lucinda

Shrish Jain, Abishek Ranjan and Anupam Chakravorthy

Rajeev Balasubramonian and Carlos Scheidegger

Oren Livne planning attack

Roni Choudhury thinks out his next move

Milestones

Students

Christiaan Gribble was selected as the 2005 University of Utah Graduate Research Fellow. His proposal was deemed superior over the other outstanding proposals that were submitted. The award is intended to help in fostering independent work from outstanding graduate students. Christiaan received $10,000 for the academic year.

Claurissa Tuttle, a graphics student, received an NSF Graduate Research Fellowship Award.

Brian Westphal, a new graduate to the SoC received the Brown Fellowship Award.

Former student **Peter Ashdown**, founder and CEO of XMission, an Internet provider based in Salt Lake, is running for the U.S. Senate. Ashdown, a Democrat will be running against long time Republican Orrin Hatch in next year's election.

Faculty

Elaine Cohen was honored September 23rd with the YWCA Outstanding Achievement Award. During the annual luncheon ceremony Elaine was recognized as a mentor and role model to young women pursuing careers in mathematics, science and engineering.


Claudio Silva

Claudio Silva was granted a 2005 IBM Faculty Award in recognition of his work in scientific visualization techniques. This highly competitive award is intended to recognize outstanding research efforts and foster collaboration between researchers at leading universities worldwide and those in IBM research.
Claudio's project: "Efficient Rendering Techniques For Large-Scale Scientific Visualization" helps to develop interactive scientific visualization techniques for very large datasets. In particular his work will focus on developing novel out-of-core, streaming, and parallel algorithms for optimizing the visualization of large datasets.

New Faculty Joins the SoC


Jim de St. Germain

A short move for **Jim de St. Germain** as he transitioned from research associate at the School of Computing to a Clinical Assistant Professor. He was working with Rich Riesenfeld and Elaine Cohen before he made the change. Jim earned his B.S. in computer science at New Mexico State University. He completed his Ph.D. in Computer Science at the University of Utah. "I chose the SoC because of its strong tradition for producing undergraduate students with both the necessary background to be of immediate use in industry, and the strong understanding of the concepts necessary for advanced degrees. I am proud to be on the front lines of this process and hope to help evolve the curriculum to continue to meet the goals and needs of our students; and perhaps to inspire a few new students to embark on a career in Computer Science," said St. Germain.

While not at work you can find Jim juggling, playing soccer, hiking or spending time with his wife Monica and their new baby Henri.

Meet new faculty member Juliana Freire in the next issue of The Teapot.

WEB Construction Update

Construction for the new Warnock Engineering Building is underway. The 100,000 square foot structure is scheduled for completion Fall 2006. Look for updates on the building's progress in future issues of The Teapot.
For more information go to www.coe.utah.edu/web

Real Mobility, Real Wireless: A New Kind of Testbed

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might try to validate your design with simulation; however, simulation simply cannot capture the complexity of radio propagation, especially indoors. Research has shown that such wireless simulation often yields wildly inaccurate results.

You could build a small testbed with fixed nodes, but that does nothing to address mobility or automate the tedious process of device configuration and running experiments. The Army can spend large sums having "free" soldiers drive wireless-equipped Humvees around the desert—but normal researchers and students don't have that luxury.

Sponsored by NSF and Cisco, our Flux Research Group had already shown that Emulab, our highly-automated public network testbed, sped up wired experimentation by two orders of magnitude. Experiments are entirely controlled by researchers thousands of miles away, through their Web browsers. Naturally we asked: could we similarly lower the barriers to research in wireless networking, for tiny motes, …*and even for motes mounted on mobile robots?* Could we make it reliable? How accurately could we control and measure position? Could we manage without on-site human operators? Could we do it at modest hardware cost, using standard robots and parts?

After nearly a year of hard work most of the answers are in: "yes." We created the world's first remotely accessible testbed for mobile wireless and sensor net research. Our team included ten people from the School of Computing and ME department, although of course not full time: 3 grad students, 1 undergrad, 4 research staff, and 2 faculty. We developed two entirely new software and hardware subsystems: a localization system ("Exactly where is each robot, right now?") and a robot control system ("Move to x,y without colliding with anything.").

In the mobile Emulab, small computers and wireless devices are mounted on robots that researchers directly control. Users specify positions to which robots move automatically, in real time, avoiding any obstacles along the way. Our localization system tracks robots and provides the "ground truth" location of each robot, accurate to within 1 cm. Such precise information on antenna position enables a fine-grained analysis of the radio environment. Location information is also required to close the robot movement control loop, since robots never go exactly where you tell them.

Armed with these tools, a researcher can use robot motion to study the effect of mobility and real-world RF effects on wireless applications and network protocols. Our extended testbed offers unique evaluation opportunities.

In our current small but production deployment, each of six small robots carries a naked PDA-like computer with an 802.11 WiFi card. The WiFi PDA runs Linux and provides the "control channel" for the robots and motes. Users literally login to their robots. Each of the PDAs hosts the device under test: a "Mica2" sensor network mote with a microcontroller, sensor board, and 900MHz radio. Finally, 25 motes with similar temperature, light, and motion sensors are anchored on the walls and ceilings of the robotic area.

Remote researchers can "drag and drop" robots via a web interface as well as programmatically control their motion and network activity. Researchers monitor robot motion via live video streams, maps, and telemetry, all integrated into the Web pages. Custom software can be easily loaded onto the robots and motes for evaluation.

Two key components underlie these features. First, a network of overhead video cameras provides real-time position and orientation information for each robot. Computer vision algorithms "see" and track the robots. We enhanced an open source computer vision system to handle multiple cameras and to improve the precision from 15 cm to 1 cm. The second component is our robot movement system. Using feedback from the vision system, on each "move" it iteratively guides the robot to that destination. Our path planning and obstacle avoidance algorithms free the experimenter from low-level movement concerns.

This testbed is not only innovative, it is real, in public production use. Both wired and wireless testbeds are freely available to students, researchers, and developers from universities and industry. Visit **www.emulab.net** for more information, or to sign up for a test drive or "real" research use.

Emulab: a portable, device-independent "operating system" to control testbeds of networked devices
- **security and containment facilities**
- **400,000 lines of code**
- **11 other Emulab installations**
- **The Utah testbed:**
  - **1100 users**
  - **360 PC nodes**
  - **9 miles of cable, in 2600 segments**
  - **WiFi nodes**
  - **PDAs & motes: fixed and mounted on robots**
  - **remote nodes around the world**
  - **soon: software defined radio!**

David Johnson is an MS student and Jay Lepreau is a Research Professor, both in the School of Computing.

School of Computing
University of Utah
50 S Central Campus Dr, Rm 3190
Salt Lake City, UT 84112-9205

Upcoming Events

November 24-25, 2005
Thanksgiving Break

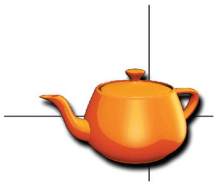
December 8, 2005
Classes End

December 17, 2005 - January 8, 2006
Winter Break

January 9, 2006
Classes begin

Go to: http://www.cs.utah.edu/info/e&s.shtml for information on the upcoming:

2005-2006
Evans & Sutherland Distinguished Lecture Series



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SCHOOL OF COMPUTING
THE UNIVERSITY OF UTAH
50 S. Central Campus Drive, Room 3190
Salt Lake City, Utah 84112-9205

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http://www.cs.utah.edu

News, comments and suggestions are welcome. Please send email to: **teapot@cs.utah.edu.**