

# News & Notes

The University of North Carolina at Chapel Hill  
Department of Computer Science

## *from Sitterson Hall*

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## Chairman's corner



Greetings from Sitterson Hall! As I write this, we are at the close of the spring semester, with a faculty retreat and graduation remaining this week.

One of the major events this spring has been Maze Day, an entertaining and educational fun-fair for blind and low-visual acuity children featuring computer-based games and educational programs specifically designed for sightless operation in Professor Gary Bishop's Assistive Technologies course. Fifty-one children and fifty-six adults from around the state were in attendance for this exciting event. Eighteen different demonstrations were set up throughout the department and manned by student volunteers. The event was organized by our new demo coordinator Missy Wood and was a huge success. You can read more about Maze Day and Gary's work in the Fall 2005 edition of News & Notes.

The Science Complex expansion has also been in full swing this spring. A 128,000-square-foot addition to Phillips Hall that will house Physics and Marine Sciences has sprung up beside Sitterson with an estimated completion date of July 2006. The next

step in the Science Complex expansion is an addition to Sitterson Hall. While the funding details are far from settled, we have been meeting regularly with architects with a target start date for construction in summer 2006.

In this edition of News & Notes you will find the latest computer services news, as well as news from our Networking Research Group, among other updates. We are finding that we have many short announcements of awards and activities that could be more rapidly disseminated by the "recent news" section of our web site. We invite you to visit our departmental web site for the latest news. Our newsletter will continue to come to you with focus on research projects and alumni and faculty news.

Congratulations to the spring semester 2005 Computer Science alumni fellowship recipient, Olufisayo Omojokun. For more about his research, see page 3. I thank you for your support of this important fellowship! While the normal term for the fellowship is one academic year, the fall recipient, Miguel Otaduy, was so productive that he completed and defended his dissertation in the first semester.

As always, I welcome your comments and questions about any aspect of the department. If you are in Chapel Hill, be sure to stop by the department for a visit.

*Jan F. Prins*

## Welcomes and Farewells

### NEW FACULTY

**Naga Govindaraju** (Ph.D. 2004) was named Research Assistant Professor, effective November 2004.

### NEW STAFF

**Faye Lewis**, administrative assistant, joined the department in February 2005. Faye comes to us with many

years of office experience at Lucent Technologies in Greensboro. Most recently, she worked with the Director of Secondary and Career-Technical Education in the Alamance-Burlington School System.

## Congratulations to...

### FACULTY AND STAFF

**Delphine Bull**, administrative assistant, who graduated from UNC in

## Family matters

**Kevin Arthur** (Ph.D. 2000) married **Maureen McClarnon** on October 13, 2004, in Lake Tahoe, California. (*kevina@alienskin.com*)

**Fred and Nancy Brooks** welcomed their ninth grandchild, **Roger Greenwood Brooks, Jr.**, born to **Roger and Ann Brooks** on February 23, 2005, in N.Y. (*brooks@cs.unc.edu*)

**Dennis G. Brown** (M.S. 1998) and his wife, **Lisa**, welcomed their daughter, **Jessica**, on September 16, 2004, in Waldorf, Md. (*dennis.g.brown@nrl.navy.mil*)

**Kelly Corbet** (B.S.M.Sci. 1987) married **Stephanie Price** on March 20, 2004, in Raleigh, N.C. (*kscorbet-subst@nc.rr.com*)

**Tim Culver** (Ph.D. 2000) and his wife, **Kathleen**, welcomed their daughter, **Grace Ann**, on October 2, 2004, in Waltham, Mass. Grace joins big brother **Matthew**. (*culver@acm.org*)

**Scott Larsen**, graduate student, and his wife, **Amy**, welcomed their son, **Seth**, on November 2, 2004, in Chapel Hill. Seth joins siblings **Jacob, David, and Lorin**. (*larsene@cs.unc.edu*)

**Gopi Meenakshisundaram** (Ph.D. 2001) and **Aditi Majumder** (Ph.D. 2003) welcomed their daughter, **Sucheta M. Sundaram**, on December 15, 2004. (*gopi@ics.uci.edu, majumder@ics.uci.edu*)

**Derek Merck**, graduate student, married **Dr. Lisa Fagan** on the beach in Santa Barbara on August 8, 2004. (*derek@cs.unc.edu*)

**Mark Moir** (Ph.D. 1996) and **Vikki Genys** welcomed their son, **Maxwell John**, on December 12, 2004, in Wellington, NZ. (*Mark.Moir@Sun.com*)

**Jai Glasgow Pausch**, former outreach coordinator, and her husband, **Randy**, welcomed their son, **Logan Maxwell**, on October 2, 2004, in Pittsburgh, Penn. Logan joins big brother **Dylan**. (*jai@pausch@mac.com*)

## Congratulations to...

December 2004 with a B.A. in Management and Society, completing the degree she began at Florida International University. Delphi started with one course at UNC in fall 1999 and increased up to five courses a year. She joined the department in January 2001 as administrative support to Steve Pizer and Guido Gerig.

**Tim Quigg**, associate chair for administration and finance, who received the 2004 Excellence in Research Administration: Research Administrator of the Year Award from the Office of the Vice Chancellor of Research and Economic Development. This annual award recognizes a University employee for meritorious and distinguished accomplishments in research administration at UNC-Chapel Hill.

**Jenni Styron** and **Marie Tarjan**, who were both promoted to Program Assistant V's in September 2004. They provide administrative support for the faculty and department. Jenni joined the department in January 2001 and Marie joined the department in April 1996.

**Missy Wood**, who was promoted to Administrative Assistant II in September 2004, and will now provide support for proposal development and resurrect the demo/outreach program for the department. Missy also received a "Big Buddy" award in October 2004 from the Employee Forum Recognition Program. She was nominated by Jenni Styron and selected by a committee to receive a gift basket to Southern Seasons along with a UNC One Card Gift Certificate.

### GRADUATE STUDENTS

**Sudipta Sinha**, who was one of the winners of Phase One of the CanestaVision™ Contest, sponsored by Canesta, Inc. Phase One of the contest asked participants to explore innovative applications of Canesta's new depth cameras (active infrared time-of-flight cameras). In the context of this contest, Sudipta proposed to extend his work on camera network calibration to depth cameras and hybrid camera networks. As one of the ten selected winners, Sudipta received a \$7,500 electronic perception development kit. Sudipta is a Ph.D.

student in the department, and his advisor is **Marc Pollefeys**. You can read his winning entry at <http://www.canesta.com/contest/>.

Graduate student **Gokul Varadhan** and Professor **Dinesh Manocha** were the recipients of the Best Paper Award at Pacific Graphics 2004. The title of the paper was "Accurate Minkowski Sum of Polyhedral Models," and the conference was held in Seoul, South Korea, on October 6 - 8, 2004.

**December 2004 Ph.D. Recipients:** **William Valentine Baxter, III**, "Physically-Based Modeling Techniques for Interactive Digital Painting." (Ming Lin)

**Tom Fletcher**, "Statistical Variability in Nonlinear Spaces: Application to Shape Analysis and DT-MRI." (Stephen Pizer)

**Yoni Fridman**, "Extracting Branching Object Geometry via Cores." (Stephen Pizer)

**Shelby Funk**, "Implementing Real-time Systems on Heterogeneous Multiprocessors." (Sanjoy Baruah)

**Sean Ho**, "Profile Scale Spaces for Statistical Image Match in Bayesian Segmentation." (Guido Gerig)

**Martin Isenburg**, "Compression and Streaming of Polygon Meshes." (Jack Snoeyink)

**Miguel A. Otaduy**, "6-DoF Haptic Rendering Using Contact Levels of Detail and Haptic Textures." (Ming Lin)

**Erin Parker**, "Analyzing the Behavior of Loop Nests in the Memory Hierarchy: Methods, Tools, and Applications." (Siddhartha Chatterjee)

**Adam Seeger**, "Surface Reconstruction from Combination AFM/SEM Images." (Russell Taylor)

**December 2004 M.S. Recipients:** John Chek, Timothy Cogger, Justin Hensely, David O'Brien, Chris Oates, Max Smolens, Ben Wiseman.

## UNDERGRADUATE STUDENTS

**Austin Hogue**, a junior business major who was enrolled in Jeannie Walsh's COMP 90 A.P.P.L.E.S. Service Learning course (a companion course to COMP 4) during the fall 2004 semester, who was presented with the President's Choice Award for Outstanding Community Service from the Orange County Disability Awareness Council in November 2004, at a banquet held at the Sheraton Inn in Chapel Hill. A.P.P.L.E.S. is a service learning program that gives students the opportunity to implement skills they have learned in class in a real life setting. Austin worked as a technical advisor intern for the OCDAC, utilizing his understanding of office software to organize the Council's databases, educate members on how to use Microsoft Office programs, develop an easy-to-read training manual, and set up computer units at employees' homes. Austin was the first person to receive an award from the OCDAC after such a short term of service – he had only worked with the Council for three months at the time. Austin was recently accepted into the Kenan-Flagler Business School at UNC.

**Kristopher Jordan**, a sophomore, on being awarded a 2004 Robert E. Bryan Fellowship. Kris was the only undergraduate student to be named a Bryan Fellow in 2004. Named in honor of alumnus Robert E. Bryan, of Newton Grove, the Bryan Fellowships are given each summer to students to support public service projects addressing identifiable needs in the state. Fellowships plan and implement the projects in conjunction with a community partner and a UNC faculty mentor, in this case, **Dr. Gary Bishop**.

Kris' project was to design a Web site for the KidSenses Children's Museum, located in his hometown of Rutherfordton, N.C. The Web site, NCKidScience.com, is designed to help elementary school teachers across North Carolina prepare their students for the End-of-Grade examinations in science, allow them to access current state science curriculums online, and connect them through teacher message boards.

**December 2004 B.S. Recipients:** Joshua Branscomb\*, Joshua Hester, Emily Humphrey, Eric Stone, James Watts.

\* With Highest Honors

## Grants and Contracts

**Ming C. Lin**, professor (PI). "Conference Support for ACM Workshop on General Purpose Computation using Graphics Processors," ARO.

**Dinesh Manocha**, professor (PI), and **Ming C. Lin**, professor (Co-PI). "Computer Generated Force Scalability," U.S. Army RDECOM.

**Leonard McMillan**, associate professor (PI), and **Wei Wang**, assistant professor (Co-PI). "Enhanced Night Vision Via a Combination of Poisson Interpolation and Machine Learning," DARPA.

**Andrew Noble**, adjunct associate professor (PI), and **Wei Wang**, assistant professor (Co-PI). "Analysis of High Dimensional Data Using Subspace Clustering," NSF.

The "Computer-Integrated Systems for Microscopy and Manipulation" (CISMM) NIH National Research Resource has had its funding continued for the next five years. This grant is the continuation of **Fred Brooks'** GRIP project, which enjoyed decades of success. **Richard Superfine** and **Russell Taylor** are co-directors of the main line of research; **Fred Brooks** and **Mary Whitton** lead the "Advanced technology" team that explores upcoming technology for use in biomedical application. The long-term funding was a result of a successful construction and validation of a fully-functional prototype for the 3D magnetic force microscope that was designed and constructed by **Leandra Vicci** and **Kurtis Keller** in the MSL; **David Marshburn** integrated the software efforts. Hard work by biologist **Tim O'Brien** and a number of graduate students in computer science, physics and astronomy, materials science, and biomedical engineering produced a body of scientific experiments useful to our collaborators, who showed up in D.C. for our reverse site visit. Image analysis imported from the UNC MIDAG group continues to enable rapid and quantitative measurement of the resulting images.

This grant supports building both software tools and new microscopy systems to enable novel biomedical research. It supports bringing these tools to local and national collaborators and providing them as a service to the broader biomedical community. It is funded through the new National Institute for Biomedical Imaging and Bioengineering.

## ALUMNI FELLOWSHIP RECIPIENT

**Olufisayo Omojokun** (M.S. 2001) is the recipient of the spring semester 2005 Computer Science Alumni Fellowship. The fellowship is awarded annually to a Ph.D. candidate in his or her final year of study, allowing the student to work full time on dissertation research. Generous contributions by alumni and friends help to make this fellowship possible.

Olufisayo's research falls in the areas of mobile and ubiquitous computing. He is particularly interested in universal interaction, which is the ability to interact with arbitrary networked devices and their compositions through software-based user-interfaces deployed on mobile computers. To illustrate, a mobile computer could provide a multi-device user-interface allowing a user to transfer pictures on a digital camera to a nearby printer. An important issue raised by universal interaction is: how should mobile computers deploy user-interfaces for interacting with remote devices? Addressing this issue is at the core of his research.

The approach that Olufisayo is investigating is to dynamically generate user-interfaces for both single and multiple devices. This approach, however, has a set of unique limitations, including that it takes a long time for a mobile computer to automatically create a user-interface "on the fly." In general, his research goal is to overcome this and other existing limitations of the generation approach. To overcome generation latency, for example, he is using the ideas of user-interface retargeting and lazy generation. User-interface retargeting involves dynamically mapping a previously generated user-interface of a (source) device to another (target) device that can share the user-interface. Lazy generation allows a generator to spend time opportunistically generating only subsets of a device's user-interface that a user needs at a given time.





## 4 Recent publications

Baruah S., and J. Anderson. "Energy-efficient Synthesis of Periodic Task Systems upon Identical Multiprocessor Platforms," *Proc. of the 24th IEEE International Conference on Distributed Computing Systems*, IEEE Computer Society Press, 428-435, March 2004.

Baxter, W., Y. Liu, and M. Lin. "A Viscous Paint Model for Interactive Applications," *Journal of Computer Animation and Virtual Worlds*, 2004.

Block, A., and J. Anderson. "Task Reweighting on Multiprocessors: Efficiency versus Accuracy," *Proc. of the 13th International Workshop on Parallel and Distributed Real-time Systems*, April 2005.

Bullitt, E., M. Ewend, S. Aylward, W. Lin, G. Gerig, S. Joshi, I. Jung, K. Muller, and K. Smith. "Abnormal vessel tortuosity as a marker of treatment response of malignant gliomas: Preliminary report," *Technology in Cancer Research and Treatment*, 3: 577-584, 2004.

Bullitt, E., I. Jung, K. Muller, G. Gerig, S. Aylward, S. Joshi, K. Smith, and M. Ewend. "Determining Malignancy of Brain Tumors by Analysis of Vessel Shape," *Proc. of Medical Image Computing and Computer-Assisted Intervention (MICCAI) Conference*, LNCS 3217: 645-653, September 2004.

Chaney, E., S. Pizer, S. Joshi, R. Broadhurst, T. Fletcher, G. Gash, Q. Han, J.Y. Jeong, C. Lu, D. Merck, J. Stough, G. Tracton, J. Bechtel, J. Rosenman, Y.Y. Chi, and K. Muller. "Automatic Male Pelvis Segmentation from CT Images via Statistically Trained Multi-Object Deformable M-rep Models," *American Society for Therapeutic Radiology and Oncology (ASTRO)*, 2004.

Corouge, I., S. Gouttard, and G. Gerig. "Towards a Shape Model of White Matter Fiber Bundles using Diffusion Tensor MRI," *Proc. of International Symposium on Biomedical Imaging (ISBI)*, 344-347, 2004.

Corouge, I., S. Gouttard, and G. Gerig. "A Statistical Shape Model of Individual Fiber Tracts Extracted from Diffusion Tensor MRI," *Proc. of Medical Image Computing and Computer-Assisted Intervention (MICCAI) Conference*, LNCS 3217: 671-679, September 2004.

Dam, E., T. Fletcher, S. Pizer, G. Tracton, and J. Rosenman. "Prostate Shape Modeling based on Principal Geodesic Analysis Bootstrapping," *Proc. of Medical Image Computing and Computer-Assisted Intervention (MICCAI) Conference*, LNCS 3217: 1008-1016, September 2004.

Davis, B., P. Lorenzen, and S. Joshi. "Large Deformation Minimum Mean Squared Error Template Estimation for Computational Anatomy," *Proc. of International Symposium on Biomedical Imaging (ISBI)*, 173-176, 2004.

Devi, U., and J. Anderson. "Desynchronized Pfair Scheduling on Multiprocessors," *Proc. of the 19th IEEE International Parallel and Distributed Processing Symposium*, April 2005.

Devi, U., and J. Anderson. "Fair Integrated Scheduling of Soft Real-time Tardiness Classes on Multiprocessor Platforms," *Proc. of the 10th IEEE Real-time and Embedded Technology and Applications Symposium*, IEEE Computer Society Press, 554-561, May 2004.

Devi, U., and J. Anderson. "Improved Conditions for Bounded Tardiness under EPDF Fair Multiprocessor Scheduling," *Proc. of the 12th International Workshop on Parallel and Distributed Real-time Systems*, 8 pages, 2004. (On CD ROM.)

Devi, U., and J. Anderson. "Schedulable Utilization Bounds for EPDF Fair Multiprocessor Scheduling," *Proc. of the 10th International Conference on Real-time and Embedded Computing Systems and Applications*, Springer-Verlag Lecture Notes in Computer Science, August 2004.

Fletcher, T., C. Lu, S. Pizer, and S. Joshi. "Principal Geodesic Analysis for the Study of Nonlinear Statistics of Shape," *IEEE Transactions on Medical Imaging*, 23(8): 995-1005, 2004.

Foskey, M., M.C. Lin, and D. Manocha. "Efficient Computation of a Simplified Medial Axis," *Special Issue of ASME Journal of Computing and Information Science in Engineering*, 12 pages, 2004.

Fridman, Y., S. Pizer, S. Aylward, and E. Bullitt. "Extracting Branching Tubular Object Geometry via Cores," *Medical Image Analysis*, 8(3): 169-176, 2004.

Gerig, G., S. Gouttard, and I. Corouge. "Analysis of Brain White Matter via Fiber Tract Modeling," *Conference on Engineering in Medicine and Biology Society (EMBS)*, September 2004.

Govindaraju, N., B. Lloyd, W. Wang, M. Lin, and D. Manocha. "Fast Computation of Database Operations using Graphics Processors," *Proc. of ACM SIGMOD International Conference on Management of Data*, June 2004.

Han, Q., C. Lu, G. Liu, S. Pizer, S. Joshi, and A. Thall. "Representing Multi-Figure Anatomical Objects," *Proc. of International Symposium on Biomedical Imaging (ISBI)*, 1251-1254, 2004.

Ho, S. and G. Gerig. "Profile Scale-spaces for Multiscale Image Match," *Proc. of Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, LNCS 3216: 176-183, September 2004.

Holman, P., and J. Anderson. "Implementing Pfairness on a Symmetric Multiprocessor," *Proc. of the 10th IEEE Real-time and Embedded Technology and Applications Symposium*, IEEE Computer Society Press, 544-553, May 2004.

Jomier, J., E. Rault, and S. Aylward. "Automatic Quantification of Pupil Dilation Under Stress," *Proc. of International Symposium on Biomedical Imaging (ISBI)*, 249-252, 2004.

Jomier, J. and S. Aylward. "Rigid and Deformable Vasculature-to-Image Registration: a Hierarchical Approach," *Proc. of Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, LNCS 3216: 829-836, September 2004.

Joshi, S., B. Davis, M. Jomier, and G. Gerig. "Unbiased Diffeomorphic Atlas Construction for Computational Anatomy," *NeuroImage: Supplement issue on Mathematics in Brain Imaging*, 23(S1): S151-S160, 2004.

Kim, Y., G. Varadhan, M.C. Lin, and D. Manocha. "Fast Swept Volume Approximation of Complex Polyhedral Models," *Computer-Aided Design*, 36(11): 1013-1027, September 2004.

Lin, M.C., and D. Manocha. "Collision Detection," *Handbook of Data Structures and Applications*, 17 pages, Eds. S. Sahni and D. Mehta, CRC Press, 2004.

Lorenzen, P., B. Davis, and S. Joshi. "Model Based Symmetric Information Theoretic Large Deformation Multi-Modal Image Registration," *Proc. of International Symposium on Biomedical Imaging (ISBI)*, 720-723, 2004.

Lorenzen, P., B. Davis, G. Gerig, E. Bullitt, and S. Joshi. "Multi-scale Posterior Atlas Formation via Unbiased Kullback-Leibler Template Estimation," *Proc. of Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, LNCS 3216: 95-102, September 2004.

Otaduy, M., N. Jain, A. Sud, and M. Lin. "Haptic Rendering of Interaction between Textured Models," *Proc. of IEEE Visualization*, October 2004.

Otaduy, M., and M. Lin. "A Perceptually-Inspired Force Model for Haptic Texture Rendering," *Proc. of ACM Symposium on Applied Perception on Graphics and Visualization*, August 2004.

Pappas, I.P., M. Puja, M. Styner, J. Liu, and M. Caversaccio. "New method to assess the registration of CT-MR images of the head," *Injury*. 35: S-A105-S-A112, 2004.

Prastawa, M., J. Gilmore, W. Lin, and G. Gerig. "Automatic Segmentation of Neonatal Brain MRI," *Proc. of Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, LNCS 3216:10-17, September 2004.

Prastawa, M., E. Bullitt, S. Ho, and G. Gerig. "A Brain Tumor Segmentation Framework Based on Outlier Detection," *Medical Image Analysis Journal*, Special issue on MICCAI, 8(3): 275-283, 2004.

Schmidl, H., and M. Lin. "Geometry-Driven Physical Interaction Between Avatars and Virtual Environments," *Journal of Computer Animation and Virtual Worlds*, 2004.

Schmidl, H., N. Walker, and M. Lin. "Fast Update of OBBTrees for Articulated-Body Collision Detection," *Journal of Graphics Tools*, 9(2): 1-9.

Stough, J., S. Pizer, E. Chaney, and M. Rao. "Clustering on Image Boundary Regions for Deformable Model Segmentation," *Proc. of International Symposium on Biomedical Imaging (ISBI)*, 436-439, 2004.

Styner, M., J. Lieberman, D. Pantazis, and G. Gerig. "Boundary and Medial Shape Analysis of the Hippocampus in Schizophrenia," *Medical Image Analysis Journal*, Special issue on MICCAI, 8(3): 197-203, 2004.

Styner, M., and G. Gerig. "Correction scheme for multiple correlated statistical tests in local shape analysis," 5370: 233-240, *SPIE*, 2004.

Yoon, S., B. Salomon, M. Lin, and D. Manocha. "Fast Collision Detection between Massive Models using Dynamic Simplification," *Proc. of Eurographics Symposium on Geometry Processing*, July 2004.

## Computer Services News

The last Computer Services Update in the News & Notes was in summer 2003. Below are highlights of projects that Computer Services has worked on since then.

### Windows Changes

Most of the department's Windows computers are running some flavor of Windows, primarily Windows XP, with Windows Server 2003 on the servers. In spring 2004, the campus gave the department another 60 IBM PCs as part of the Carolina Computing Initiative, and we quickly rolled those out, with many going to graduate students. Last summer we deployed SUS (software update server) so we could automatically apply security and other patches, which are often needed on Windows systems. Just keeping up with the service packs and patches for over 400 Windows systems is a major undertaking, and we are continuing work to further automate the process.

### Linux and UNIX Changes

The department has largely shifted off Sun computers, which we have used for years as our major server systems. Last spring the Computer Services staff migrated our users from the department's old Sun mail server to the campus IMAP email server. We're currently completing work on a Linux email server so that our users will have the option of using the campus server, the department's server, or both. In another shift of services off the Suns, we completed the move of all our AFS file services from Suns to new Linux systems in February 2005. We have moved many other services from Suns to Linux systems, and the few remaining services now on Suns will be moved to Linux or Windows systems by the end of this year. Practically all of our Linux systems are now running the latest version of Red Hat Enterprise Linux. In addition, we still have a small fleet of Macintosh computers running

Apple's latest operating system, OS/X 10.3, which is UNIX-based. The only other UNIX systems in the department are the one remaining SGI system, Evans, which now is primarily a compute server, and a large set of FreeBSD computers run by systems researchers in what is still known as the Colab.

### New Services Added

In fall 2004, we added a server whose function is running CVS version control software and providing disk space for CVS repositories of source code. The service is still in its infancy as Computer Services staff, who don't write a lot of code, are learning the complexities of using and administering this service. In addition, with a relatively new infrastructure grant that bought a large number of video projectors, the facilities staff now fully supports the installation and maintenance of multiple video projectors in offices, which have become a common sight around the department.

## High Schoolers Benefit from CS First Year Seminar

First year seminars at UNC give professors a chance to teach something new and interdisciplinary, and give students a chance to have a small class academic experience in their first year at the university. Courses cover the gamut of disciplines, and make many wish they were freshmen again.

Jack Snoeyink's first year seminar "Folding: from paper to proteins" was created in fall 2002 and taught for the second time in fall 2004. The course examines shape and structure, explored through origami, robotics, and molecular biology. Students consider many puzzle-like questions about folding shapes and structures, including what is arguably the biggest puzzle in science: how does the sequence of amino acids coded by a gene reliably fold into the three-dimensional structure to be a functioning protein?

The final assignment for the fall 2004 class was to develop a lesson plan to teach a middle school class about some aspect of math or science through folding. These opportunities were advertised through the UNC Office of International Student and Scholar Services, and a couple of class visits were made.

Nikki Malatin, a science teacher at West Caldwell High School, was one of the first to reply because she was excited by the idea of using origami to present lessons in chemistry. Jack visited the school, along with graduate student Andrea Mantler and freshman seminar student Amy Jensen to present lessons on chemical bonding in two science classes.

Each student in Ms. Malatin's class made an atom out of two squares of paper, using a module designed by Yoshihide Momotani. This allowed the students to talk about the geometry of bonds: carbons with four bonds in tetrahedral conformation, zwitterions in a benzene ring, and how the geometric properties of the oxygen bonding leads to the charged nature of water (oxygen with two bound hydrogens).



West Caldwell H.S. student Marcus Corpening plays with the origami maze man. (photo: Nikki Malatin)

# Internet Traffic Measurements

Kevin Jeffay and Don Smith

One of the most important and productive aspects of networking research in the department is our ongoing monitoring of Internet traffic entering and leaving the UNC campus. Because the user population is large (over 35,000) and very diverse in terms of how they use the Internet, the data we have collected represents a rich mix of applications that exchange data with destination hosts located all over the world. Consider that all units of the university, including administration, academic departments, research institutions, student housing, and the medical complex (with a teaching hospital that is the center of a regional health-care network) use the Internet link where we collect measurement data. As a result we are able to capture network workloads from a broad cross-section of Internet usage that includes, to give just a few examples, email, instant messaging, student “web surfing,” peer-to-peer file sharing (and music downloading), access to research data, business-to-consumer shopping, business-to-business services (e.g., purchasing), and even denial-of-service attacks.

The data is collected by passive “splitting” of the optical fibers that carry the inbound and outbound

Internet traffic and directing a “copy” to a monitoring system that records traces of the Ethernet and TCP/IP protocol headers (with a timestamp) on each frame passing over the link. Host IP addresses are anonymized to ensure user anonymity and no user or application data is recorded. When we first began the measurements in late 1998, UNC was connected to the Internet with a single OC-3 (155 Mbps) full-duplex, ATM link. Today, there are two 1 Gbps full-duplex Ethernet links, one carrying only Ibiblio (<http://www.ibiblio.org/>) traffic and the other carrying everything else. Until recently we constructed several generations of the monitoring systems from high-end Intel-based server machines (donated by IBM) using off-the-shelf network interface adapters. As traffic loads and link speeds increased, we found it necessary to purchase a network interface adapter optimized for traffic monitoring (the Endace DAG 4.3G). This device provides high precision and accuracy in timestamps and allows trace capture at line rates with no losses on our server machines.

We have captured and warehoused several terabytes of traces in the mass storage system operated by the campus

IITS organization. These traces have been a tremendous resource for our research where they have been used for application workload modeling (Felix Hernandez, Michele Weigle), studies of network properties and TCP connection dynamics (Jasleen Kaur, Jay Aikat, Sushant Rewaskar), traffic generation in network experiments (Long Le, Jay Aikat, David Ott), studies of web caching for mobile devices (Maria Papadopouli), and research on statistical methods for traffic analysis (Steve Marron, Andrew Noble). In addition, a number of external groups have used our data, including Lucent Bell Labs, Boston University, University of Texas-Austin, University of Melbourne, and University of Michigan. References for papers resulting from various uses of our data can be found at <http://www.cs.unc.edu/~smithfd/measurement/>.

We gratefully acknowledge the assistance of Jim Gogan (UNC director of networking), Jim Kitchen, Todd Lane, and others on the UNC IITS Networking staff without whom none of this would have been possible.

## Department Acquires High-Speed Packet Processing Engine

With support from the Provost and the Dean of Arts & Sciences, the department recently acquired a CloudShield CS2200 server computer. The CS2200 is a “deep packet inspection” engine built around the Intel IXP2800 network processor. It enables in-line processing of network packets at gigabit per second speeds. The CS2200 supports a data-flow-like programming model wherein users can write programs to read and modify packets in real-time. For example, packets can be scanned for known viruses and worms and discarded, traffic management policies can be implemented, and traffic accounting data can be gathered.

The CloudShield server is currently being used by undergraduates Boriana

Ditcheva, Lisa Fowler, and Elise London as part of a CRA funded Collaborative Research Experience for Undergraduates in Computer Science and Engineering (CREU) project (see picture, page 8). In the project, a collaboration between UNC and CloudShield, the students are implementing a method for real-time construction of application-level models of TCP traffic from data carried in packet headers. The method, developed by graduate student Felix Hernandez Campos, constructs a feature vector for each TCP connection that provides a succinct, abstract characterization of how an application used the network. The feature vectors are used to develop traffic measurement and accounting tools, network

intrusion detection algorithms, and synthetic traffic generators. Students in a current graduate seminar in Network Intrusion detection (COMP 290-040) are also using the server for class projects.

Beyond networking research, the Real-Time Systems research cluster is also considering using the CloudShield server as a platform for its research on multiprocessor resource allocation policies. The IXP network processor contains 16, 32-bit microengines, each microengine providing 8 hardware threads. The processor supports a three-level memory hierarchy and hence provides a challenging environment for task scheduling.



## M.S. AND PH.D. ALUMNI

**Ronald Azuma** (Ph.D. 1995) is serving as Program Chair for the 2005 IEEE/ACM International Symposium on Mixed and Augmented Reality, to be held in Vienna, Austria in October 2005. ([azuma@HRL.com](mailto:azuma@HRL.com))

**Steve Bellovin** (Ph.D. 1982) has been named a professor of computer science at Columbia University, after many years at AT&T (first Bell Labs, then AT&T Labs). ([smb@cs.columbia.edu](mailto:smb@cs.columbia.edu))

**Chandna Bhatnagar** (M.S. 2000) and **Anand Srinivasan** (Ph.D. 2003) recently moved to Bangalore, India in January 2005. Anand joined Lucent Bell Labs as a researcher and Chandna continues working for Cisco Systems in Bangalore. Prior to their move, the couple was living in Seattle since 2003. ([anands@umc.edu](mailto:anands@umc.edu), [cbhatnag@cisco.com](mailto:cbhatnag@cisco.com))

**Dennis Brown** (M.S. 1998) and his wife, **Lisa**, moved to Waldorf, Md., in summer 2004. Dennis still works at the Naval Research Lab in Washington, DC, as a Computer Scientist, exploring uses of augmented and virtual reality for training and operations. ([dennis.g.brown@nrl.navy.mil](mailto:dennis.g.brown@nrl.navy.mil))

**Randy Brown** (M.S. 1990) became Technical Director of America's Army Government Applications in August 2004. AAGA develops interactive single and multi-player 3D training and simulation software for government and private agencies, such as the Army, Special Forces, and the Secret Service. They also contribute to the integration of new content and technologies into the public multiplayer online application America's Army ([www.americasarmy.com](http://www.americasarmy.com)), such as vehicles and AI. ([randy.brown@americasarmy.com](mailto:randy.brown@americasarmy.com))

**Derrick Cole** (M.S. 1988) has entered the MBA Program at N.C. State, after a 20-year hiatus from higher education. He should graduate in 2007, and says his blood still runs Carolina Blue. ([derrick@nc.rr.com](mailto:derrick@nc.rr.com))

**Wm Leler** (Ph.D. 1987) and Cindy von Ofenheim recently moved to Wellington, New Zealand. Wm has taken a visiting position at the Victoria University of Wellington. They invite old friends to visit them. ([wml@leler.com](mailto:wml@leler.com))

**John McInroy** (Ph.D. 1978) says he is enjoying early retirement and has been

working on building web sites that are easy to use (or are intended to be) based on his work with human factors psychologists at IBM. He also recently finished a Web site for a technical conference: [www.ts.se2004.org](http://www.ts.se2004.org). ([mcinroy\\_mt@hotmail.com](mailto:mcinroy_mt@hotmail.com))

**Gopi Meenakshisundaram** (Ph.D. 2001) won the second best paper award at Eurographics 2004 for the paper "Single Strip Triangulation of Manifolds with Arbitrary Topology" coauthored with David Eppstein. Gopi is an Assistant Professor at the University of California, Irvine. ([gopi@ics.uci.edu](mailto:gopi@ics.uci.edu))

**Ramesh Raskar** (Ph.D. 2002) received a TR100 award in September 2004 from MIT Technology Review Magazine. The TR100 award recognizes the top 100 innovators under 35 in the field of computing, biotech and nanotech, selected from 650 nominations worldwide. Ramesh was also the Keynote Speaker at the Symposium on Virtual Reality in Sao Paulo, Brazil in October 2004 on the topic of "New Directions in Augmented Reality." ([raskar@merl.com](mailto:raskar@merl.com))

**Amitabh Varshney** (Ph.D. 1994) received the first IEEE Visualization Technical Achievement Award "in recognition of Seminal Achievements in Scientific Visualization of Molecular Surfaces" in October 2004. ([varshney@cs.umd.edu](mailto:varshney@cs.umd.edu))

## UNDERGRADUATE ALUMNI

**Lawrence Bercini** (B.S. M.Sci. 1977) has recently achieved certification as a Business Intelligence Professional via the ICCP/TDWT with a specialization in Data Warehousing and Data Resource Management, mastery level. ([lbercini@transunion.com](mailto:lbercini@transunion.com))

**Mark Hutchinson** (B.S. M.Sci. 1981) is an independent software instructor, developer, and consultant in the RTP area. He started the RTP-Delphi Interest Group ([rtpdig.org](http://rtpdig.org)) in 1996 and serves on the leadership committee of the Triangle Net User Group ([trinnug.org](http://trinnug.org)). He has a few commercial EMC wave modeling products for electrical engineers (EZ-EMC, EZ-FDTD, EZ-PowerPlane) co-developed with U. Missouri at Rolla. He recently started Shunner Technologies ([shunner.com](http://shunner.com)), producing a network/host intrusion detection and prevention product. ([aikemark@aol.com](mailto:aikemark@aol.com))

**John Kelso** (B.S. M.Sci. 1976) is on the staff of the Scientific Applications and Visualization Group at NIST, the National Institute of Standards and Technology. Visit [math.nist.gov/mcsd/savg/](http://math.nist.gov/mcsd/savg/) for details. ([kelso@nist.gov](mailto:kelso@nist.gov))

**Matthew McCallus** (B.S. 2003) is currently working for Red Storm Entertainment in Morrisville, N.C., as a software engineer. In his job, he is programming the audio engines for the major upcoming games Ghost Recon 2 and Rainbow Six 4, as well as programming for the PC, the Xbox, and Playstation2 consoles. ([matt.mccallus@gmail.com](mailto:matt.mccallus@gmail.com))



*Hiking in Cappadocia:* Professor Emeritus **Peter Calingaert** led a Sierra Club trip to western Turkey in October 2004. (photo: Isabel Calingaert)

# News & Notes

from Sitterson Hall

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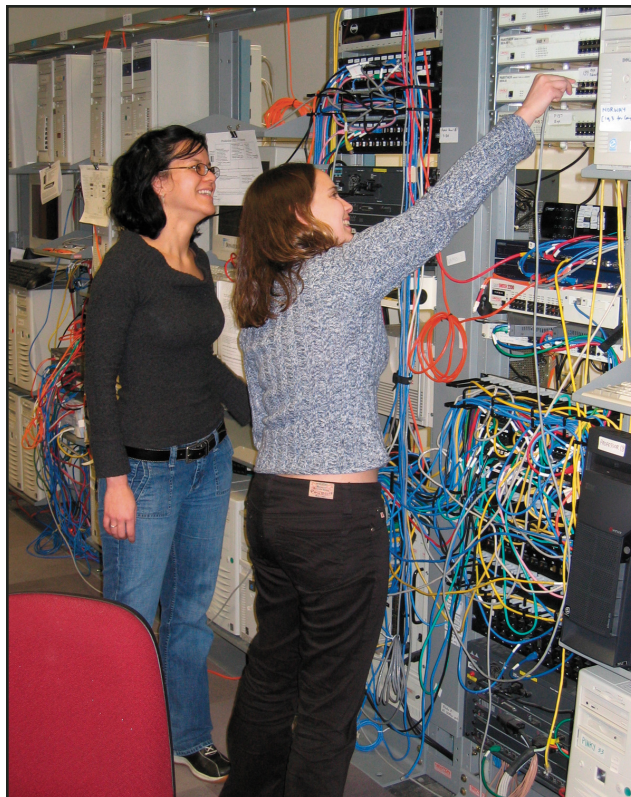
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Let us know where you are and what you are doing so that we can include you in our next issue! Send us information via e-mail to [pubs@cs.unc.edu](mailto:pubs@cs.unc.edu); fax it to (919) 962-1799; or mail it to the address below, c/o News & Notes. If you fax or mail your information, please include your e-mail address.

*Throughout News & Notes, we list degree information for all our B.S., M.S., and Ph.D. Computer Science and Math Sciences alumni.*



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CS undergraduates Lisa Fowler (left) and Elise London (right) configure a network in the DiRT lab to test intrusion detection methods. (photo: Kevin Jeffay)