SCHOOL OF COMPUTING
THE UNIVERSITY OF UTAH

The Utah Teapot

IN THIS ISSUE

Utah Team Wins Award in Semi-Finals of Microsoft's Imagine Cup

This past spring a team of engineering students from Utah competed in the 2009 Microsoft's Imagine Cup Student Technology Competition. The University of Utah Safe Teen Driving team was one of 15 teams selected to compete in the semi-finals held in Boston. The team, comprised of computer science and civil engineering students won the Microsoft's Imagine Cup's Windows Mobile Challenge.

Their project entitled Key2SafeDriving is an application that evaluates how safely a teenager or adult is driving. The application uses a safe routing system to find the safest possible route, by using an accelerometer and call blocking, the application creates a safer road and environment. The teams system starts with a location based service for calculating routes and takes it one step further by allowing them to encourage safe driving by tracking driving behavior as well as reducing driving distractions.

University of Utah Safe Teen Driving Team - Rohan Madtha (computer science), Kenneth Williams (computer science), Tao Xing (civil engineering) , Daniel van Tassell (computer science). Not pictured: Dr. Xuesong Zhou, (team mentor, civil engineering), Chao Yang (computer science) .

"Our goal is to transform the cell phone from a dangerous distraction to a useful guide in helping teens drive more safely," said team member, Kenneth Williams.

Each student was awarded a Windows mobile phone and the opportunity to interview with Microsoft.

Construction Begins on USTAR Research Center

On April 23rd Layton Construction broke ground on the new James L. Sorenson Molecular Biotechnology Building - A USTAR Innovation Center. The building is the first of four in the university's new Interdisciplinary Quad. The state of the art research center will be home to researchers from the Utah Science, Technology and Research (USTAR) Initiative, which was created in 2005.

Alumni Profile

Eric Jensen

Eric Jensen embarked on his computer science journey in the fall of 2000. After visiting a number of different campuses throughout the country Eric selected the University of Utah. "What really cemented the deal for me was visiting with some of the faculty in the School of Computing and finding that they were passionate about their jobs and wanted to recruit good students", said Eric. With a passion and knack for technology he left his home in Idaho Falls and accepted a four-year full tuition scholarship at the University of Utah.

UT: When did you graduate?

EJ: I finished class work in the spring of 2006 and walked in May, but wrapped up a final project for my Masters over the summer. I was part of the first batch of applicants accepted into the combined BS/MS program, which I felt was a fantastic experience. That additional year of studies really helped me deep dive into core areas of interest and focus.

UT: Looking back at your academic experience is there anything you wish you would have known or done different?

Eric Jensen with wife Tausha

EJ: It wasn't until about my third year that I started working as a Teaching Assistant and got to better know the faculty. I wish I would have started that process sooner - earlier on I had been intimidated by large classes and didn't really interact or take advantage of some of the opportunities you have to inquire about to find. Talk to your professors!

UT: While here at the U did you get involved in any committees or activities?

EJ: I participated in some Microsoft sponsored programs for academic outreach, including being a 'Student Consultant' and 'Student Ambassador' for the University of Utah. The programs typically had some stipend budgets for bringing in speakers and would provide books and software for students. Additionally, I was involved in a group called 'SIGDA', which was a student chapter of the International Game Developers Association. I acted as member, Vice President, and President of that group over three years and helped bring in industry speakers from a wide variety of both large and small game development studios, including names like Bungee and Valve. Both of these activities were really valuable for me in developing leadership and communication skills as well as networking with a ton of fantastic developers.

UT: What has changed the most since you were a student?

EJ: Technology is continuing to proliferate in almost every aspect of our daily lives. When I first started as a student almost nobody in classes had a notebook, an iPod, GPS Navigation in their car, or any of a countless range of other gadgets that are now almost passé because it's assumed everybody has one or even a few. It's exciting to see that sort of drastic change because it's affecting teaching and learning in every discipline, but few as much as computer science. The fundamentals aren't really changing, but the things we are doing with software and the web amaze me every day.

UT: You are currently working at TrueNorthLogic as their Chief Technical Officer, how did you get to where you are today?

EJ: I started out as a software engineer, taking in requirements and building enterprise web applications. Early on in that work my communication and organizational skills put me in a position of a technical lead, working directly with clients to answer technical questions and formulate requirements needed to solve problems. Next I was offered the position of Director of Engineering, where I continued to act as an engineer but also led efforts to more fully adopt agile methodology and predictably and frequently release code to all clients in a software-as-a-service (SaaS) like environment. At that point I also took on management responsibilities, such as interviewing, hiring, and reviewing technical personnel on a regular basis. My next and current position taken was as Chief Technical Officer (CTO). A company's size and culture can assign a lot of different types of responsibilities to a title like CTO. In the case of my current position, I act as the executive sponsor of all technical (software development and information technology) activities within the company, provide mentoring, guidance, and decision making in maintaining and implementing new functionality in

continued on next page

our products, and manage directors working in product development, engineering, and technical support branches of the company.

UT: Outside the technology sector, Eric spends his time in the outdoors and traveling. He spends a great deal of time exploring, hiking and backpacking all over southern Utah during warmer weather and loves to ski and snowmobile during the winter months. This past spring he spent two weeks in New Zealand and looks forward to exploring new destionations. Last summer Eric was married in Mazatlan, Mexico.

128 GPU NVIDIA Cluster

The SCI Institute and School of Computing and the University of Utah have built a large GPU computing cluster that consists of 32 NVIDIA S1070 systems (128 GPUs). The GPUs are connected to 64 high-end CPU workstations by a high-speed Infiniband network, purchased with grants from NSF, NIH, and USTAR. The new high performance computing system will have a peak performance of over 128 Teraflops. This supercomputer will enable innovative computational research ranging from the computation of brain anatomical atlas construction from MRI images to the development of new algorithms for the visualization of extremely large datasets. The system also includes state-of-the-art display capabilities, including a 100 megapixel display wall (shown).

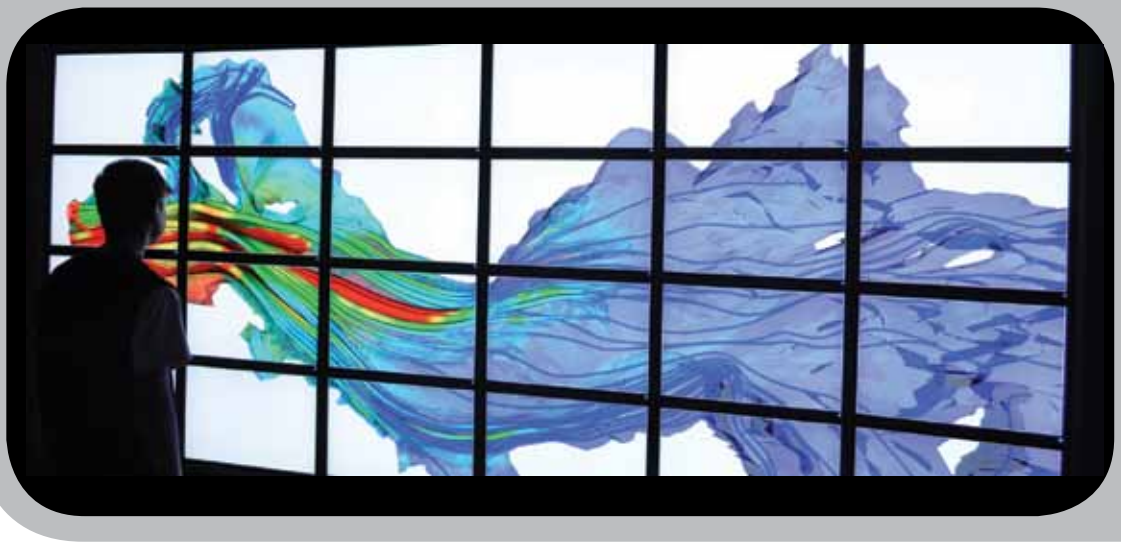
TECHNICAL SPECS

qty 1 HP DL380 G5 Xeon Admin Node

qty 64 HP DL160 G6 computation nodes
512 Xeon X5550 2.67GHz Processors, 8 Core per node
1.5TB of memory, 24GB of RAM per node
750GB local scratch disk space
HP InfiniBand 4X DDR Conn-X PCI-E G2 Dual Port HCA
OS Red Hat Enterprise Linux Server release 5.3

qty 32 NVIDIA Tesla S1070's
128 Tesla GPUs, 4 per S1070 1U Tesla
512GB of dedicated GPU Memory (16 per Tesla, 8 per CPU node)

"Tess" 128 GPU NVIDIA Cluster



Using VisTrails, researchers can create large visualizations from complex data sets relatively easily and inexpensively. Here a simulation from the NSF Center for Coastal Margin Observation & Prediction (CMOP) shows an oceanographic simulation of a river, with streamlines colored according to fluid vorticity.

Analysis of White Matter Pathways in Diffusion Tensor MRI and Its Applications to Autism Research

Tom Fletcher, Won-Ki Jeong, Ran Tao, Ross Whitaker, Janet Lainhart (Dept. of Psychiatry)

Diffusion tensor magnetic resonance imaging (DT-MRI) has the ability to reveal *in vivo* properties of white matter tissue in the human brain. The white matter consists mostly of myelinated axons, which serve as the major communication pathways between neurons in different regions of the brain. As such, DT-MRI is becoming a powerful technique for studying the connectivity of the brain, including clinical studies of white matter abnormalities in neurological disorders as well as studies of normal brain development. In DT-MRI a diffusion tensor at each location in the image gives an estimated model of the pattern of water diffusion aggregated over a small 3D region (typically around 2x2x2 mm^3). The usefulness of diffusion imaging relies on the fact that water molecules can move freely in directions parallel to the axons, but they are impeded in directions that are not parallel to the axons. Therefore, neural fiber orientation is typically inferred from the main axis of the diffusion tensor, which is the direction of highest probability of water motion.

Volumetric Pathways from DT-MRI

We have recently developed a volumetric approach for quantitatively studying white matter connectivity from DT-MRI [1]. Our method is based on a minimization of path cost between two regions, defined as the integral of local costs that are derived from the full tensor data along the path. We solve the minimal path problem using a Hamilton-Jacobi formulation of the problem and a new, fast iterative method that computes updates on the propagating front of the cost function at every point. The solutions for the fronts emanating from the two initial regions are combined, giving a voxel-wise connectivity measurement of the optimal paths between the regions that pass through those voxels. The resulting high-connectivity voxels provide a volumetric representation of the white matter pathway between the terminal regions. Figure 1 shows examples of several white-matter pathways extracted from a DT-MRI using our method.

We have recently implemented a fast solver for the volumetric white matter connectivity using graphics hardware, i.e., the graphics processing unit (GPU) [2]. This method takes advantage of the massively parallel nature of modern GPUs and runs 50-100 times faster than a standard implementation on the CPU. The fast solver allows interactive visualization of white matter pathways. We have developed a user interface in which a user can select two endpoint regions for the white matter tract of interest, which is typically computed and displayed within 1-3 seconds (Figure 2).

Identifying white matter fiber connections as volumetric pathways leaves us with a collection of unparameterized voxels, defined on the original DT-MRI grid, each of which contains information on the tensor, path cost, path length, and path orientation. This collection of raw voxel data offers several possibilities for quantification of the white matter tissue properties along these paths. One such possibility is the mean diffusivity (MD), which is a measurement of the overall tensor size. Lower MD is typically considered to indicate that the axons in a particular voxel are more densely packed, thus reducing the overall probability of water movement. By quantifying such properties in white matter pathways, we can then perform statistical comparisons of these white matter properties between groups, such as typically developing individuals compared to individuals with autism.

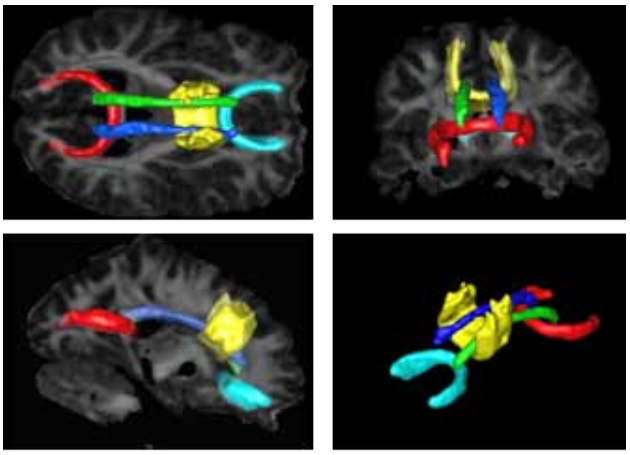


Figure 1. Volumetric pathways for the genu (cyan), body (yellow), and splenium (red) of the corpus callosum; and the left (green) and right (blue) cingulum bundles.

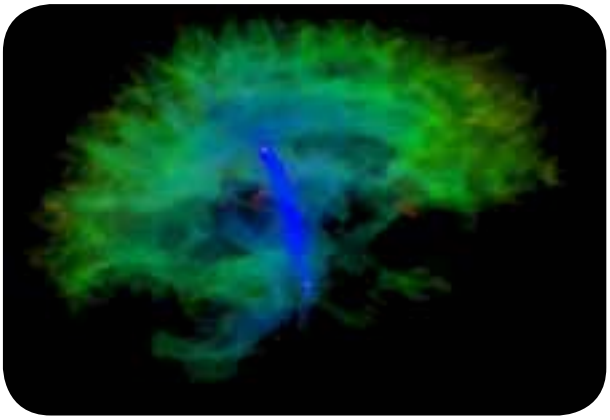


Figure 2. A screen shot from the interactive white matter connectivity solver. Shown are two selected endpoint regions and the resulting white matter pathway.

Language Networks in Autism

In a collaboration between the School of Computing and the Department of Psychiatry, we are applying these new DT-MRI analysis techniques to study language pathways in children with autism. Impairments in language development and functioning are striking in autism. Onset of spoken language is often significantly delayed. Approximately one-third of individuals with autism *never* develop functional use of language. Response to spoken language is sometimes so profoundly impaired during early childhood that some children with autism seem deaf even though their hearing is normal. Comprehension of simple or complex language is deficient. When language does develop, deviant and unusual forms of language may occur. Rapid processing and production of fluent, flexible, and appropriate social language, so important in interacting with others, may never fully develop. Despite the striking nature of the language phenotype of autism at all stages of development, little is known about the brain-basis of this fundamental feature of autism. Our first goal is to study the arcuate fasciculus, a white-matter tract that is involved in the production and understanding of language.

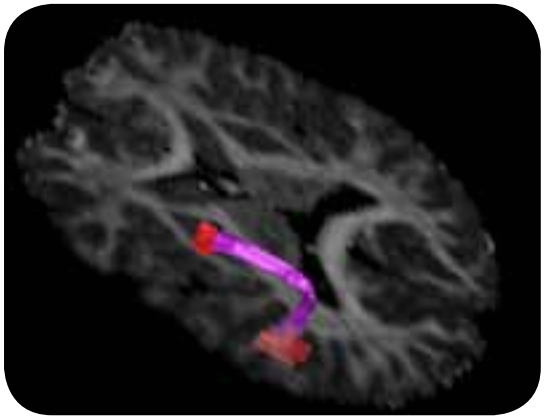


Figure 3. Segmentation of the arcuate fasciculus from a single individual in the autism study.

DT-MRI data were collected from 10 individuals with autism and 10 control subjects as part of an ongoing longitudinal MRI study on brain development in autism. The arcuate fasciculus was extracted from the images using our new automated volumetric DT-MRI segmentation algorithm. Figure 3 shows an example arcuate fasciculus from one of the subjects that was segmented with our method. Average MD values were computed in the arcuate fasciculus and compared across groups. Lateralization scores between the left and right arcuate fasciculi were also computed. As a group, those with autism displayed a significant increase in MD (p = 0.0002). A comparison of lateralization showed a lateralization in controls (decreased MD on the left side) that was absent in the autism group. This indicates that the normal specialization in language, which manifests on the left side for right-handed individuals, is not present in autism.

Acknowledgments

The project described was supported, in part, by Grant Number RO1 MH080826 from the National Institute Of Mental Health. This work is also part of the National Alliance for Medical Image Computing

(NAMIC), funded by the National Institutes of Health through the NIH Roadmap for Medical Research, Grant U54 EB005149. This work was also supported by Autism Speaks Mentor-based Postdoctoral and Predoctoral Fellowship Grants and a University of Utah Seed Grant. We would like to thank our many collaborators in the autism project, including Molly DuBray, Dr. Alyson Froehlich, Dr. Erin Bigler (BYU), Dr. Andrew Alexander (Wisconsin), and Dr. Nicholas Lange (Harvard).

References

Fletcher, P.T., Tao, R., Jeong, W.-K., Whitaker, R.T., A Volumetric Approach to Quantifying Region-to-Region White Matter Connectivity in Diffusion Tensor MRI, In Information Processing in Medical Imaging (IPMI), LNCS 4584, pp. 346-358, 2007.

W.-K. Jeong, P.T. Fletcher, R. Tao, R.T. Whitaker. Interactive Visualization of Volumetric White Matter Connectivity in DT-MRI Using a Parallel-Hardware Hamilton-Jacobi Solver, In IEEE Transactions on Visualization and Computer Graphics (Proceedings of IEEE Visualization 2007), Vol. 13, No. 6, pp. 1480--1487. 2007.

Tom Fletcher, Assistant Professor
fletcher@sci.utah.edu
Won-Ki Jeong, PhD Student
wkjeong@sci.utah.edu
Ran Tao, PhD Student
rantao@sci.utah.edu
Ross Whitaker, Professor
whitaker@cs.utah.edu
Janet Lainhart, Associate Professor
Department of Psychiatry

Faculty

The paper "Strengthening the Case for Pair Programming" written by **Bob Kessler,** Laurie Williams (MS '00), Ward Cunningham and Ron Jeffries was selected by IEEE Software as one the 25th Anniversary Top Picks. Their paper was one of 35 articles selected out of more than 1200 peer-reviewed articles.

Chris Johnson, director of the Scientific Computing and Imaging Institute, will receive the prestigious Cyber Pioneer Award. Alan Hall, chair of the Utah Technology Council, will present the award at the 2009 Utah Cyber Symposium on September 25th. The award is designed to honor individuals who are pioneers in Utah's high tech industry.

Elaine Cohen and **Rich Riesenfeld** were awarded the Pierre Bézier Award. The international award recognizes outstanding contributions to Solid, Geometric and Physical Modeling and Applications.

Students

Huy Vo, a PhD student was awarded a 2009 NVIDIA Fellowship. Huy is just one of the 10 applicants selected through out the country to receive this award. The NVIDIA Fellowship Program provides funding to Ph.D. students who are researching topics that will lead to major advances in the graphics and digital media industry, and are investigating innovative ways of leveraging the power of the GPU. Huy will receive $25,000 in research money. Congratulation Huy!

Graduate student **Aniruddha Udipi** earned Best Paper Award at the 16th International Conference on High Performance Computing (HiPC 2009) for his paper "Non-Uniform Power Access in Large Caches with Low-Swing Wires". This was joint work with Utah alumnus Naveen Muralimanohar (HP Labs) and his advisor Rajeev Balasubramonian.

Alumni

Telle Whitney (BS '78) was recognized by the ACM Distinguished Service Award. Telle is the President and CEO of the Anita Borg Institute for Women and Technology (ABI), co-founded the Grace Hopper Celebration of Women in Computing.

New School of Computing Faculty


Thomas Fletcher

Tom Fletcher joined the school as an assistant professor in the fall of 2008.

His 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.

Tom 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.

Tom holds a position as a faculty member in the SCI Institute.


Valerio Pascucci

Valerio Pascucci joined the School of Computing in the fall of 2008 as an associate professor.

Before joining the school, Valerio served as a Project Leader at the Lawrence Livermore National Laboratory, Center for Applied Scientific Computing and Adjunct Professor at the Computer Science Department of University of California Davis.

Valerio has extensive research interests including topological methods for image segmentation, progressive and multi-resolution techniques for scientific visualization, combinatorial topology, geometric compression, computer graphics, computational geometry, geometric programming, and solid modeling. He earned a EE Laurea (Master), at the University "La Sapienza" in Roma, Italy, in 1993 and his Ph.D. in computer science at Purdue University in 2000.

Valerio also holds a faculty position in the SCI Institute.

Entertainment Arts and Engineering Demo Day

Computer science and film students teamed up to present their final projects May 5th to cap off the EAE senior project course. The annual event allows students to demonstrate their skills and creativity in developing a video game completely from scratch.

The EAE course teams up computer science and art students to build various parts of the video game including engineering the technical parts, developing the game play, and building all art assets including images, sound, and music. They use C# programming language with Microsoft XNA and target the XBOX 360 gaming console. When done the teams release the game to the world through the XBOX Live Community, outstanding games can actually earn income.

Students play video games at EAE Demo Day
photo by: Yong Wan

MACHINIMA FEST '09

What do zombies, Christian Bale, and the economy have in common? All were highlighted in movies created by students as part of the 3rd Annual Machinima Fest. This year's film festival took place May 5th in the Dumke Auditorium in the Museum of Fine Arts.

Computer science and film students teamed up to create five fascinating short films; Behind the Mustache (a mockumentary about the video game character Mario); The Rant (a machinima retelling of Christian Bale's famous rant); Zombies (a tale about playing a video game that gets out of hand); Rising Stasis (a serious film about a young man working hard to improve his stature in life); and It's the Economy (a comedy about the economy).

Members of winning team, Rising Stasis receiving awards.
photo by: Yong Wan

The Z-Team respond to questions during MachinimaFest

The films were judged by an elite group of individuals including, Martin Berzins (School of Computing), Jim Glenn (Utah Arts Council), Kevin Hanson (Division of Film Studies), Rob Nelson (Disney Interactive) and Virginia Pearce (Sundance Institute). The film Rising Stasis walked away with this year's Best Machinima Award.

Machinima Fest 2009 was sponsored by the Entertainment Arts and Engineering interdisciplinary program between the School of Computing and the Division of Film Studies, SMAC (Students' Museum Advisory Council), and the Center for Interdisciplinary Art and Technology (CIDAT).

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

CALENDAR

October 12 - 17, 2009
Fall Break

November 26-27, 2009
Thanksgiving Break

December 11, 2009
Classes end

SCHOOL OF COMPUTING
UNIVERSITY OF UTAH
50 S Central Campus Dr, Rm 3190
Salt Lake City, UT 84112-9205

EDITOR & DESIGN.....Chris Coleman

Comments and suggestions are welcome.
Please send email to teapot@cs.utah.edu.