

# Newsletter

College of Physical and Mathematical Sciences

August 2006



## BYU Scientists Create Tool for 'Virtual Surgery'

*Department of Computer Science*

*By Lois M. Collins*

### *Deseret Morning News*

Computer scientists at Brigham Young University have created a "virtual surgery" tool that lets surgeons, diagnosticians and others extract a 3-D computer image from medical scans.

New computer software program will allow surgeons to instantly visualize any part of a patient's anatomy.

The software, Live Surface, could be valuable for preoperative exams, diagnosis and evaluation — and for showing patients and their loved ones medical information in a form they can understand, said William S. Barrett, a BYU professor who, with graduate student Chris Armstrong, developed the software.

It might even have the potential to eliminate some exploratory surgeries, said Barrett, although "the proof is in the pudding, and we don't know that quite yet."

The program lets surgeons visualize any part of a patient's anatomy by extracting a 3-D computer image from MRI and CT scans or similar data. But doctors aren't the only ones who may find the program useful, said Barrett. The software also can be used to extract a single actor's performance or inanimate objects from video clips.

The 3-D rendering of anatomy is not what's new about the software. Nice renderings of anatomy have been around for years.

But the tools in the software allow doctors and others to arrive very quickly at anatomical images that in the past "took a fair amount of heroic effort," Barrett said. The new program provides "segmented tools that have been lacking."

A computer program, in processing a photographic image, doesn't know people or cats or birds or dirt roads, Barrett explained. When it looks at the picture, "it says there are a lot of ways this could be divided up."

The program, however, uses an algorithm that lets the computer do the "heavy lifting" of bringing out the image in a simple, interactive and very fast process that requires only minimal input from the user.

Barrett credits recent breakthroughs in algorithms that allow the program to work in a kind of paint-by-number fashion, extracting objects from coarse to increasingly refined levels. As for fast, he said, "we're able to traverse 10-15 levels of the hierarchy in less than a half-second."

It's as simple as telling the program, "This is the object I want," and "I don't want that."

Most of the programs that let doctors look at patient anatomy are either too basic or take too long to be useful. Live Surface is interactive and fast, Barrett said. And it lets a physician isolate tricky anatomy such as soft tissue, including blood vessels, hearts and muscles.

The software works by taking information from data collected in 3-D form. With a simple click and drag of the mouse, users tell the program what they wish to remove. The program is quick because it takes broad, coarse cuts to remove data that isn't needed. When most of that's gone, the computer can make more refined calculations much faster.

An image that has been selected and refined could be projected onto the patient's body, Barrett said, to serve as a road map during an operation. The software is also expected to help doctors make better diagnoses because a physician can look at part of a patient's anatomy — say an organ — more closely, or better locate tumors.

Software company Adobe, which has long had a relationship with BYU's computer scientists, helped fund the research for development of Live Surface. An earlier software, developed by Barrett and his students under the name Intelligent Scissors, was renamed Magnetic Lasso and is now incorporated into 5.0 Adobe PhotoShop, where it quickly yanks two-dimensional objects out of images.

BYU has applied for a patent on Live Surface, and Adobe will have nonexclusive licensing rights to the product, Barrett said.

The computer-science research behind it is being presented today at the International Workshop on Volume Graphics in Boston.

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New computer software program will allow surgeons to instantly visualize any part of a patient's anatomy.

# Important Dates and Events in the College

August and September 2006

## Thursday, Aug. 24

12 pm Summer Term grades due.

## Tuesday, Aug. 29

8-9:30am University Faculty & Staff Breakfast, Brigham Square.

10-11:30am Joint meeting for all University personnel, retirees & partners, Marriot Center.

1:30-3pm General faculty meeting, DeJong Concert Hall.

## Wednesday, Aug. 30

10-12pm College faculty meeting, W111 BNSN

12-1pm College luncheon.

1pm **Math-** Department faculty meeting, 299 TMCB.

## Friday, Sept. 1

8-4pm TA Training (Pendulum Court ESC)

1:00-2:15 pm New Student Orientation (3280 and 3290 WSC)

**CS-** New Undergraduate Student Orientation

## Tuesday, Sept. 5

First Day of Classes (Fall Semester)

## Thursday, Sept. 7

**Math-** 6:30 pm Department Faculty Dinner

**CS-** New Graduate Student Orientation

## Wednesday, Sept 13

**Chemistry-** Organic Chemistry Seminar W140 BNSN 4pm.

## Thursday, Sept. 14

**Chemistry-** Bioorganic Chemistry Seminar W140 BNSN 4pm.

**CS-** Colloquium speaker Hal Duane (host Dr. Eric Ringger) 11am 1170 TMCB

## Monday, Sept. 18

**Chemistry-** Organic Chemistry Seminar W140 BNSN 4pm.

## Thursday, Sept. 21

**CS-** Colloquium speaker Nuno Martins (host Dr. Sean Warnick) 11 am 1170 TMCB

**CS-** Darrel Whitney Seminar (student skills for interviewing and resumes-employed at Laurence Livermore Labs) Noon TMCB

**CS-** Opening Student Social (Undergraduate & Graduate Students.

## Friday, Sept. 22

GE Development/Improvement Matching Funds applications due to Office of General Education, 350 MSRB

-TA Training Fund applications due to Office of General Education, 350 MSRB

## April 2, 2007

Faculty 2007 Spring/Summer GE Replacement Instructor applications due to Office of General Education, 350 MSRB

# New Exchange Agreement

Math Department

A exchange arrangement has been agreed upon in which the BYU math department will pay the travel and local costs for Slovenian topologists to visit BYU and, in turn, the Slovenian government has agreed to pay local costs for Greg Conner, Jim Cannon, Denise Halverson and David Wright to visit the University of Ljubljana. It may sound like a wash for us, but its actually a very good thing for several reasons. First and foremost it encourages collaboration between our two groups. In fact, we already have two ongoing research projects between the Ljubljana and BYU research groups. Both of these, Greg Conner believes, benefited by this arrangement. Second, it is one of the few ways that the Slovenians can get support for travel to the US. Third, its a really inexpensive avenue for us to get colloquium speakers—we only pay their local expenses. Finally there is the possibility that this could lead to even more far reaching collaborations. For instance, Greg Conner is applying for a Fulbright Scholarship to spend a semester in Ljubljana.

# Wasatch Topology Conference: Bring Together the Local Mathematical Community

Mathematics Department

The Wasatch Topology Conference was organized in 1994 by Mladen Bestvina (University of Utah) and Greg Conner (BYU) as a venue for encouraging collaboration between the topology groups of both universities. The conference has far exceeded original Expectations, becoming extremely successful over the years as a means of showcasing new results and upcoming talent in geometric group theory and topology. The WTC has an intimate, almost workshop like setting that attracts attendees from all over the US and abroad. Initially, funding consisted of the colloquium budgets from the University of Utah and BYU, but now the conference has support from both schools as well as the National Science Foundation. This year (August 1 to August 4 in Park City, UT) marks the 23rd meeting of the WTC, so the

conference obviously has staying power. Many different formats are used in organizing the conference. Sometimes it is a one day meeting and others (like this summer's meeting) extend to four days. This year there are smaller groups of approximately 20 people, but often there are between 40 and 80 attendees—quite a large number for a conference with a relatively narrow focus and no money spent on advertising. Over the past 12 years there have been other co-organizers including Jim Cannon and Eric Swenson from BYU and Misha Kapovich from the University of Utah, and in recent years Ken Bromberg from the University of Utah has been doing most of the planning. For more information visit the WTC website at [www.math.utah.edu/wtc](http://www.math.utah.edu/wtc).



BYU Professor, Dennis Eggett

# Dennis Eggett Rides Across Iowa

Department of Statistics

Brigham Young University Statistics Professor Dennis Eggett completed a ride across Iowa as part of the 34<sup>th</sup> RAGBRAI (Registers Annual Great Bike Ride Across Iowa). This is a recreational ride just over 400 miles that is sponsored by the Des Moines Register. Each of the towns on the route provides enter-

days. Dennis claims that this was the most fun that he has ever had on a bike ride. He rode with his brother-in-law and three nephews and plans to make the ride again next year.

# July External Grants Awarded to Faculty

Department	Faculty	Project Title
Chemistry and Biochemistry	Matthew Asplund, Matt Linford	Laser Modification and Functionalization of Substrates
Chemistry and Biochemistry	Dave Dearden	Supramolecular Characterization via Mass Spectrometry
Chemistry and Biochemistry	Milton Lee	Portable GC-MS System Development
Computer Science	Michael Jones, Eric Mercer	Parallel Model Checking with SPIN
Computer Science	Kent Seamons	ITR: Automated Trust Negotiation in Open Systems
Physics and Astronomy	Kent Gee, Tim Leishman, Scott Sommerfeldt	Energy Based Acoustic Measurement Sensors
Physics and Astronomy	Tim Leishman, Scott Sommerfeldt	Acoustics Research

## Y. chemists hoping to ease pain

### Morphine like compound may lack addictiveness

Mark A. Philbrick,

By Lois M. Collins

Deseret Morning News

Brigham Young University chemists hope that a synthetic compound they created that is similar to the molecular structure of morphine will have painkilling properties without the drug's addictive quality.

The researchers, led by undergraduate Spencer Jones and advised by Steven Castle, assistant professor of chemistry, created a mirror-image version of a molecule from the Japanese tape vine. That new synthetic molecule is very similar to the molecule for morphine. Now they're making more of the compound so it can be sent to the National Institutes of Health, which will check to see if it does, indeed, have painkilling properties, as they suspect.

Japanese tape vine, or *Stephania japonica*, from which they derived their Hasubanonine compound, is found in Australia on the outskirts of rain forests. Japanese scientists had already isolated the Hasubanonine molecule from the plant. How the BYU team, in turn, created the synthetic version of the molecule is outlined in the most recent issue of "Organic Letters." Castle, Jones and postdoctoral researcher Liwen He co-wrote the article.

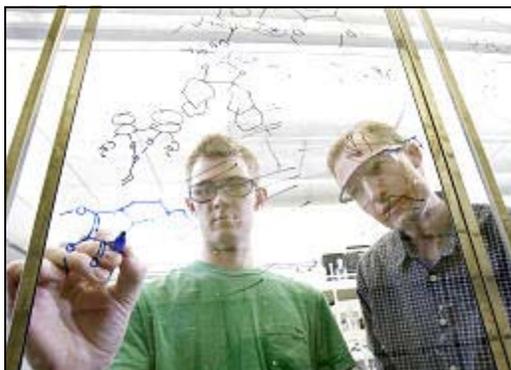
It's unusual for so much of published research to be done by an undergraduate, Castle said, but BYU emphasizes undergraduate mentoring that lets students work closely with professors on research. He called Jones, who is 90 percent or more responsible for the research and will start graduate school at Princeton in September, "exceptional."

A release from BYU quotes Erik Sorensen, the Arthur Allan Patchett Professor in Organic Chemistry at Princeton, on the difficulty involved in such chemical synthesis and synthetic compound creation. They are complex, and it's

hard to make them efficiently, he said.

"Steve and his students did beautifully in solving a difficult problem in complex alkaloid synthesis," said Sorensen, in the release. "I am impressed by the logic of their plan for synthesis and the outcomes they achieved."

The molecule made by the vine has no painkilling properties, Castle said,



Professor Steven Castle, left, joins student Spencer Jones, who has led the way in creating a synthetic compound.

but most naturally produced molecules have mirror images. And the tape-vine's mirror image is close in structure to the morphine molecule. "We've synthesized a mixture of the two mirror-image compounds, the idea being we can take the mirror image of the natural one, send it to NIH to be tested to see if it kills pain. We are optimistic it has painkilling properties, and, if that's true, we are able to synthesize it fairly easily."

It's not well understood what structural features are responsible for the addictive properties of morphine, Castle said. But it is possible they have found a key to a kinder morphine like drug that would have potential medicinal applications.

Morphine has been used for many years as a painkiller. And though new drugs have come along,

it is still widely used. Soldiers, for instance, carry it onto the battlefield. It is also, Castle notes, much harder to synthesize than the compound they've created, so if it does prove to be an effective painkiller, it has some built-in advantages.

### Statistics Student Receives National Recognition

Statistics graduate student Jeff Lingwall was awarded 2<sup>nd</sup> place in the 2006 WJAR/IMS Student Paper Competition held in Flagstaff, Arizona, in June. This is especially impressive since the other competitors were PhD candidates. We appreciate Jeff for representing the BYU Statistics Department in such a favorable manner and we congratulate him on his accomplishment.

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