FACULTY newsletter

CPMS Physical and Mathematical Sciences

ABOVE Dr. Jani Radebaugh

Mark Philbrick

Geology Professor Scopes Out Distant Moon

Geology professor Jani Radebaugh has found a true geologist's paradise and is making plans to explore this paradise from high above its surface.

Plans to send a drone aircraft to Saturn's moon, Titan, are just in the developing stages, but the mission would provide an opportunity to explore one of the most interesting moons in the solar system — a moon that has some amazing similarities to Earth. This mission would build on the wealth of data currently returning from the Cassini spacecraft in orbit around Saturn.

Titan, like Earth, has an atmosphere composed mostly of nitrogen, and its mountains, rivers, lakes and clouds are morphologically reminiscent of Earth. This is astonishing considering the fact that the surface temperature of Titan is just a few degrees warmer than a tub of liquid nitrogen. However, by observing and studying the surface of Titan, geologists may better understand physical processes on Earth.

"When we go to Titan, all of a sudden the atmosphere is a lot like Earth's in terms of its pressure," Radebaugh said. "I think that's probably been really important in shaping landforms that look so much like those on Earth."

By studying the mountains on Titan, Radebaugh believes scientists will be able to more fully understand the tectonic processes occurring in the Himalayas and Andes on Earth.

She is also analyzing the sand dunes on Titan, which cover 20 percent of its surface. In order to discover any significant similarities between Titan's sand

Gaming Their Way to Better Grades

Who says video games are always bad for kids?

Through a collaborative effort between several faculty and students in the Ira A. Fulton College of Engineering and Technology, the David O. McKay School of Education and the College of Physical and Mathematical Sciences, there is evidence that algebra comprehension in junior high and high school students could be enhanced by teaching them to program their own video games.

Using an innovative curriculum called Bootstrap, developed by a Harvard graduate student, the BYU research team implemented the project in various middle and high schools across Utah Valley. The Bootstrap programming language uses algebra to create and animate images.

Robert Lee, a grad student in the Ira A. Fulton College of Engineering and Technology, who is involved in the research, said students used mathematical equations to animate characters and complete goals in their very own computer game.

"[The kids] all use the same basic game, but they choose a unique background and three actors," he said.

One student chose a forest background with a fairy as her main character. Her next actors were a sparkling sprite and a green frog. In this case, the goal is for the student to move her fairy toward the sprite and stay away from the frog. If the fairy catches the sprite, she gains points. If she touches the frog, she loses points.

"When we get into algebra, we have them find the coordinates of [each character]," Lee said. "Then we ask, 'Okay, how can you tell if they collide? How can you tell how far apart they are?' The students then use a right triangle and the Pythagorean theorem."

Professor Keith Leatham and senior Kiya Hall from the Mathematics Education Department in CPMS aided in the research project by designing a test to assess students' understanding of basic math skills and concepts.

Before the kids even saw the computer games, they were given a basic skills math test. These tests showed that students lacked many math fundamentals. A control group of kids who used regular algebra curriculum was used to assess the data.

Levi Price

ABOVE Dr. Keith Leatham (standing) with Dr. Peter Rich, from the McKay School of Education, Robert Lee, an engineering grad student

CS Prof Recognized for a Lifetime of Research

Computer science professor Dan Olsen received the SIGCHI (Special Interest Group on Computer-Human Interaction) Lifetime Research Award from the Association for Computing Machinery. The association recognized him for a lifetime of studying computer technology. Olsen is the 14th SIGCHI awardee since the award's creation in 2000.

Olsen joined BYU faculty in 1984 and has taught a variety of CS classes, including compiler construction, computer graphics and user interfaces. However, his love for computers began years earlier, when he first came to campus as a freshman in 1972. Having never used a computer in his life, he chose to take a beginning CS class when a spot in his schedule opened up.

"As soon as they started teaching, it was absolutely obvious to me how it worked," he said. "It was fun and I started ditching my math classes to go play with my programming — it was the first time I ever got a bad grade in math."

Soon after, Olsen declared himself a computer science major.

"It was either that or fail college," he said.

Forty years later, Olsen's passion for computer science remains strong. Olsen said his area of expertise, computer-human interaction, is a unique research area with many applicable projects.

"The nice thing about computer-human interaction is you really get to follow any part of computer science you want," he said. "Because really, what you are researching is what people need. You get to dabble in everything — which I like."

Olsen and his students have worked on many projects like building robots and researching interactive television.

Unlike some computer scientists who say they chose CS because of an emerging technology trend, Olsen said his reason for a lifetime of research is much simpler.

"It's just fun," he said. "[Computers] are the world's coolest tinker toys."

by: Stacie Carnley

Mark Philbrick

ABOVE Dr. Dan Olsen and student

Exploring Distant Moons continued from page 1

dunes and sand dunes on Earth, Radebaugh studied the shape and internal structure of individual dunes in the Sahara desert.

By conducting research in the Sahara with students, she has been able to discover distinct parallels between the size and shape of Titan's dunes compared to the Sahara's dunes.

"The dunes [on Titan] are exactly the size that they are in the Sahara desert, for example; however, they are just made essentially of black plastic sand," she said. "In reality, our understanding of the long-term evolution of big dunes in huge deserts is not that good."

Examining the dunes on Titan will ultimately help scientists understand long-term climate change and regional desert effects on Earth that affect populations living near deserts.

Researchers at NASA are interested in furthering our understanding of the dense atmosphere of Titan, which is composed of both nitrogen and methane. At this location in the solar system,

methane acts as water does on Earth, sitting on the moon's surface as a liquid and functioning as a vapor in the atmosphere.

When sunlight hits Titan's atmosphere, methane breaks apart into carbon and hydrogen before recombining into longer-chain hydrogen and carbon molecules. Studying Titan's organic molecules may help researchers understand these building blocks of life on Earth.

Along with investigating Titan's physical aspects from Cassini data, Radebaugh is involved in the Titan airplane study, now called AVIATR (Aerial Vehicle for In-situ and Airborne Titan Reconnaissance).

"For the airplane, we want to study the diversity of Titan," Radebaugh said. "Titan has something for everybody. There are lots of atmospheric dynamics, so you can do some good climate global circulation modeling. You can bring that back to a more complicated Earth and better understand what's going on in Earth."

by: Chris Scheitinger

College Grants

Chemistry and Biochemistry

Daniel Ess
Sponsor: University of Virginia (DOE)
Title: Quantum Mechanical Calculations of Hydrocarbon C-H Bond

Announcement

Due to construction, the Dean's Office is temporarily located in C-381 ESC. The Advisement Center is in N-227 ESC. To make an appointment with one of the deans, please call 2-3882.

Math Video Games

"Basically, there were like two questions they could answer, and the rest of the test was just blank pages," Hall said. "It was sad because it was a lot of material they should have already known."

Hall said that after completing the semester long course, students' scores dramatically improved.

"We saw a huge improvement in their comprehension of order of operations and what a function is. We gave this test to 15- to 17-year-old kids, and they just couldn't do it at first," she said. "But then we put them through the program, and they'd end up doing a lot better."

Hall attributes at least some of the students' success to involved learning.

"They were engaged in the learning and got to apply their knowledge," she said. "And it was really fun for them. They were able to see their success in the game and became motivated to learn other things later on."

Lee's faculty advisor, professor Geoff Wright from the BYU School of Technology, said the purpose of the project was to improve students' confidence and ability to solve math problems.

"We used this idea of blended learning," he said. "We knew intuitively that when kids learn programming, they understand math better. So our hypothesis was we'll teach kids programming and their mathematical self-efficacy will improve."

So far, Wright said there is reason to believe that completing the programming course could have potentially improved mathematical comprehension.

"We've implemented it on five occasions in junior high and high school classrooms in Utah Valley," he said. "And the results are interesting. We haven't gone through all the data so far, but qualitatively, we feel that it is having a positive influence."

by: Stacie Carnley

CPMS Achievements Recognized by BYU News

CPMS has gotten a lot of attention from BYU News. You can find stories and videos on our professors and students at the following links.

Rising Technology
According to BYU News, CS professor Tom Sederberg and his students "solved a problem that has troubled the computer-aided design industry since 1980." Now, that solution is paying off with the acquisition of their company by Autodesk. Story at *http://news.byu.edu/archive12-mar-tsplines.aspx*.

A New Kind of Game
The numbers don't lie: Sam Dittmer, Hiram Golze and Robert Yang are schooling the competition across the country. These math superstars got the royal treatment from BYU News. Video and story at *http://news.byu.edu/archive12-mar-mathletes.aspx*.

Research on Ice
Even the most extreme climate can't stop Randy Skinner, Summer Rupper and their students from having a great time and studying the environment. Video and story at *http://news.byu.edu/archive12-mar-antarctica.aspx*.

by: Katie Pitts

Mark Philbrick

LEFT BYU celebrates its mathletes

Dates to Remember

Discontinuance Deadline & 2nd Block Withdrawal Deadline
Friday, March 30

Finals
April 14 -19

Commencement
Thursday, April 19, 4 p.m., Marriott Center. Line up in the north ASB lot at 3:15 p.m.

Convocation
Friday, April 20, 8:30 a.m., WSC Ballroom. Line up in the Garden Court at 7:30 a.m.

Spring Term Begins
Tuesday, April 24

Grade Submission Deadline
Thursday, April 26

Grades Online for Students
Monday, April 30

Add/Drop Deadline
Tuesday, May 1

College Publications

Chemistry and Biochemistry

Y. Li, P. Aggarwal, H. D. Tolley, M. Lee, "Organic Monolith Column Technology for Capillary Liquid Chromatography", Advances in Chromatography, 2012, volume 50, pp. 237

D. Li, T. Truong, T. Bills, B. Holt, D. VanDerwerken, J. Williams, A. Acharya, R. Robison, H. D. Tolley, M. Lee, "GC/MS Method for Positive Detection of Bacillus anthracis Endospores", Analytical Chemistry, 2012, volume 84/issue 3, pp. 1637-44

K. Liu, H. D. Tolley, M. Lee, "Highly Cross-linked Polymeric Monoliths for Reversed-Phase Capillary Liquid Chromatography of Small Molecules", Journal of Chromatography A, 2012 volume 1227, pp. 96-104

Z. Ma, B. Naylor, B. Loertscher, D. Hafen, J. Li, S. Castle, "Regioselective Base-Free Intermolecular Aminohydroxylations of Hindered and Functionalized Alkenes", The Journal of Organic Chemistry, 2012, volume 77/issue 2, pp. 1208-14

I. Nowak, V. Damaraju, C. Cass, J. Young, M. Robins, "Autofluorescent Fused-Pyrimidine Nucleosides: Synthesis and Evaluation as Permeants and Inhibitors of Human Nucleoside Transporters", Collection of Czechoxlovak Chemical Communications, 2011, volume 76/issue 12, pp. 1395-1412

A. Quast, A. Curtis, B. Horn, S. Goates, J. Patterson, "Role of Nonresonant Sum-Frequency Generation in the Investigation of Model Liquid Chromatography Systems", Analytical Chemistry, 2012, volume 84/issue 4, pp. 1862-70

Computer Science

B. Morse, D. Thornton, M. Goodrich, "Color Anomaly Detection and Suggestion for Wilderness Search and Rescue", Proceedings of the 7th ACM/IEEE International Conference on Human-Robot Interaction, 2012

D. Ventura, "No Free Lunch in the Search for Creativity", Proceedings of the Second International Conference on Computational Creativity, 2011, pp. 108-10

D. Ventura, D. Norton, D. Heath, "An Artistic Dialogue with the Artificial", ACM Creativity & Cognition, 2011

D. Ventura, D. Norton, D. Heath, "Autonomously Creating Quality Images", Proceedings of the Second International Conference on Computational Creativity, 2011, pp. 10-15

D. Ventura, K. Dickerson, "A SOM-Based Multimodal System for Musical Query-by-Content", Proceedings of the International Joint Conference on Neural Networks, 2011, pp. 291-98

D. Ventura, M. Clement, K. Sundberg, Q. Snell, M. Whiting, K. Crandall, "Partial Tree Mixing, a Novel Approach to Phylogenetic Search", Biotechnology and Bioinformatics Symposium, 2011

D. Ventura, T. Martinez, K. Monteith, "Automatic Generation of Emotionally-Targeted Soundtracks", Proceedings of the Second International Conference on Computational Creativity, 2011, pp. 60-62

Mathematics

J. Chahal, N. Priddis, "Some Congruence Properties of the Pell Equation", Annales des Sciences Mathematiques du Quebec, 2011, volume 35/issue 2, pp. 175-84

V. Truong, R. Roundy, "Multidimensional Approximation Algorithms for Capacity-Expansion Problems", Operations Research, 2011, volume 59/issue 2, pp. 313-27

Statistics

Y. Li, P. Aggarwal, H. D. Tolley, M. Lee, "Organic Monolith Column Technology for Capillary Liquid Chromatography", Advances in Chromatography, 2012, volume 50, pp. 237

D. Li, T. Truong, T. Bills, B. Holt, D. VanDerwerken, J. Williams, A. Acharya, R. Robison, H. D. Tolley, M. Lee, "GC/MS Method for Positive Detection of Bacillus anthracis Endospores", Analytical Chemistry, 2012, volume 84/issue 3, pp. 1637-44

K. Liu, H. D. Tolley, M. Lee, "Highly Cross-linked Polymeric Monoliths for Reversed-Phase Capillary Liquid Chromatography of Small Molecules", Journal of Chromatography A, 2012 volume 1227, pp. 96-104