february 2011

FACULTY newsletter

CPMS Physical and Mathematical Sciences

ABOVE Dr. John McBride

Lending an Ear to the Earth's Faults

Using a new application of old technology, BYU geology professor John McBride and his students discovered previously unmapped faults, re-evaluated earthquake hazards, and confirmed pre-existing geological theories.

While the area around Rock Canyon has been thoroughly studied by geologists, small faults associated with the Wasatch Fault zone near Provo were unknown because they had been covered by residential development. With housing developments already in place, faults that would otherwise be visible at the surface are hard to locate.

"We're at the stage where the building has already happened, and thus all we have is a limited picture of what the faulting looks like at the earth's surface," McBride said.

Locating these hidden faults is important in evaluating an area for seismic (earthquake) potential and hazards, a task that can be difficult in a well-developed area like the neighborhoods around Rock Canyon. To map out hidden faults, geologists use sound waves to "see" breaks in rock formations under the ground.

In order to perform a "seismic survey," geophysicists often drill holes and place dynamite in them as a sound source. However, it can be difficult or impossible to get permission to use explosives in a populated area like Provo, so when McBride was offered a day with a vibroseis vehicle and a professional survey crew from the United States Geological Survey, he gladly accepted.

"One of the things that we wanted to show is that this particular strategy of geophysical surveys can detect these faults," McBride said.

A vibroseis vehicle is a large truck with a vibrating disk underneath that, when lowered to the ground, sends sound waves that bounce off the rock

Continued on page 2

ABOVE Dr. Tiancheng Ouyang

Professor Studies Celestial Stability

The solar system has existed for billions of years – but is it stable?

Or can planets veer off course? That is one of many questions posed by the field of celestial mechanics and explored by mathematicians like Tiancheng Ouyang.

Ouyang studies the movement of a group of interacting celestial bodies like planets and stars. Using a differential equation, Ouyang can solve what is known as the n-body problem and predict planetary motions in the past and the future.

"We're using mathematics to discover," Ouyang said. Equations involving just two planetary bodies are simple, but become more difficult with three or more celestial objects, he said – and the problems get even more complex when they involve a third dimension.

Because of the difficulty of a 3D problem, scientists are still not certain whether the solar system is stable, Ouyang said.

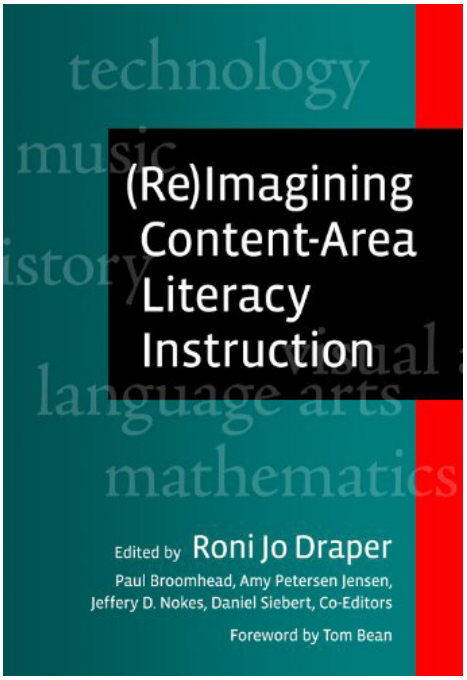
"Our solar system is very close to 2D," he said, "but it's not exactly flat, so under the assumption it's flat, someone could prove our solar system is stable. But if you consider [it as three dimensional] then nobody knows if our solar system is stable or unstable."

Ouyang and his colleagues developed a numerical simulation that shows the ways bodies of different mass will interact with one another. Tiny spheres spin around his computer screen, the stable systems moving along intricate orbits and the unstable systems careening out of control.

"We try to find the right position and the right velocity to make the points run the orbit that [we] designed," Ouyang said. "The difficult part is getting the initial position and the initial velocity."

Whether it's launching satellites, determining the Space Shuttle's orbit or unlocking the mysteries of the Solar System or the universe, celestial mechanics allow Ouyang and his colleagues to continue using math to discover.

by: Justin Ritter



ABOVE Dr. Siebert's book, "(Re) Imagining Content-Area Literacy Instruction."

Re-imagining Literacy in the Classroom

"(Re)Imagining content-area literacy instruction" has been Daniel Siebert's academic life for the past ten years. Now, the mathematics education professor, along with colleagues from across campus, has published a book of the same title outlining his beliefs on how reading should be incorporated into math.

As a mathematics teacher, Siebert recognized the incompatibility between what he sought to teach and what literacy specialists recommended. He found the demand for more reading and writing to be a hindrance to the ultimate goal: becoming proficient in math.

"With this, students become very good at reading novels, but not very good at reading equations," Siebert said.

He felt that the best way to address this problem was to broaden the definition of literacy to include more than written prose with only words, sentences, and paragraphs. The currently accepted narrow definition of literacy limits teaching and, essentially, learning. For many disciplines, basic prose is not the fundamental method for creating, negotiating, or communicating knowledge.

"By broadening text to include other things, it makes literacy an important part of instruction in every content-area," Siebert said. "We define text to be anything people create or use to convey or negotiate meaning."

Equations, graphs, discussions, lectures and gestures all qualify as literacy under Siebert's definition. As each type of text is used uniquely in different disciplines, Siebert expanded his framework into other subject areas. Working with professors in other disciplines, Siebert and his associates defined literacy in a variety of content-areas in addition to math, including: history, art, science, music, and technology.

In order to communicate his findings, Siebert has written a book targeted at content-area literacy instructors. Though it has been a controversial topic in the past, his work has been well received at this point. The book pushes for professors and teachers to take it upon themselves to identify and teach the texts, genres, and literacies unique to their subjects, thereby making a wider range of communication tools available to their students.

"If people accept our framework, it will radically change the role of content-area literacy specialists in the school," Siebert said. "Content-area teachers will have a lot more freedom and a lot more responsibility for the literacy instruction in their classroom. It gives them freedom to address [literacy activities] that are important and useful from their perspective. "

by: Justin Ritter

Earth's Faults continued

formations below. The sound waves are received by a set of geophones spread out over 1000 meters along the ground surface.

Originally used by oil companies to look for oil deep beneath the ground, McBride used the technology to look at the shallower rock formations broken up by the Wasatch Fault near Rock Canyon in Provo.

Using vibroseis, McBride and his students were able to accurately map fault lines in Provo without any explosives. They confirmed the theory that the Wasatch Fault is not just one thin line, but a wider zone of faulting.

During their study they also found evidence that in poorly consolidated horizontal sediments, like the beds of ancient Lake Bonneville where Provo sits today, the angle of faulting is almost vertical. This had been previously seen in geological studies near the surface, such as in trenches crossing the Wasatch Fault, but had not been observed deeper below the ground surface.

"We found a way to actually see those faults that people suspect are already there," McBride said.

This new information also contributes to seismic hazard studies, McBride said. The angle of the fault determines what direction the ground will move if it breaks apart along pre-existing fault lines.

Using this technology, McBride has gained a better understanding of how faulting occurs. More detailed fault line maps will allow builders to better plan for and protect important structures.

by: Erik Westesen

Dates to Remember

Student Reseach Conference Abstract Submission Deadline
February 25, Midnight

Student Research Conference
March 19, 8 a.m.
1102 Jesse Knight Building

ABOVE CPMS honored several faculty and staff members for their efforts at a banquet on January 21.

College Honors Outstanding Faculty & Staff

After enjoying a festive meal among colleagues and friends, attention turned to the podium where Dean Sommerfeldt honored both staff and faculty members at the College's annual awards banquet held on Friday, January 21.

Nine staff members from the College were given University Service Awards, based on how many years of service they have given to the university. From Chemistry and Biochemistry: Janet Fonoimoana (5 years); Wayne Anderson (15); Keith Kling (25); and Bruce Jackson (30). From Computer Science: Gordon Billings (5). From Physics and Astronomy: Mark Erickson (10); Wes Lifferth (30); Scott Daniel (35); and Wayne Peterson (35).

Following the service awards, the dean proceeded to announce the College award recipients. With a big smile, Kim Christensen accepted the Outstanding Staff/Administrative Employee award. His exceptional efforts and contributions as business manager in the Department of Chemistry and Biochemistry qualified him as a most worthy recipient. Christensen is known for balancing his responsibilities with great attention to detail.

Two Faculty Excellence in Teaching awards were also presented. Each year, one award is given to a professor who has been at BYU for three to ten years, and the second goes to a professor who has taught at BYU for ten or more years. This year's recipient of the three-to-ten-year award was Jennifer Nielson, a gifted professor in the Department of Chemistry and Biochemistry who has a knack for putting her students at ease in the classroom while boosting their confidence. She infuses her lectures with her passion for the subject, while still maintaining high academic rigor. Her students continually receive high scores on the American Chemical Society's standardized examination.

Tim Leishman of the Department of Physics and Astronomy received the Faculty Excellence in Teaching award in the category of ten or more years. Whether giving instruction in general education, major, or graduate level courses, Leishman prepares lectures that are both intellectually enlarging and spiritually strengthening. The personal interest he takes in his students is witnessed by the extra help sessions he holds to answer questions and the one-on-one mentoring he provides for both graduates and undergraduates.

The dean highlighted Leishman's work for the LDS church. "When Tim was asked by the Church to help with the acoustics in the Conference Center," Sommerfeldt said, "he involved about a dozen undergraduate students in taking measurements and teaching them to analyze and understand those measurements – an experience that many of them noted as a highlight of their education here."

Due to his outstanding productivity since his arrival in 2005, Kent Gee of the Department of Physics and Astronomy was chosen as the recipient of the Faculty Young Scholar Award. Gee has shown deep commitment to mentoring students. In total, Gee has 22 peer-reviewed journal articles, 16 in process, and 6 more submitted and accepted – all with student co-authors.

The College is not alone in recognizing Gee's accomplishments. The Acoustical Society of America chose him as the recipient of the R. Bruce Lindsay Award, reserved for a particularly outstanding young member of the society under age 35. He has also received over $1,000,000 in external funding since 2005.

Paul Farnsworth was chosen to receive the Distinguished Citizenship award. He first served as associate chair in the Department of Chemistry and Biochemistry, then for six more years as the chair.

His focus on the university's mission and goal for excellence in teaching has driven him to treat all faculty and staff with respect, and also to continually offer his excellent talents and services. The dean noted evidence for this in how Farnsworth volunteered to take on a demanding teaching assignment this semester to help the department meet their needs.

"Even with significant citizenship assignments," Sommerfeldt continued, "Paul has not only been effective in those assignments, but has also maintained high standards in his teaching and has maintained an active research program that has been highly regarded.

"There are many deserving faculty in the college," Dean Sommerfeldt concluded. He hopes in the future to recognize many more.

by: Natalie Wilson

COLLEGE GRANTS

Chemistry and Biochemistry

Paul Savage
Sponsor: Sandia (DOE)
Title: Synthesis & Characterization of Ceragenins

Richard Watt
Sponsor: NASA
Title: Encapsulating Peroxide in Ferritin for Nanopropellant Applications

Computer Science

Michael Goodrich
Sponsor: Army Research Lab
Title: Temporal Latency in Supervisory HRI

Physics and Astronomy

John Colton
Sponsor: NASA - EPSCoR
Title: Electrons in Semiconductor Quantum Dots: Spins and Optics

COLLEGE PUBLICATIONS

Chemistry and Biochemistry

J. Johnson, J. Kenealey, R. Hilton, D. Brosnahan, R. Watt, G. Watt, "Non-reductive Iron Release from Horse Spleen Ferritin Using Desferoxamine Chelation," Journal of Inorganic Biochemistry, 2011, volume 105, pp. 202-207

L. Hansen, G. Fellingham, D. Russell, "Simultaneous Determiniation of Equilibrium Constants and Enthalpy Changes by Titration Calorimetry: Methods, Instruments, and Uncertainties," Analytical Biochemistry, 2011, volume 409, pp. 220-229

D. Ess, S. Liu, F. De Proft, "Density-Functional Steric Analysis of Linear and Branched Alkanes," Journal of Physical Chemistry A, 2010, volume 114, pp. 12952-12957

D. Ess, W. Goddard III, R. Periana, "Electrophilic, Ambiphilic, and Nucleophilic C-H Bond Activation: Understanding the Electronic Continuum of C-H Bond Activation Through Transition-state and Reaction Pathway Interaction Energy Decompositions," Organometallics, 2010, volume 29, pp. 6459-6472

Z. Zhang, H. Quist, Y. Peng, B. Hansen, J. Wang, A. Hawkins, D. Austin, "Effects of Higher-order Multipoles on the Performance of a Two-plate Quadrupole Ion Trap Mass Analyzer," International Journal of Mass Spectrometry, 2011, volume 299, pp. 151-157

A. Yevenes, V. Marquez, R. Watt, "Cloning and Characterization of Chlorobium Tepidum Ferritin." Biochimie, 2011, volume 93, pp. 352-360

A. Woolley, M. Larsen, P. Nge, W. Yang, D. Eves, "A Microchip Capillary Electrophoresis Experiment for the Instrumental Analysis Laboratory," Journal of Analytical Sciences Digital Library, 2011, volume 10061

D. Ess, R. Gunnoew, T. Cundari, W. Goddard III, R. Periana, "Ligand Lone-Pair Influence on Hydrocarbon C–H Activation: A Computational Perspective," Organometallics, 2010, volume 29, pp. 6801-6815

D. Ess, E. Johnson, X. Hu, W. Yang, "Singlet–Triplet Energy Gaps for Diradicals from Fractional-Spin Density-Functional," Journal of Physical Chemistry A, 2011, volume 115, pp. 76-83

G. Watt, D. Hansen, D. Dodson, M. Andrus, D. Wheeler, "Electrical Energy From Carbohydrate Oxidation During Viologen-catalyzed O2-oxidation: Mechanistic Insights," Renewable Energy, 2011, volume 36, pp. 1523-1528

Computer Science

D. Olsen, B. Partridge, S. Lynn, "Time Warp Sports for Internet Television," ACM Transactions on Computer-Human Interaction, 2011, volume 17/issue 4 ,pp. 16:1-16:37

T. O'Connor, K. Sundberg, H. Carroll, M. Clement, Q. Snell, "Analysis of Long Branch Extraction and Long Branch Shortening," BMC Genomics, 2010, volume 11/ suppl 2, pp. 1-9

Mathematics

J. Fernández, K. Kuttler, "An Existence and Uniqueness Result for a Strain-Adaptive Bone Remodeling Problem," Nonlinear Analysis: Real World Applications, 2011, volume 12, pp. 288-294

D. Futer, E. Kalfagianni, J. Purcell, "Cusp Areas of Farey Manifolds and Applications to Knot Theory," International Mathematics Research Notices, 2010, volume 2010/issue 23, pp. 4434-4497

D. Futer, E. Kalfagianni, J. Purcell, "Slopes and Colored Jones Polynomials of Adequate Knots," Proceedings of the American Mathematical Society, 2011, volume 139/ issue 5, pp. 1889-1896

J. Purcell, J. Souto, "Geometric Limits of Knot Complements," Journal of Topology, 2010, volume 3/issue 4, pp. 759-785

D. Garity, D. Repovš, D. Wright, and M. Željko, "Distinguishing Bing-Whitehead Cantor Sets," Transactions of the American Mathematical Society, 2011, volume 363, pp. 1007-1022

Mathematics Education

H. Gerson, E. Bateman, "Authority in an Agency-Centered, Inquiry-Based University Calculus Classroom," The Journal of Mathematical Behavior, 2010, volume 29/issue 4, pp. 195-206

K. Leatham, B. Peterson, "Purposefully Designing Student Teaching to Focus on Students' Mathematical Thinking," J. Luebeck & J. W. Lott (Eds.), Mathematics Teaching: Putting Research into Practice at all Levels, San Diego, CA: Association of Mathematics Teacher Educators, 2010, pp. 225-239

B. Peterson, (2010) "Mathematics Student Teaching in Japan: Where's the Management," G. Anthony & B. Grevhold (Eds.), Teachers of Mathematics: Recruitment and Retention, Professional Development and Identity, Kristiansand, Norway: Writings from Swedish Society for Research in Mathematics Education, 2010, no. 8, pp. 135-144

Physics and Astronomy

B. Anderson, M. Griffa, P. Le Bas, T. Ulrich, P. Johnson, "Experimental Implementation of Reverse Time Migration for Nondestructive Evaluation Applications," Journal of the Acoustical Society of America, 2011, volume 129/issue 1, pp. EL8-EL14

J. Farley, B. Anderson, "Ultrasonic, Airborne Insertion Loss Measurements at Normal Incidence (L)," Journal of the Acoustical Society of America, 2010, volume 128/ issue 6, pp. 3305-3307

B. Hsu, M. Berrondo, J. Van Huele, "Stern-Gerlach dynamics with quantum propagators," Physical Review A, 2011, 83/1

H. Stokes, B. Campbell and S. van Smaalen, "Generation of (3 + d)-dimensional superspace groups for describing the symmetry of modulated crystalline structures," Acta Crystallographica Section A, 2011, A67, pp 45-55

O. Levy, M. Jahntek, R. Chepulskii, G. Hart, and S. Curtarolo, "Ordered Structures in Rhenium Binary Alloys from First-Principles Calculations," Journal of the American Chemical Society, 2011, volume 133/issue 1, pp. 158-163

M. Mehl, G. Hart, S. Curtarolo, "Density Functional Study of the L10–IrV Transition in IrV and RhV," Journal of Alloys and Compounds, 2011, volume 509/issue 3, pp. 560-567

Statistics

L. Hansen, G. Fellingham, D. Russell, "Simultaneous Determiniation of Equilibrium Constants and Enthalpy Changes by Titration Calorimetry: Methods, Instruments, and Uncertainties," Analytical Biochemistry, 2011, volume 409, pp. 220-229