FRONTIERS

BYU COLLEGE OF PHYSICAL & MATHEMATICAL SCIENCES • FALL 2006

BYU ASTRONOMY COMES OF AGE

LIVE SURFACE ENABLES VIRTUAL SURGERY

PROBABILISTIC RECORD LINKAGE

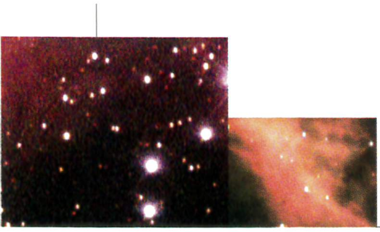
DEAN'S MESSAGE

GREETINGS! IF YOU HAVE BEEN ON OUR MAILING LIST FOR A WHILE, THEN YOU WILL NOT BE SURPRISED THAT OUR FOCUS CONTINUES TO BE THE ENHANCEMENT OF UNDERGRADUATE EDUCATION THROUGH MENTORED-STUDENT LEARNING. If you are new to *Frontiers,* then you may wonder what we mean by mentoring. All of you have attended classes, taken notes, participated in discussions, and read textbooks, and you know that these activities helped you understand the content of a course. Imagine how much more learning would occur if you could apply what you had learned to real-world research problems under the guidance of, and in partnership with, a member of the faculty—one-on-one, outside the classroom. That is undergraduate mentoring.

Mentoring is, of course, a natural consequence of our graduate programs, and we take those very seriously. However, BYU continues to have exceptionally well-prepared, industrious, and curious undergraduate students who not only ask What? but Why? After two or three years in the undergraduate majors' curriculum, many of our students want to be involved in applying what they have learned and in participating in intellectual discovery—and they are quite capable. Many of the most interesting problems are not answered in textbooks, or even in the journals that reflect current scientific research. Sometimes the inquiry of a bright undergraduate who has not yet "learned" what cannot be done leads to new and clear insights not seen by scholars treading familiar paths. An inquisitive student who asks the "simple" questions can lead even the most sophisticated scientist to question the logic of "answers" already learned.

Our fall 2006 *Frontiers* covers a broad front, including a computer application that could someday be important to your health, statistical work that might make family history research more successful, and the BYU telescopes that help our students "reach for the stars." Some of these endeavors involve undergraduate students, some graduate students, and some both. All depend on our capable and dedicated faculty who guide the work. We hope the vignettes you read in this issue of *Frontiers* will cause you to smile and remember the joy of discovery.

—Earl M. Woolley



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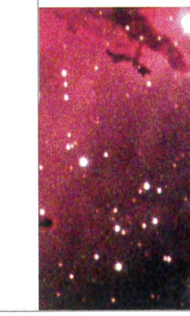
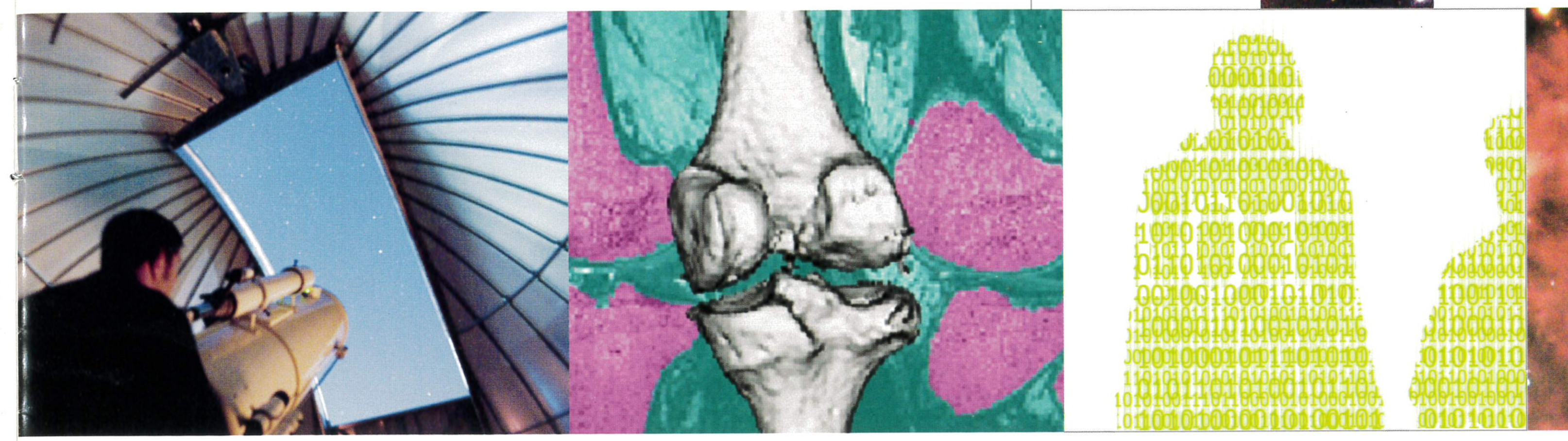
FRONTIERS

FALL 2006





CONTENTS

STARS ALIGN

for Undergraduate Astronomy at BYU

WITH 60–70 STUDENTS AT A TIME MAJORING IN THE DECADE-OLD BS IN PHYSICS-ASTRONOMY, THE PROGRAM IS NOT ONLY ALIVE BUT ALSO FLOURISHING. Says Dr. J. Ward Moody, one of the BYU astronomers in the Department of Physics and Astronomy, "I don't know of any other program in the nation with that many undergraduate majors." And the students are talented. He continues, "Our students are good. We add to their talents, but they come to us good." That means that when they are ready to leave BYU they can compete successfully with students from elsewhere for admission to good graduate programs.

The Department of Physics and Astronomy is a state leader in astronomy and is building a tradition of excellence. BYU is the only university in Utah with a planetarium on campus (see the fall 2005 issue of *Frontiers* to learn about the new planetarium), and it has the largest telescope of any university in the state. In fact, it offers the only undergraduate astronomy degree and the only astronomy doctorate available in Utah. The strong emphasis on fundamental physics that is required of our astronomy majors is seen as a real advantage in preparing students for careers in the field. Recent PhD graduates are now professors at universities or scientists at national laboratories.

Six professors make up the "astronomy group" at BYU: Clark Christensen, Eric Hintz, Michael Joner, J. Ward Moody, Denise Stephens, and Benjamin Taylor. Stephens is the newest member of the team, replacing Harold McNamara, who recently retired after a remarkable 51-year teaching career. Stephens comes to BYU from the Space Telescope Science Institute, which administers the science program of the Hubble Space Telescope.

Astronomers have diverse specialties and use a variety of tools, but when someone mentions astronomers, most people think of telescopes. The telescopes at BYU observatories give students the practical experience they need in gathering, processing, and interpreting astronomical data.

A Telescope on the Roof

The most easily accessible telescope, known to the astronomers as the David Derrick Telescope for its donor, is on the roof of the Eyring Science Center in the Orson Pratt Observatory (OPO). Its 16-inch aperture is small by modern professional standards, and its location near the bright lights of Provo is a disadvantage, but the combination of easy accessibility and sensitive electronic detectors makes it a good choice for introducing observational skills to students early on. In fact, students can get some good results on a wide variety of projects from a convenient campus location, which is a real plus during the winter months when the undergraduate applied observing class is taught. The observing program at OPO has had remarkable success. "Undergraduates are involved in about 70 percent of the observing done there," says Hintz, "and in the past seven years we have had 30 undergraduate presentations at the American Astronomical Society meetings, most of which have been based on data taken with the David Derrick Telescope."

The observatory dome, long a landmark on the campus, was recently replaced. Although most people would not recognize the difference from the sidewalk, Joner says, "If the old dome were a two-and-a-half ton army truck, the new one would be a shiny new sports car. The old one served well for 50 years and was always pretty rough and ready, being made of steel

The well-known star field M16 seen from the Orson Pratt Observatory

West Mountain Observatory

plate. But it had reached the point where the upkeep was leading to significant downtime at the OPO. The new dome should be maintenance-free for years." The new dome, as well as many telescope functions, can be controlled from the warm room beneath the OPO—an important factor for students on frigid winter nights.

Telescopes on the Mountain

Three of the BYU telescopes are housed at the West Mountain Observatory (WMO), flagship of the BYU observational astronomy program. Chosen for its relatively dark and unobstructed night sky, the site is an hour from campus, west of Spanish Fork, Utah. Though not as convenient as climbing to the top of the Eyring Science Center, the trip to WMO is rewarded by much better sky conditions for astronomical work.

The observatory currently features three telescopes, with apertures of 24, 20, and 16 inches. But that will change soon in a very significant way. A large grant from the National Science Foundation will replace the aging 24-inch telescope with a modern 36-inch instrument. Says Joner, "The new 36-inch telescope will have a state-of-the-art computerized tracking system that will enable objects to be studied for much longer intervals than was ever possible with the 24-inch telescope. The instrumentation, optics, and dome of the new telescope will also be automated and computer controlled, so that gains will be significantly greater than just the larger size of the telescope." When the new instrument is finished and installed on West Mountain, it will take the BYU student astronomy experience to a new level.

A Telescope in the Desert

Chances are, if you type *ROVOR* into your word processor, the spell-checker will ask you to change it to *ROVER*. If you are a BYU astronomer, though, *ROVOR* is just right. That's an acronym for Remote Observatory for Variable Object Research, and ROVOR is a telescope strategically placed in the west desert of Utah.

The ROVOR story began when J. Ward Moody was in graduate school. Some work he did involved remotely operated sensors, and it occurred to him that one could use the same

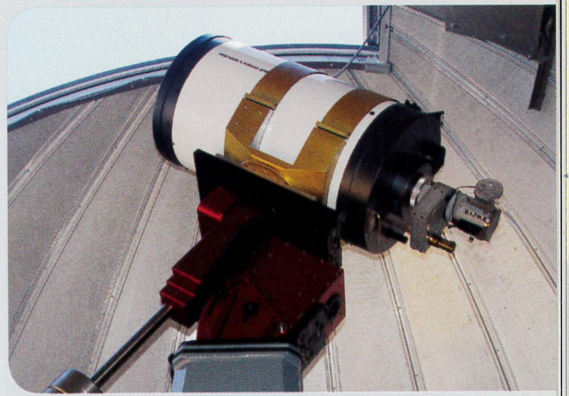
> The development of ROVOR has given several undergraduate astronomy majors valuable and unique training and experience.

ideas to create a remotely operated telescope. The concept lay dormant for years, until David Derrick, a long-time friend of the Department of Physics and Astronomy and an avid astronomy enthusiast, donated a second telescope to the department. The modest 22-inch aperture of the instrument made this an ideal telescope on which to test the remote-operation concept—large enough for serious work in some areas of astronomy, yet small enough not to create overwhelming engineering problems.

ROVOR sits in a small building in a lonely area west of Delta, Utah, near the termination of commercial power lines. ROVOR can be controlled locally from a station inside another small building nearby, but it is designed to be operated remotely by commands sent over a satellite link. A glance at the structures makes it clear why they were affectionately called the "doghouse" and the "outhouse" during construction! The so-called doghouse has its own climate control, has a unique one-of-a-kind roof that lifts off the walls to give the telescope unobstructed access to the sky, and even has sensors to warn of precipitation so that the roof is not removed in inclement weather.

The development of ROVOR has given several undergraduate astronomy majors valuable and unique training and experience. The team has been headed by students who are now in first-rate graduate programs—Jason Gilbert at the University of Michigan, Peter Brown at Penn State University, and Chris Olsen at Rice. The current team leader, Paul Iverson, has a year left until graduation.

When fully operational within the next few months, ROVOR will be used in the study of supernovae (exploding stars), variable stars (those whose brightness changes either regularly or at random), and bright quasars ("quasi-stellar objects" that are the brightest objects in the universe but so distant that only telescopes reveal them).



The 16-inch telescope at West Mountain awaiting nightfall

Focusing on the Undergraduate Experience

A remarkable thing about these five telescopes is their availability to undergraduate students. At most universities undergraduates would get limited access to a telescope as part of an astronomy class, but they would not be involved with faculty members working on meaningful research. At BYU all of the telescopes—and that will include the new 36-inch telescope—are used regularly by undergraduates. If you have read previous issues of *Frontiers*, then you know that undergraduate mentoring takes top priority in the College of Physical and Mathematical Sciences. Astronomy majors at BYU will tell you that the concept works—and works well. ■

LIVE SURFACE

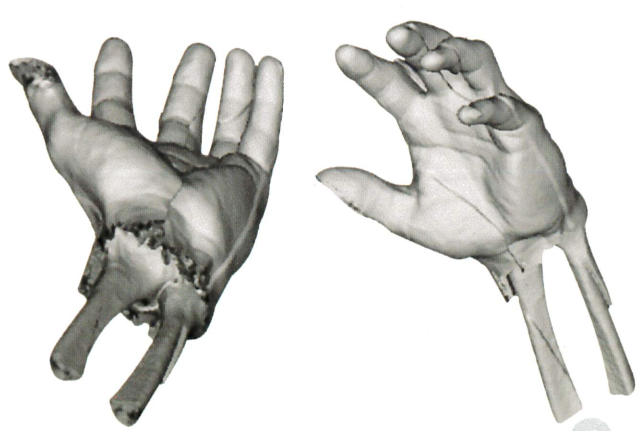
Computer Scientists Create a Tool for "Virtual Surgery"

MOST PATIENTS FACING SURGERY WOULD LIKE THEIR SURGEONS AND OTHER PHYSICIANS TO KNOW AS MUCH AS POSSIBLE ABOUT THE TASK AHEAD BEFORE PICKING UP A SCALPEL. ALTHOUGH TOOLS SUCH AS MRI'S AND CT SCANS PROVIDE ACCURATE DATA, TURNING THAT DATA INTO INSTANTLY USEFUL IMAGES TO GUIDE SURGICAL DECISIONS IS A CHALLENGE. A computer application developed by BYU graduate student Chris Armstrong and his faculty advisor, Professor William Barrett, may soon change that. Called "Live Surface," the software tool uses volume data from, for example, an MRI and creates a full 3-D computer image with a few clicks of the mouse.

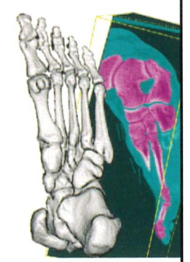
Chris Armstrong says he came to BYU from "a few different places." He was born in Alaska, grew up in Arizona, and attended high school in La Center, Washington. Armstrong's family, who moved to Provo while he was an undergraduate, has enjoyed a long relationship with BYU. His grandmother, Dr. Virginia S. Armstrong, was a physician at the Student Health Center for many years (she passed away in January), and both his older brother and most of his cousins have attended the Y. Chris and his wife, Jill, are likely to continue the tradition. They recently celebrated their fourth wedding anniversary with their daughters Carol Lin (almost three years) and Emma (almost three months).

An early interest in video games led eventually to a BS and MS in computer science, but Armstrong's focus shifted away from games and toward more substantive applications. When Barrett approached him about researching the new software tool as a possible master's thesis, he says, "I thought, 'This is a field in which research has the potential for saving lives.' Furthermore, over the weekend I couldn't get the idea out of my head. I found myself returning to it and puzzling over it again and again. I decided that the only thing to do was to volunteer, so I told Dr. Barrett that I'd like to take a crack at it. The result is Live Surface."

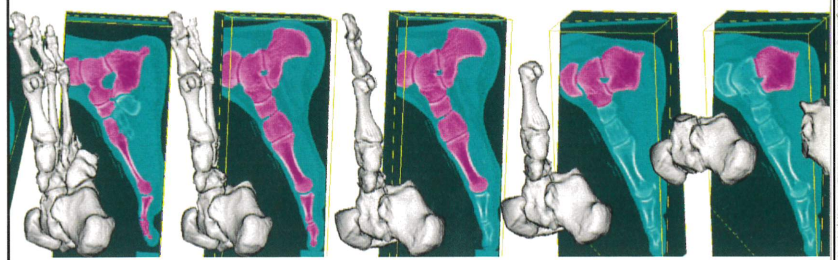
So just what does Live Surface do? "The main goal in developing Live Surface was to give the physician a powerful, practical tool that could be used interactively," says Barrett. Existing software and techniques available to give doctors a look at a patient's anatomy are either too simplistic or take too long to provide immediate, real-time feedback. Barrett adds, "A program like this has to be incredibly fast and very interactive, or else it's frustrating for the user, who currently has time to go get a sandwich before he has what he wants. Live Surface has the additional benefit of allowing users to easily isolate 'tricky' anatomy such as soft tissue—blood vessels, hearts, and muscles— that a lot of other techniques can't readily extract independent of surrounding, competing anatomy. Our program provides more robust isolation of soft tissue [than do other software tools], which is quite a breakthrough." Live Surface might someday make exploratory surgery less "exploratory" and may even eliminate the need for some of it.



The BYU software works by extracting information from data collected in 3-D volumes—



Doctors could use the tool to make better diagnoses after visualizing a patient's organs from multiple angles or to do a better job of locating malignant tumors.



CT scans, MRIs, or 3-D ultrasounds. With a click and drag of the mouse, a user identifies the object he wishes to extract. Next he identifies those portions of the data that surround the object. Immediately the desired object is extracted from the data. And this is not just a simple two-dimensional image; it is a full-fledged 3-D image that can be rotated and viewed from any desired direction. There is no need to carefully trace around the volume of interest. Rather, a quick "brush stroke" on the object and another on what is around it enables the software to find the best surface between the two, which can be further refined as needed.

"It's how you might envision cutting a toothpick out of a redwood tree," says Armstrong. "You'd start with a chainsaw and make very big cuts at first. By the end you'd use a knife to delicately shape the toothpick. Instead of 'cuts,' our program intelligently identifies shapes. As you refine more and more, that shape becomes more exact. 'This is the object I want, and this is not the object I want.' But our process is much faster. In less than half a second, it pulls the object you want out of the data. It's really that simple."

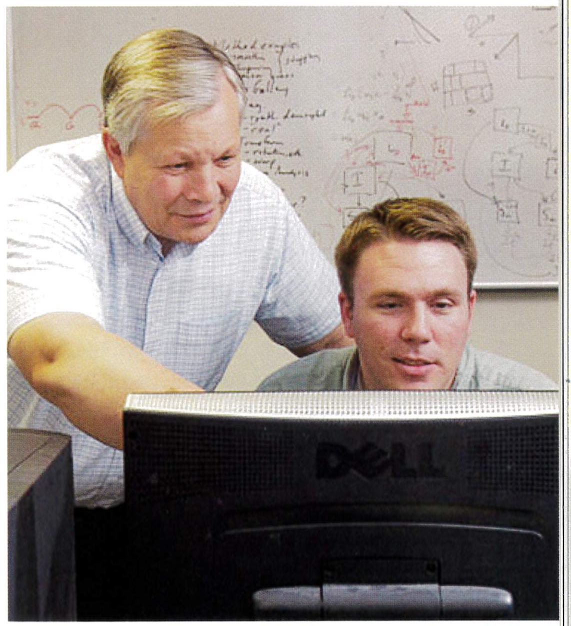
The program is able to perform its manipulations rapidly because it extracts the object using a hierarchical algorithm, or set of mathematical rules, that tells the computer to eliminate irrelevant information in broad, coarse cuts. Once the bulk of unwanted data is gone, the program has less data to deal with, and the computer can make more refined calculations with greater speed.

A surgeon might, for example, extract a 3-D image of a person's heart or brain using Live Surface. The image could then be projected onto the patient's body and fitted to create a road map for the surgeon as he or she operated. Additionally, doctors could use the tool to make better diagnoses after visualizing a patient's organs from multiple angles or to do a better job of locating malignant tumors.

On July 31 in Boston Armstrong presented the computer science research behind Live Surface at the Fifth International Workshop on Volume Graphics. "Volume graphics," or VG, is concerned with modeling, processing, and presenting data that is typically acquired using medical scanners or other techniques such as analytical methods, computational simulations, or statistical measurements. Researchers in VG aim at modeling both interiors and surfaces of objects that may be surrounded by other materials and producing graphical images of these objects that are truly three-dimensional. This prestigious conference brings together both academic and industrial researchers with interests in volume graphics.

Research for Live Surface was partially funded by Adobe, makers of the popular image-editing program Photoshop. Barrett's lab has had a long-running relationship with Adobe. Live Surface builds on Barrett's development of Intelligent Scissors, a program that allows users to quickly pull 2-D objects out of images. The program, renamed "magnetic lasso," was incorporated into version 5.0 and subsequent versions of Photoshop and is used by millions of designers, artists, and photographers.

Combining computer science with his personal values has had a marked impact on Armstrong. He says, "One of the biggest industries in computer science is the entertainment industry with computer animation and video games. Products produced by this industry are becoming more and more violent and immoral; I noticed this disappointing trend while attending BYU. It is great to be able to employ my skills and talents in computer science in an area that is intended to improve lives rather than to simply entertain." With his master's thesis completed, Armstrong has accepted a position as a software developer in Coeur d'Alene, Idaho, with a company that produces software to assist in architectural design, furnishing, and landscaping. ■



William Barrett (left) and Chris Armstrong

Record Linkage

Probabilistic Record Linkage: An Aid to Family Researchers

IF THE NUMBER OF HITS ON GENEALOGICAL WEB SITES IS ANY INDICATION, FAMILY HISTORY, OR GENEALOGY, HAS BECOME AN ENGROSSING HOBBY FOR AN INCREASINGLY LARGE PORTION OF THE POPULATION. AND FOR MANY MEMBERS OF THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS IT IS AN ACTIVITY OF TRANSCENDENT IMPORTANCE, FAR BEYOND THE LEVEL OF A HOBBY. The growing number of records—census records, vital records, local histories, and so forth—available through various Internet sources has made family history research much faster and more convenient for those who are drawn to it than was the case a generation ago. And it isn't just the volume of material available that makes a difference—it is also the ability to search it electronically instead of scanning visually through microforms or printed volumes. Sometimes, though, the search algorithms are a poor substitute for human judgment.

Consider the following scenario, which could be played out repeatedly for numerous of your own ancestors' records: Mariah W. Reynolds was born July 1831 in Dutchess County, New York, to Isaac and Sarah Reynolds. She eventually married Robert Johnston, and they lived in Ontario County in the western part of the state. An electronic search of the 1870 census in one of the popular family history Internet sources reveals Mariah and Robert in Manchester, Ontario County, and her age is given as 38 years. A similar electronic search for her in the 1880 New York census yields no results, even with the "exact matches only" option turned off. Did Mariah die between 1870 and 1880, or did she move from the state? Did Robert die and Mariah remarry, thus changing her last name? Or was she just missed by the census taker?

The mystery is solved by a visual search of the Ontario County census records, which shows Maria (not Mariah) Johnston, 48 years old, living in Farmington (not Manchester) with her husband, Robert. A quick check of a road atlas shows that Farmington and Manchester are neighboring communities. To the human mind, it seems clear that Mariah and Robert simply moved down the road sometime in the decade of the 1870s. But to the automated search algorithm, Mariah and Maria are not the same person. Surely there must be a way to improve this scenario!

Enter Professor John Lawson of the BYU Department of Statistics. For several years he and his students have been addressing this problem with a technique called probabilistic record linkage (PRL). Computerized PRL has been around for 50 years. It has been used for diverse purposes, from linking nutrition surveys and mortality data to studying the collective behavior of certain organizations in order to thwart terrorist attacks. Not until recently, however, has it been brought to bear on genealogy. The idea is that information in records is, or can be, pigeonholed into various fields: name, age, location, etc. In an ideal world, records from two sources that referred to the same person would contain the same information spelled the same way, and there would be no ambiguity. In the real world of nicknames, poor spellers, reversal of month and day numbers, omitted information, and so forth, determining whether two records match the same person is rarely that straightforward. Probabilistic record linkage is a way to increase the probability of a correct decision.

Much of Lawson and his students' foundational work concerns linking census index records from the 1910 and 1920 censuses in 12 counties located in five states. Each census index record contains nine fields: surname, given name, age, gender, race, birthplace (state or foreign country), and the state, county, and locale of the census district. Lawson's group has found that, for any two people located on both the 1910 and 1920 censuses, surname, given name, age adjusted for census year, gender, race, and birthplace are identical only about half of the time. Consequently, if a computer search engine requires fields to be identical to qualify them as matching the same individual, most matches will be missed. On the other hand, if the criteria are too loose (such as requiring only the last name to match), an unhelpfully long list of "matches" may result.

Probabilistic record linkage allows the computer to simulate some level of judgment. Says Lawson, "Rather than rejecting every record that doesn't match exactly on one or more of the fields, the [PRL] program assigns a weight to each field based on the comparison." Fields that match exactly are given a positive weight. Those that are clearly different are given a negative weight. For fields that are close (for example, if one record uses William and the other uses Wm.), an intermediate weight is assigned. The "score" for a pair of records is the sum of the weights. If the score is a high positive number, the records likely refer to the same person; if a low negative number, they probably do not. By adjusting the threshold value for acceptance of a possible match, one can enhance the probability of finding real matches while also limiting the number of false matches.

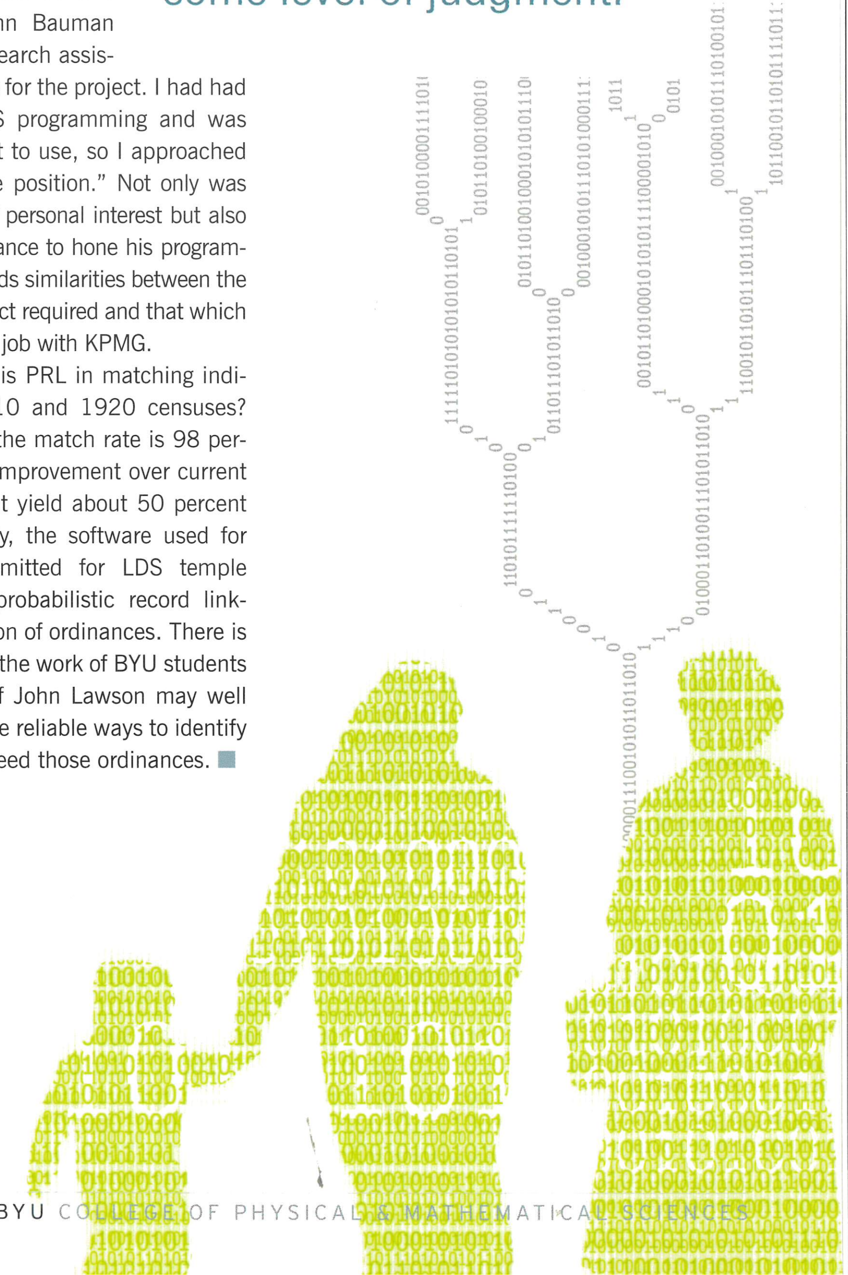
Of course, the success of the method depends heavily on having a meaningful set of weights. Weights are based on the probabilities of two records matching if the fields are identical and of two records matching despite fields being different. These can be calculated by using a set of data with known matches that are processed manually. Lawson's group found that, while the weights for different sets of census index records were somewhat different, averaging the weights provided good results for the time periods being considered.

This work has moved forward with both graduate and undergraduate student help. Brenda Price, Ryan Yamagata, Marcie Francis, Krista Jensen, and John Bauman are former master's students who have each completed master's projects based on PRL from 2000 through 2006. Nathan Orien, an undergraduate statistics major who also worked on the PRL project, graduated in April 2006. Originally an engineering major, he took Statistics 221 and Accounting 200 concurrently during a spring term. He explains, "I enjoyed both classes and discovered career paths that would benefit from a solid understanding of both disciplines. For my situation at the time, the better route to graduation was through statistics." He is completing graduate accounting work at the University of Washington and has accepted employment with KPMG Forensic Practice.

Probabilistic record linkage allows the computer to simulate some level of judgment.

Nathan says, "I got involved with PRL research after John Lawson announced that he and graduate student John Bauman were looking for a research assistant to write SAS code for the project. I had had a few classes in SAS programming and was interested in putting it to use, so I approached Dr. Lawson about the position." Not only was the research project of personal interest but also it offered Nathan a chance to hone his programming skills. He now finds similarities between the data analysis this project required and that which will be required on the job with KPMG.

So how successful is PRL in matching individuals from the 1910 and 1920 censuses? Using PRL software, the match rate is 98 percent—an impressive improvement over current search algorithms that yield about 50 percent success! TempleReady, the software used for processing data submitted for LDS temple work, already uses probabilistic record linkage to avoid duplication of ordinances. There is much to be done, but the work of BYU students under the direction of John Lawson may well lead to faster and more reliable ways to identify the individuals who need those ordinances. ■



FEATURED DONOR

Jean Pedersen

FOR JEAN JORGENSON, 1954 TURNED OUT TO BE A GREAT YEAR. SHE WAS A COMBINED MATHEMATICS, CHEMISTRY, AND PHYSICS MAJOR AT BYU, AND SHE HAD BEEN ASKED TO TEACH A MATHEMATICS COURSE. In the world of 2006 this may not sound too unusual, but in 1954, as a senior student, she was the first woman ever to teach in the BYU Department of Mathematics. The course evidently went well, because she was asked to teach a second one. In that class was a student named Kent Pedersen, and this led to a different sort of success—Jean and Kent celebrated their 50th wedding anniversary this year.

Jean received a BS in her combined science major, as well as a teaching certificate, in 1955 and taught at Brigham Young High School the following year. Then it was off to the University of Utah for a master's degree in mathematics, awarded in 1958. After teaching a year at Olympus High School, she taught six years in the Mathematics Department at the U of U. During those years she was also a lecturer in the National Science Foundation Visiting Scientist Program.

Professor Pedersen joined the faculty of the Mathematics Department at Santa Clara University (SCU) in 1966. Here, too, she was the first woman to teach mathematics and the first to be granted tenure in the department. Her teaching responsibilities have included most of the traditional lower-division courses, along with some upper-division ones in combinatorics and problem solving. She is also involved in teaching students whose main interests lie outside mathematics, addressing the special needs of medical, architectural, business, and continuing education students—especially teachers.

Pedersen's reach extends beyond her department at SCU. She coordinates the high school mathematics lectures, an outreach program that brings university math teachers into the high school classroom and club meetings to share the excitement of mathematical discovery. She is also director of the SCU Individual Studies Program, giving students the opportunity to tailor a degree that takes them in different directions from those offered in more traditional departmental programs.

One might think that a person who had authored or coauthored over 195 professional articles and eight books would have time for little else, but that's not true in Professor Pedersen's case. She has served as governor of the Northern California Section of the Mathematical Association of America, as a member of three editorial boards, and on several panels and committees serving professional and scholarly organizations. She has lectured in a dozen countries, but a favorite memory is of an invited lecture in Rome honoring the late graphic artist M. C. Escher. As she demonstrated a particular geometric model, she wondered aloud what Escher might have created had he known of the representation. Immediately a well-dressed man rushed to the stage, hugged her, and said, "My father would have loved it!" He was George Escher, son of the artist.

Jean and Kent have enjoyed a full family life. Their son, Chris Pedersen, received his degree in electrical engineering from BYU and now lives with his wife, Suzanna, and four children in Sunnyvale, California. Their daughter, Jennifer Pedersen Hooper, graduated in mathematics from BYU, went on to get a PhD in mathematics education from the University of Georgia, and has just moved with her husband, Rick, and two children to Pocatello, Idaho.

Recognized as the BYU College of Physical and Mathematical Sciences' 2002 Honored Alumna, Professor Pedersen has also been honored with multiple awards from SCU and the Mathematical Association of America for her teaching, scholarship, and professional service. The best "awards," however, she considers to be from students. She relates, "A student researcher came in to ask, 'Do I have to stop studying this problem just because the quarter ends? Or can I continue to study it and come in to discuss my discoveries with you in the fall?' It doesn't get much better than that!"

Jean and Kent Pedersen have been consistent supporters of BYU, particularly the Department of Mathematics Education. Their contributions have especially benefited students who are preparing to embark on careers in mathematics teaching in secondary schools. Professor Pedersen's remarkable accomplishments make her an excellent role model—a teacher who uses her talents with enthusiasm and dedication to lift those who might follow in her footsteps. She lives BYU's motto, "Enter to learn; go forth to serve." ■

CLASS NOTES

Computer Science Professors Receive Special Invitation

Two assistant professors in the Computer Science Department were among just 350 academics from 175 leading institutions attending the Microsoft Research Faculty Summit 2006 in Redmond, Washington, in July. Eric Ringger and Michael Jones attended the prestigious invitation-only conference—considered the premier gathering of academic researchers and Microsoft researchers, product group engineers, and architects—for in-depth presentations and discussions about computing problems and research trends.

BYU Team Takes Second in UAV Competition

A group of computer science, electrical engineering, computer engineering, and mechanical engineering students from BYU took second place in the Fourth Annual Student Unmanned Aerial Vehicle Competition held at Webster Field Naval Base, Maryland, in June. It was not only the first appearance in the competition for team members Breton Prall, Matthew Nokleby, Paul Millett, Andres Rodriguez, Nathan Rasmussen, and Neil Johnson but also the first for any BYU team. The 4.5-pound craft, equipped with a video camera and GPS receiver, took off, found its way to pre-designated targets on the ground, and returned in under 40 minutes. Sponsored by the Association for Unmanned Vehicle Systems International, the competition included teams from MIT, UCSD, Virginia Tech, and 14 other schools. For more on this work, see the article on robotics in the spring/summer 2006 issue of *Frontiers.*

Physics Students Score at Regional Meeting

Last year's Four Corners Section Meeting of the American Physical Society showcased not only a lot of good physics but also yielded awards for three undergraduates in the Department of Physics and Astronomy. In competition with faculty members and graduate students, Amy Baker (mentored by faculty member Steven Turley), Hiram Conley (mentored by faculty member Robert Davis), and Mark Transtrum (mentored by faculty member Jean-Francois Van Huele) received awards for best papers. This is the more impressive because the 10 winners were selected from the conference at large, and not every section had a winner. Congratulations to these students!

Women Students in Geological Sciences Recognized

Beth Hunter, a graduate student in the Department of Geological Sciences, has received the prestigious Society of Economic Geologists Student Research Grant. Kasia Harper, who has made scientific presentations at two Geological Society of America meetings on her mentored research in mineralogy, has received an *American Mineralogist* Undergraduate Award from the Mineralogical Society of America. As in many scientific fields that were once dominated by male students, about half of the Department of Geological Sciences' undergraduate majors nowadays are women.

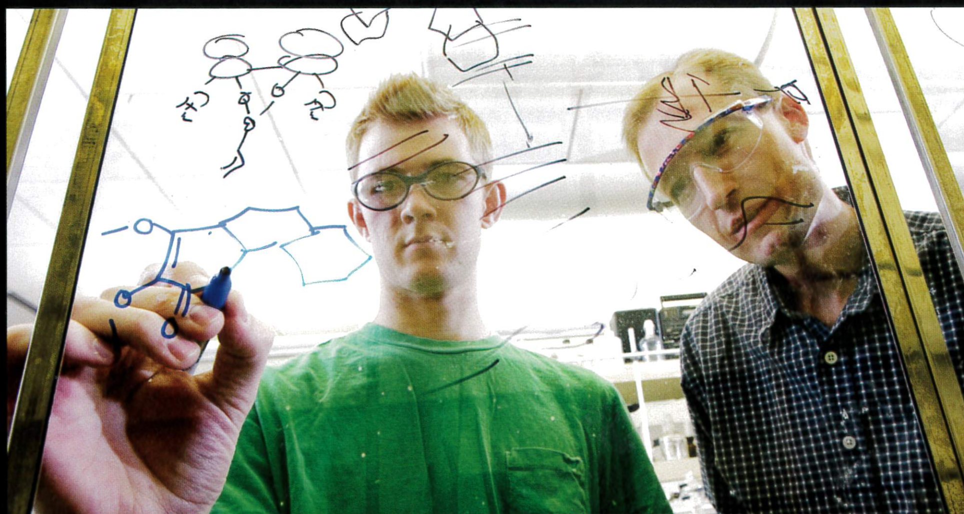
Chemists Achieve Recognition

Earl Woolley, professor of chemistry and dean of the College of Physical and Mathematical Sciences, was recently awarded the Huffman Prize at the 61st Calorimetry Conference in Boulder, Colorado. The award "honors individuals who, through their lifelong research accomplishments, emulate the creativity and care that Huffman demonstrated in his work." It is awarded to individuals whose work in thermochemistry or calorimetry constitutes a long-term and significant contribution.

Paul Farnsworth, also a professor of chemistry and chair of the Department of Chemistry and Biochemistry, received the Lester Strock Award at the September meeting of the Federation of Analytical Chemistry and Spectroscopy Societies. The award is given in recognition of substantive research in, or application of, analytical atomic spectrochemistry in the fields of earth science, life sciences, or space sciences.

Undergraduate Mentoring Continues to Open Doors

Jeremy Johnson, Andrew Duffin, and Karl Jackson have something in common: they are all former undergraduates who were mentored in the chemistry lab of Dr. Eric Sevy, and all are now in prestigious graduate programs. Johnson is at MIT, Duffin at Berkeley, and Jackson at Washington. Before them were Brian Horn (now at Berkeley), Matthew Vernon (Wisconsin Medical School), Jeff Thompson (Arizona State), and Mark Calder (Tulane Medical School). All worked on some aspect of energy transfer during molecular collisions and how that affects chemical reactivity—and the real-world research helped open doors to top programs for them. Currently Sevy has five undergraduates working with him.



EVERY STUDENT WHO LEAVES THE COLLEGE OF PHYSICAL AND MATHEMATICAL SCIENCES WITH AN UNDERGRADUATE MENTORED LEARNING EXPERIENCE IS BETTER PREPARED TO BLESS OTHERS AND HELP THE WORLD SOLVE ITS PROBLEMS. "MENTORED LEARNING"? That is what happens when a student works with a faculty member outside of class on research of consequence to them and to their scientific discipline. Instead of finding needed employment off campus, the mentored students do real-world research that will help prepare them for their professional lives.

Spencer Jones, Laura McAllister, and Dan Nielsen can tell you about the value of undergraduate mentoring. Jones, who began working in the lab of Professor Steven Castle a year ago, succeeding in synthesizing a molecule with a structure that closely resembles that of the addictive painkiller morphine. Says Jones about his experience, "One of the biggest lessons I learned is that even though you can figure out something on paper, things don't always go the same way in real life." This realization is one of the objectives of undergraduate mentoring. With Jones now in graduate school at Princeton, McAllister and Nielsen will continue the project toward a nonaddictive painkiller.

Our goal is to provide a mentored learning experience for every student in our college who wants to participate. This is, in fact, our top academic priority. Thanks to our alumni and friends, we are getting closer to that goal. I invite you to visit our college Web site (cpms.byu.edu) or to contact Brent Hall (1-800-525-8074 or brent_hall@byu.edu) to learn more about how you can help students to have this experience. Join with us in opening doors for students.

—Earl M. Woolley, Dean