IIT Welcomes New Provost

This August, Alan Cramb, former dean of the School of Engineering at Rensselaer Polytechnic Institute (RPI), joined IIT as university provost.

At RPI since 2005, Cramb was previously the head of the Department of Materials Science and Engineering at Carnegie Mellon University, where he also was a professor and co-director of the Center for Iron and Steelmaking Research. He has authored more than 190 publications, holds two patents, and is a fellow of the Iron and Steel Society. He received his Ph.D. from the University of Pennsylvania.

"Alan brings a wealth of experience and accomplishment to what is perhaps the most demanding job at a university. His ability to work with people, as well as to develop teamwork and vision within a university, will play a significant role in the advancement of IIT," says President John Anderson.

"IIT is poised to be a leading institution not only in Chicago and the United States, but also internationally, in a number of important areas, including business, law, architecture, science, and engineering," says Cramb. "It really is my pleasure to join IIT at this time when its future is looking so strong."

Cramb was selected for the position following a nearly six-month nationwide search, handled by recruiting firm Russell Reynolds Associates and the IIT Provost Search Committee, led by former College of Science and Letters dean, Buck McMorris.

New Dean for CSL

On September 1, R. Russell Betts joined IIT as the new dean of the College of Science and Letters.

Betts was formerly the vice provost for planning and programs at the University of Illinois at Chicago (UIC). A professor of physics at UIC since 1993, he was also a physicist and senior physicist at Argonne National Laboratory from 1979–1999. Prior to that, he served as assistant professor of physics at Yale University, where he worked in the A. W. Wright Nuclear Structure Laboratory. His research interests are in atomic, nuclear, and high-energy physics.

"He brings an extensive background in science and academic planning that will be a great asset to both CSL and the university as a whole," says President John Anderson.

Betts is a fellow of the American Physical Society and a member of the American Association for the Advancement of Science. He earned his Ph.D. and master of science degrees at the University of Pennsylvania, and bachelor and master of arts degrees from Oxford University.

The CSL Dean Search Committee was co-chaired by the Lewis Department of Humanities Chair Kathryn Riley and Hal Krent, dean of Chicago-Kent College of Law, with assistance from the firm Academic Search, Inc.

facultyhonors&awards

Lori Andrews

Lori Andrews, distinguished professor of law at IIT Chicago-Kent College of Law and director of IIT's Institute for Science, Law, and Technology, was recognized as a 2008 Julia Beveridge Award Recipient at a ceremony held on March 25. The annual award honors members of the IIT community who exemplify the professional and personal qualities of Julia Beveridge, librarian of Armour Mission and the first registrar of Armour Institute of Technology.

Graeme B. Dinwoodie

Graeme B. Dinwoodie, an associate dean and director of the Program in Intellectual Property Law at IIT Chicago-Kent College of Law, has received the 2008 Pattishall Medal for Teaching Excellence from the International Trademark Association for his work as an educator and for his legal scholarship. The award is presented every four years to the university or graduate school professor who best exemplifies the qualities of excellence and innovation in teaching subjects broadly related to trademarks and trade identity.

Sidney Guralnick

Sidney Guralnick, Distinguished Professor of Engineering, was recognized for 50 years of teaching at IIT at the Fifth Annual Sidney A. Guralnick Excellence in Teaching and Scholarship Awards Luncheon and Lecture, held on April 25.

Norman Lederman

Norman Lederman, chair and professor of the Department of Mathematics and Science Education, has been selected to receive an honorary doctorate from the Faculty of Science at Stockholm University on September 26 in Stockholm, Sweden. Lederman is being recognized for his essential contributions to science education.

Henry Linden

Henry Linden (Ph.D. CHE '52), Max McGraw Professor of Energy and Power Engineering and Management and Director, IIT Energy + Power Center, has been named to the list of the One Hundred Engineers of the Modern Era, compiled by the American Institute of Chemical Engineers (AIChE). Linden was selected for this prestigious list from nearly 1,000 nominations. His accomplishments will also be recognized at the AIChE Annual Meeting, to be held November 16–21 in Philadelphia.

Faculty Awards Presentation

"When we honor our colleagues we honor ourselves as well, because none of us excels without the help of our colleagues," said IIT President John Anderson in his welcome to faculty and their guests at the Third Annual Faculty Awards Presentation, held on April 24 at the Pritzker Club. The event recognized four faculty members with special honors: Kevin Cassel, associate professor of mechanical and aerospace engineering, with the Excellence in Teaching Award; David Maslanka (M.S. MATH '86, Ph.D. '90), senior lecturer of applied mathematics, with the Bauer Family Undergraduate Teaching Award; Miles Wernick, professor of electrical and computer engineering, with the Sigma Xi Senior Faculty Award; and Shangping Ren, assistant professor of computer science, with the Sigma Xi Junior Faculty Award. F. R. "Buck" McMorris [above right], professor and dean of the IIT College of Science and Letters, was also recognized with an academic leadership award commemorating nine years of service to the university prior to his retirement at the end of the academic year.

Maps Made In Heaven: Improving GPS Technology

High above the clouds, some 12,000 miles from Earth, an array of 24 satellites continuously circles the globe. These space-based elements of the Global Positioning System (GPS) speed through the heavens at an orbital velocity of 8,600 miles per hour. Each transmits a microwave message, guiding travelers on land, sea, and air with remarkable accuracy.

Originally developed for the military, GPS was eventually approved for civilian use in 1983. Since then, GPS technology has revolutionized public point-to-point navigation, particularly for car travel, the most popular application. Other practical uses include programs like Google Maps, precise land surveying, telecommunications, public safety, and even measurements of continental drift with sub-centimeter accuracy.

Boris Pervan, associate professor of mechanical and aerospace engineering at IIT, is among those hoping to exploit the potential of GPS in some of the trickiest and most demanding situations.

GPS satellites get their power from the sun. Each carries an onboard atomic clock and transmits radio frequency signals, which propagate earthward, penetrating the atmosphere and even dense cloud cover. GPS receivers read a stream of signals from four or more such satellites. By measuring the distances from the subject to each satellite, precise location of the traveler can be determined through the technique of trilateration.

Despite GPS's accuracy, some conditions challenge its navigational prowess. While satellite guidance now oversees flight paths around the world, landing an aircraft is a delicate maneuver best left to a skilled pilot. What happens, however, when weather conditions reduce visibility to zero? Pervan, under the auspices of the Federal Aviation Administration, hopes to substitute GPS technology for the pilot's compromised view of the ground in these precarious situations, allowing satellite navigation to bring the plane in for a pinpoint landing.

Such split-second applications require new heights of performance. "It's a real issue in terms of integrity," Pervan explains, "because the navigation is being provided by satellites that are about 20,000 kilometers away, and in this case, the pilot can't see anything out the window." Pervan emphasizes the life-and-death nature of such circumstances, stressing that the failure rate has to be reduced to one in a billion aircraft approaches.

Part of that effort relies on a modified form of GPS known as Differential GPS (DGPS). When signals reach the Earth from their source satellites, they often contain small errors relating to their travel time to Earth. With DGPS, two ground receivers are used, one of which remains at a stationary point whose location has been measured to very high accuracy. This receiver makes error corrections for the satellite signals it receives and sends the corrected information to the roving receivers.

Flying in poor visibility becomes riskier still when a plane is attempting to land on an aircraft carrier. The carrier has six degrees of freedom and can be moving in any direction, particularly in rough seas. Pervan has been working with the United States Navy on GPS solutions to this problem, which involves the development of high-accuracy algorithms, fault detection, and fault isolation systems to make such operations safe.

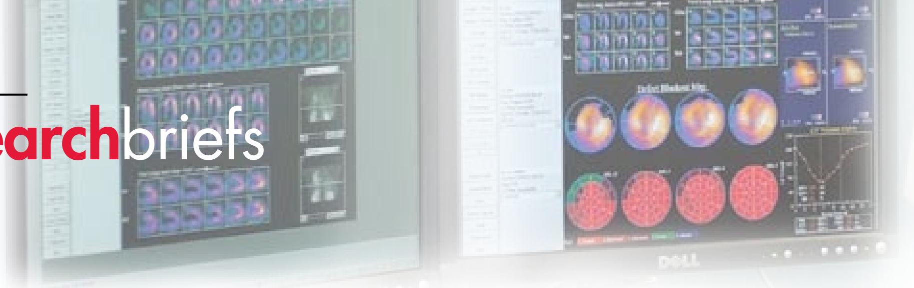
As the satellite stream is sent down, it passes through the troposphere, which actually changes the speed of light relative to a vacuum. The ionosphere—an electrically charged portion of the atmosphere—also acts to delay signal arrival and to pull the code and carrier phases of the signal away from each other. Finally, multi-path reflections from the ground can also wreak havoc with GPS accuracy. All such discrepancies must be precisely adjusted in real time.

Perhaps Pervan's most challenging research applies to unmanned aerial vehicles, or UAVs, which he hopes to successfully refuel in midair by means of GPS. In addition to extreme demands of accuracy and integrity required to position precisely the vehicle under the tanker aircraft, Pervan points to another formidable challenge: "The tanker tends to block out the sky. Just when we need that higher accuracy, the GPS satellites get snuffed out."

Using phase measurements of the higher frequency GPS carrier signals, rather than the code phase signals used in standard GPS, Pervan has demonstrated the viability of this acrobatic feat. In 2007, flight tests using a Learjet as a surrogate for the UAV were conducted at Niagara Falls. Pervan's algorithmic innovations successfully guided the plane to its position beneath the Boeing KC-135 refueling aircraft. The system was shown to be accurate to within 30 centimeters.

Commercial use of GPS for approaches and landings in zero visibility will likely arrive within a decade. "The advantage of landing with GPS is that it provides a more or less seamless navigation system from takeoff to touchdown," Pervan says, "as long as we can solve all integrity issues and accuracy for the final phase."

—*Richard Harth*



From the Heart: Jovan Brankov's Patient Observations

New techniques in diagnostic imaging have transformed the landscape of medicine, offering spectacular views not only of skeletal features, but also of virtually every organ and tissue in the body. The tricky part is deciding which images are most valuable for the task of diagnosis.

Jovan Brankov, assistant professor of electrical and computer engineering and member of the IIT Medical Imaging Research Center (MIRC), is an expert on cardiac nuclear medicine. His research, using a type of imaging known as SPECT (Single-Photon Emission Computed Tomography), hopes to add precision and efficiency to the diagnostic process.

During SPECT, the patient is injected with a biologically active substance, which travels through the blood stream to the heart. Because the substance is labeled radioactively, the heart essentially glows with this circulating fluid. A camera rotating around the body then captures the emitted gamma rays, and the data is assembled into a three-dimensional image.

While other modes of imaging, such as MRI, produce more highly detailed pictures, SPECT has enormous advantages in cardiology because it allows the physician to evaluate cardiac function. Multiple images can be integrated into a short video, for example, revealing the motion of the heart—critical for many kinds of diagnoses. Perfusion, the ability of the myocardium to receive substances from the blood stream, also can be observed. As the scanner's camera rotates, a full volumetric representation of blood flow through the heart can be generated.

"If you think about the heart as a cup pointing from left to right," Brankov explains, "and you take a slice through the body along the long axis of that cup, you will see a doughnut shape, which is bright where there is a lot of perfusion and dark where there is no perfusion." Darkened areas of the doughnut generally represent some degree of arterial blockage and restricted blood flow.

But is the image good enough for a full and accurate diagnosis? Has the system been fine-tuned in such a way as to produce the most clinically useful scan?

In the past, the only way to make such evaluations was to assemble many images from patients with known diagnoses and to ask trained radiologists to judge the diagnostic value of the images. The process is extremely time consuming, difficult to coordinate, and in general, prohibitively expensive.

Currently, Brankov is working on a solution to this problem. This spring he received a five-year, $2.1 million grant from the National Institutes of Health for his project, "A New Class of Numerical Observers for Nuclear Cardiology."

Brankov's numerical observers (NOs) are mathematical algorithms based on novel techniques of machine learning. Their job is to examine SPECT images (supplied by the University of Massachusetts Medical School) and to assess their diagnostic value. Numerical observers are designed to predict the judgments a human observer would make based on the same collection of image variables.

The goal is to develop a suite of algorithms that will pore over numerous aspects of the images, like hundreds of eyes searching for diagnostic clues. Is a blockage present? What is the location and extent of this blockage? Has scar tissue already formed from an infarct or does the tissue remain viable? Is the motion of the heart healthy? On the basis of its findings, the numerical observer then selects the most diagnostically useful images, thus defining the protocol for future scans.

Brankov points out that the numerical observers at present only evaluate the properties of a given image. They are ignorant of other diagnostic factors, such as the patient's prior medical history, age, weight, sex, and specific health risks. Nevertheless, the preliminary results have been impressive, with numerical observers performing some diagnostic tasks (like identifying the presence of certain defects) and input from a radiologist.

The German company Siemens, manufacturer of SPECT scanning devices, has taken a keen interest in Brankov's research, implementing some of his work in its software.

Brankov hopes that his research eventually can be expanded to other imaging modalities and to tasks beyond cardiac medicine. "My goal with the numerical observers is to combine them and make a computer software program for evaluating images in nuclear cardiology," he says. "I plan to share this program with the research community so that it can make use of and benefit from it."

—Richard Harth

Photo: Bonnie Robinson