CASE

ENGINEERING

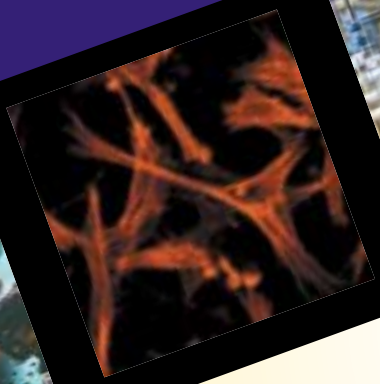
News from the Case School of Engineering at Case Western Reserve University

Vol. 1, Issue 1

Plus: The Ultimate Coaster, Groping the Elephant, And More

Premier Issue Fall 2002

[SET YOURSELF APART]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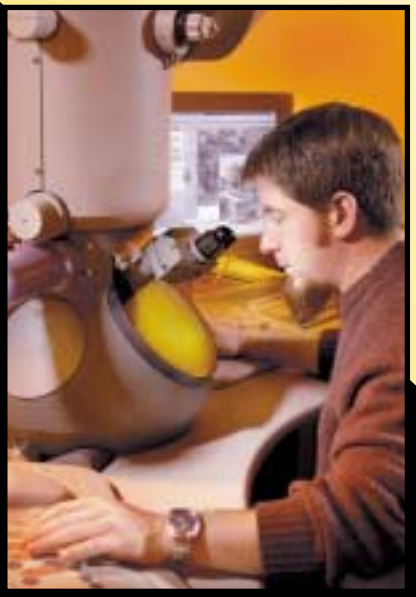

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Case Western Reserve University
Office of Curricular Enhancements and External Assessment
10900 Euclid Avenue, Cleveland, Ohio 44106-7240

CASE ENGINEERING

News from the
Case School of Engineering
at Case Western Reserve University

Vol. 1, Issue 1

The Case School of Engineering
at Case Western Reserve University

Dean
Robert F. Savinell

Director of Marketing
Editor & Publisher, *Case Engineering*
Jayne F. Hoon

Contributing Writers
John Deitzer, Susan Keen Flynn, Katrina Fritz, Kate Garmey, Preeti Junnarkar, Katie Polasek, Ann Rowlett, Joe Szabo, Mary Rose Tichar

Photography
Tom Pastoric (Clix), Mike Sands

Art Direction & Design
Z-Med Marketing Services

Special Thanks To
Jim Buckett, Mary Buckett, Dave Conger, Jody Crawford, Laurie Dudik, F. Gökhan Ergin, Hayley Every, Kathy Gill, Brandie Heald, Sandra Jones, Dale Mikol, Beatrix Norton, Lucy Russell, Olivier Salvado, Peter Shaw, Matt Shelley

The faculty of The Case School of Engineering
Case Alumni Association
Cleveland FES Center
Center for Micro and Nano Processing
Center for Modeling Integrated Metabolic Systems
NASA Glenn Research Center
National Center for Microgravity Research on Fluids and Combustion

Case Engineering is published twice yearly for everyone interested in the Case School of Engineering.

We welcome comments and letters. Please indicate whether they may be published, and direct to: *Case Engineering* Magazine, Office of the Dean, The Case School of Engineering, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, Ohio, 44106-7220; or e-mail to cseinfo@po.cwru.edu with subject, "Attention-*Case Engineering* Magazine".

Cover Photo by Clix

WHAT'S INSIDE

FROM THE DEAN

It is with great pride and enthusiasm that I welcome you to this first issue of *Case Engineering!* This is one of the new vehicles through which we're sharing the vision and accomplishments of The Case School of Engineering. I hope you find it dynamic, informative and alive with our story.

The Case School of Engineering at Case Western Reserve University is among the top research universities in the nation. Our strength lies in the combination of strong departments, dedicated researchers and effective and concerned teachers. We have many programs on which to hang our hats. Members of our more than one hundred faculty are among the most internationally recognized, award winning and highly respected engineers in the world.

Case is in a new state of awakening. Academically and scientifically we're just as rigorous and respected as ever, and we are now working hard to distinguish Case among its peers as a center of excellence and innovation in targeted engineering education and research.

We formalized the Case School of Engineering Vision in a document unveiled last spring. This publication is designed to communicate our progress as we move toward that vision. I welcome your feedback on this and all our communications, our programs, our innovation.

Enjoy this issue of *Case Engineering*!

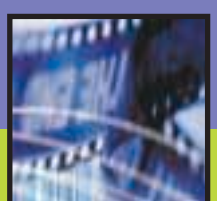
Robert F. Savinell
Dean
George S. Dively Professor of Engineering

AT THE MOVIES

Case won "Best Video" at the 2002 IEEE International Conference on Robotics and Automation. This is the world's premier conference in the field of robotics, and Case's second time in the number one spot. In fact, Case has had a robotics video published here every year since 1994.

This year's honorees included co-authors Wyatt Newman and Michael Branicky (both professors in the Department of Electrical Engineering and Computer Science), Ph.D. students Ravi Hebbar, Siddharth Chhatpar and Craig Birkhimer, and industrial collaborators Ford, Sandia National Labs, ComauPico, and Microdexterity Systems, Inc.

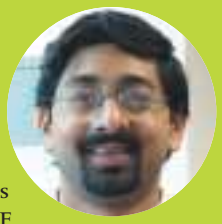
View the three-minute award-winning video on http://vorlon.cwru.edu/~wsn/ (and click on "33MB MPG video: FRAPA project, ICRA 2002 best video award").



CASINGTHEPLACE

John Angus, Professor of Chemical Engineering, is part of an international team that received funding from the Japanese agency NEDO for a large, interdisciplinary project based at the University of Tokyo. The team is studying the electrochemistry of diamond electrodes.

B. Ross Barmish, Professor of Electrical Engineering and Computer Science, was appointed to serve a two-year term on the Board of Governors for the IEEE Control Systems Society.



Ravi V. Bellamkonda, Associate Professor of Biomedical Engineering, secured grants from both NSF and NIH in August. Collaborating with chemical engineers at Cleveland State University, "A Novel Multiple Ligand Approach to Targeting Tumors" will develop nanometer-sized drug delivery vehicles to treat brain tumors, with minimal side effect. Separately, Bellamkonda was awarded an NIH R01 grant, "Bioengineered Scaffolds for Peripheral Nerve Repair." The $1.6 million award will fund development of biomaterials-based implants to help regenerate severed peripheral nerves.

Jianmin Cui, Assistant Professor of Biomedical Engineering, received a four-year NIH RO1 grant of $1,515,690 to study the structure-function relations of a potassium ion channel. This channel is an important regulator of nerve and muscle function and has been implicated in hypertension and certain cancers. A commentary published by the *Journal of General Physiology* called this a "landmark study" because the question had been unsolved for fifteen years. Cui was also published in NATURE (August 22, 2002).

Dominique Durand, Professor of Biomedical Engineering, is the principal investigator on a $639,543 training grant from the Department of Education's Graduate Assistance in Areas of National Need program. The grant will be used to train graduate students to combine engineering, mathematics, physics, and chemistry to solve problems related to the nervous system. In addition, Durand received a four-year $916,000 grant from NIH to study a new type of epilepsy that propagates in the brain in the absence of synaptic communication between the neurons.

Igor Efimov, Associate Professor of Biomedical Engineering, received a four-year $1,800,445 grant from NIH for his project "Virtual Electrode Hypothesis of Defibrillation". In addition, Efimov was elected Fellow of the American Heart Association and the Council on Basic Cardiovascular Sciences and became a member of the editorial boards of the *Journal of Cardiovascular Electrophysiology,* the *Journal of Molecular* and *Cellular Cardiology,* and *Circulation Research*.

Steve Eppell, Assistant Professor of Biomedical Engineering, received an award of $709,014 from NSF and the State of Ohio for the "Construction of Near Field Optical Probe for Bioinspired Research and Education". The project brings together investigators from the departments of Biomedical Engineering, Electrical Engineering, Physics, and Gastroenterology who will design a machine capable of probing tissues, cells and molecules using light with a resolution greater than 10X that which is available with the best state-of-the-art microscopes.

Frank Ernst and Arthur Heuer, Professors of Materials Science and Engineering, received $450,000 from NSF, $225,000 from Ohio Board of Regents and $267,000 from DARPA to acquire a new 300,000-volt transmission electron microscope.

NEW FACULTY

Cheri X. Deng, as Elmer L. Lindseth Assistant Professor in Biomedical Engineering.
Andrew M. Rollins, as Assistant Professor in Biomedical Engineering.
Harihara Baskaran, as Assistant Professor in Chemical Engineering.
Heidi B. Martin, as Nord Distinguished Assistant Professor in Chemical Engineering.
Peter N. Pintauro, as professor and chair of the Department of Chemical Engineering.
Thomas A. Zawodzinski, as Professor in Chemical Engineering, F. Alex Nason Professor of Engineering, and Ohio Eminent Scholar for Fuel Cell Research.
M. Cenk Cavusoglu, as Assistant Professor in Electrical Engineering & Computer Science.
Christian A. Zorman, as Associate Professor in Electrical Engineering & Computer Science.
Elena Dormidontova, as Assistant Professor in Macromolecular Science & Engineering.
David A. Schiraldi, as Associate Professor in Macromolecular Science & Engineering.

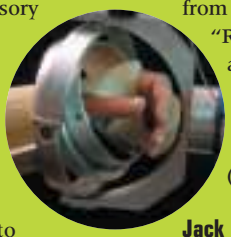
Jinming Gao, Assistant Professor of Biomedical Engineering, was awarded a four-year $1,247,782 NIH RO1 grant for his project, "Interstitial Drug Delivery to Thermoblated Liver Tumors."

Miklos Gratzl, Associate Professor of Biomedical Engineering, was invited to serve on the Editorial Board of the *Journal of Mathematical and Physical Sciences* and the International Advisory Board of *Sensors*. Both are new electronic journals (fully referenced).

Warren Grill and Bob Kirsch, Assistant Professors of Biomedical Engineering, were invited to serve as Associate Editors of the IEEE *Transactions on Neural Systems and Rehabilitation Engineering*. Professor Grill also received a three-year $570,570 grant from NIH for his project "Neural prosthetic control of continence and micturition". In addition, Grill was among the winners in *Northern Ohio Live* magazine's annual Awards of Achievement issue. Grill and Cleveland Clinic doctors Ali Rezei and Edwin Montgomery were awarded the magazine's Award of Achievement in Health and Medicine for research they are doing on deep brain stimulation.

Anne Hiltner, Professor of Macromolecular Science and Engineering, received a $400,000 DARPA award for her project "Thermal Conductivity, Phononics and Structural Relaxation of Polymer Glasses in Nanolayers".

Bob Kirsch, Assistant Professor of Biomedical Engineering, received a four-year $3.3 million grant from NIH for the study "Restoration of Hand and Arm Function by Functional Neuromuscular Stimulation (FNS)".



Jack L. Koenig, Donnell Institute Professor of Macromolecular Science and Engineering, will receive the 2003 Maurice F. Hasler Award from the Spectroscopy Society of Pittsburgh and Thermo Electron Corporation. The award recognizes lifetime achievement in the various fields of spectroscopy and will be presented at a special symposium honoring Dr. Koenig at PITTCON in Orlando. Koenig is recognized for his contributions to vibrational spectroscopic methods for the characterization of polymeric materials.

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Photos by Joe Glick; Clix

CAPI Powers Up

Looking to power everything from model airplanes and laptops to cars and commercial buildings, Tom Zawodzinski says fuel cells are the energy source of the future.

"Fuel cell centers are popping up like weeds all over the country," says Zawodzinski, director of the new Case Advanced Power Institute (CAPI) and the F. Alex Nason Professor of Engineering at Case. "But there are only a small number of institutes with our kind of practical experience, and our combination of expertise is unique." Zawodzinski has never been one to mince words…and he's right.

CAPI, with its cutting-edge lab facilities and imaginative team of engineers, will push the technology to its limits to make fuel cells a viable power choice for industry and consumers.

Now in the final stages of construction, CAPI will include a 2,000-square-foot lab with equipment for physical evaluation of fuel cell materials, and an upper mezzanine with offices for staff and students.

The principle of fuel cells was discovered in1839, but it wasn't until the 1960s that industry recognized their potential. Technical barriers and high investment costs deterred their development. Then, in 1984, the Office of Transportation Technologies at the U.S. Department of Energy began supporting research of fuel cell technology for automotive applications. Now hundreds of companies and research institutes are striving to make fuel cells the power choice of tomorrow.

"There's a long tradition of fuel cell research at Case," explains Zawodzinski, who calls himself the "third-generation" of researchers. He follows in the footsteps of the late Ernest B. Yeager, professor of chemistry and founder and namesake of the Yeager Center for Electrochemical Science, and

Continued on Page 5

Two of the area's primary industries, manufacturing and plastics/polymers, are perfect fits for fuel cells...

Robert F. Savinell, now dean of the Case School of Engineering and George S. Dively Professor of Engineering, who has led an effort spanning the last ten years to introduce new polymer electrolytes into various applications. "Case is a flagship university in fuel cells," says Zawodzinski "and we want to make sure alumni know that and are proudly talking about it and supporting it."

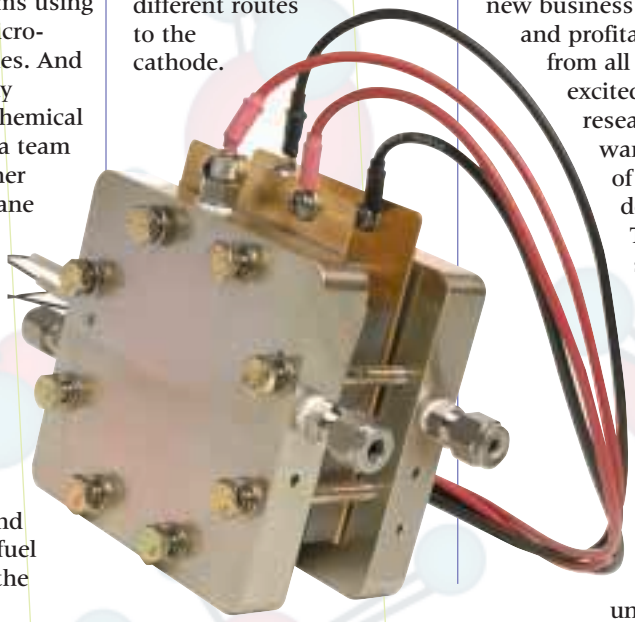
A hard-driving personality and fun-loving spirit, Zawodzinski himself brings considerable expertise to CAPI. In the spring, Ohio Governor Bob Taft announced the researcher's appointment as the state's first Eminent Scholar for Fuel Cell Research. Prior to joining Case, Zawodzinski was the team leader of fuel cell research at Los Alamos National Laboratory in New Mexico. For more than a dozen years, he's worked on the development of fuel cells and electrochemical sensors.

Other members of the existing Case team include Morton Litt, professor of macromolecular science, who enabled development of a polymer electrolyte – harbinger of a new generation of materials that perform at high temperature. Jesse Wainright, a research assistant professor and well-known fuel cell researcher, has led development of micro-fuel cell systems using Case's distinctive micro-fabrication capabilities. And Peter Pintauro, newly appointed chair of Chemical Engineering, brings a team developing yet another new class of membrane technology. CAPI is also embracing Case research efforts to advance closely related solid oxide fuel cell technology.

What's driving the race to get fuel cells to the marketplace? Cleaner emissions and greater efficiency. A fuel cell system can use the hydrogen from any hydrocarbon fuel, including natural gas, methanol and gasoline. Because fuel cells rely on chemistry rather than combustion, emissions are significantly lower than those from even the cleanest fuel combustion processes. The only byproduct of a hydrogen-based fuel cell system is water. And fuel cells are two to three times more efficient at converting fuel to power than internal combustion engines.

How do they work? Fuel cells are electrochemical energy conversion devices that operate like batteries. But unlike a battery, a fuel cell doesn't need recharging. As long as fuel is supplied, it produces energy in the form of electricity and heat.

A fuel cell is comprised of a membrane wedged between two electrodes. Hydrogen passes over one electrode (the anode side), while oxygen passes over the other (the cathode), thereby generating electricity, water and heat. With the help of a catalyst, the hydrogen atom splits into aprotons and electrons, which take different routes to the cathode.



The proton passes through the membrane (the center of the fuel cell), and with the help of the catalyst, combines with oxygen and electrons on the cathode side, producing water. The electrons, unable to pass through the membrane, flow from the anode to the cathode through an external circuit containing a motor or other electric load. This consumes the power generated by the cell.

Before you find fuel cells in efficient, emission-free cars or your cell phone, however, researchers like Zawodzinski have some work to do. A maze of technical and market issues must be navigated to commercialize it. Fortunately, he says, "People want to be a part of fuel cell research...it's going to take imaginative and creative engineers to push this technology to the limit." Founded in the spring, CAPI has had a running start.

Perhaps because of the promise of efficient, emission-free cars and ultimately a cleaner environment, or perhaps because of the promise of new business opportunities and profitability, people from all walks of life are excited by fuel cell research, and many want to be a part of its development. Taft wants to see it power up the Ohio economy.

Zawodzinski expects to involve people from both the Northeast Ohio community and the university. "CAPI will cut across the university," he says. "Virtually every department on campus will be involved, including chemistry, physics and all engineering departments."

And as a member of the Ohio Fuel Cell Coalition, CAPI

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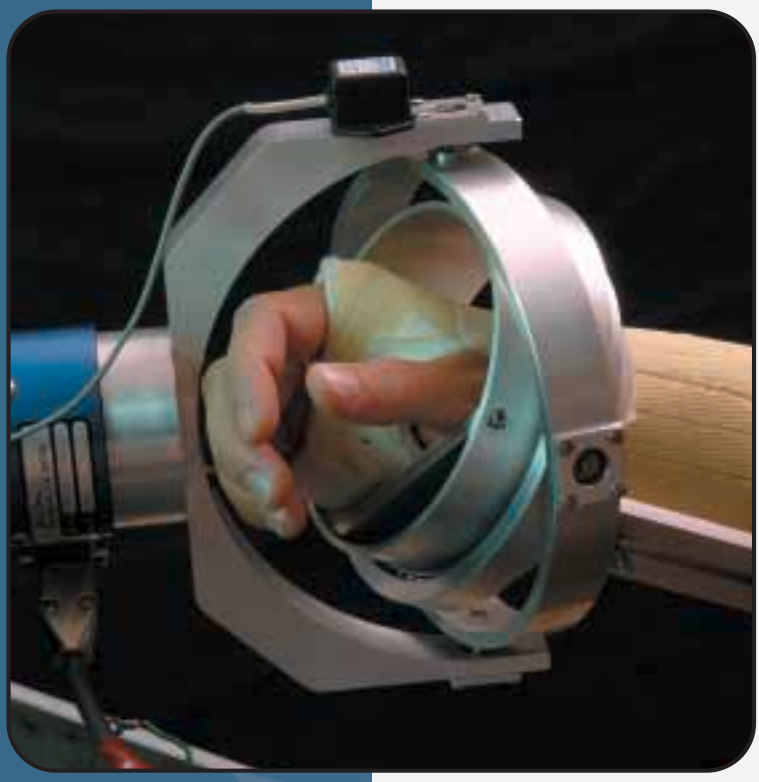
Photo by Clix

Science from Science Fiction

It may sound like something from a science fiction novel, and in fact it is. The inspiration for my research comes straight from the pages of a book I first read in high school. A sci-fi novel where the main character is given new power through the attachment of an artificial hand. A hand that looks and feels real. More importantly it functions naturally, its motion controlled through nothing more than the existing tendons and muscles connected to the brain and nervous systems. I've always wanted to turn that science fiction into reality.

This dream led me to pursue an undergraduate degree in mechanical engineering at the University of Michigan. Being so close to Detroit and the auto industry, I had the opportunity to work as a research and development engineer on the Dodge Ram truck. But I remained more interested in the hands that drove the truck.



Wanting to combine my work in mechanical engineering with my interest in medicine and anatomy, I began searching the Internet for key words like "nerves muscles motion." Again and again, Case Western Reserve University kept popping up. As I looked more closely, I found that Case was a highly respected engineering school surrounded by world-class medical institutions – the perfect environment to pursue my dream research.

I chose to work with the Functional Electronic Stimulation Center (FESC) at Case. FES involves stimulation of muscles to restore function lost through paralysis or stroke. With FES I could have chosen to develop computer models of the human body to obtain data not easily gathered using human subjects, or to engage in animal experimentation to understand the complicated interactions between the nervous system and the rest of the body. But I decided that I really wanted to interact with patients, to actually see my work improve someone's life.

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Case's undergraduate and graduate engineering programs are both Top 50.

Case's Department of Biomedical Engineering is Top 10.

U.S.News Best Graduate Schools 2003

At the moment I am working with tetraplegics—persons who have suffered a neck-level spinal cord injury. These patients have some retained voluntary shoulder motion, but are unable to extend their arm or bring their hand to their face. Through my research, I want to help these individuals hug a child or eat an apple when before these tasks had to be performed for them by others.

The object of my work is to use the activations of their functioning muscles to predict where they want their arms to go, and then stimulate the paralyzed muscles to make this motion possible. To do this, I use a computer model of the shoulder customized to each patient, and run simulations that predict how much force needs to be generated by each muscle to maintain different positions in space. This data is used to "train" an artificial neural network. The neural network will then be able to predict the required stimulation levels of the paralyzed muscles to produce the desired motion.

The most critical—and exciting—step is next: recruiting volunteer tetraplegics to see how the system works. During these experiments, I will be measuring quantitative data to compare the predicted output angles and the actual position of the arm. Just as importantly, I'll record qualitative information: does the movement feel natural and fluid to the patient?

This is only the first in what will be numerous studies to test the feasibility of using artificial neural networks to interact with the nervous system. Our outstanding group of researchers and students at FESC have one common pursuit — to restore as much function as possible, as soon as possible, to stroke victims and paralyzed individuals.

Through research and development in areas like functional electrical stimulation, the dream of artificial arms, hands and legs controlled by an individual's own nervous system is now closer to reality. Science has come to approach science fiction.

Katie Polasek is a second-year graduate student in biomedical engineering at Case.

Check out the August 22 issue of *Nature* for Jianmin Cui's article, "Mechanism of Magnesium Activation of Calcium Activated Potassium Channels."

Muscle Mania

Imagine a sudden car accident. In the change of one lane, you're paralyzed. Spinal cord injury changes life in a split second. Victims of paralysis—from injury like this or natural conditions like stroke—hope for medical science to give them back what so many of us take for granted.

Functional electrical stimulation (FES) uses bio-machinery to solve problems in body functioning. One of the uses coming to life at the Cleveland FES Center addresses paralysis due to central nervous system disorders like spinal cord injury or stroke.

Biomedical investigators with the Center are affiliated with Case, the Louis Stokes Cleveland VA Medical Center, and MetroHealth Medical Center. One-third of the sixty-seven employees at the Center are Case graduates.

The field of biomedical engineering began at Case thirty years ago. Today, investigators have designed sophisticated pacemaker-like implanted systems that can induce movement in paralyzed muscles. The implant systems enable individuals with spinal cord injury to grasp objects, stand, take steps, or empty their bladder or bowels. Studies are underway to determine how individuals with stroke can improve their upper and lower body function with electrical stimulation.

Research projects range from basic research studies to full-fledged clinical trials with the aim of technology commercialization. Two FES systems developed and/or tested at the Cleveland FES Center a hand grasp neuroprosthesis and a system to restore bladder and bowel function have met the rigorous standards of the Food and Drug Administration, and received their approval.

The Cleveland FES Center has seen the spotlight on such nationally televised programs as "Scientific American Frontiers" (*PBS,* "Body Building", May 28, 2002), "Classic Geographic" (*National Geographic Channel*, June 24, 2002), and "Science Times" (*NGC,* "The Prosthetic Revolution", August 2, 2002). Internationally, the Cleveland FES Center has been featured on the *Discovery Channel* on *Discovery Canada* and *Discovery Europe.*

Cleveland FES Center research is funded primarily by the U.S. Department of Veterans Affairs and the National Institutes of Health, receiving more than $5 million annually. P. Hunter Peckham, professor of biomedical engineering at Case, heads the center. For more information, e-mail pxp2@po.cwru.edu.

Photos by Clix

KUDOSTO Co-op's Top 10 Employers

Co-op at Case places students looking to get hands-on engineering experience in companies that see the value of fresh eyes on the job. Co-op is a big deal at Case—-last year more than 200 students worked at 91 different organizations. The program's success is built on the collaboration of industrial organizations and businesses teaming up with students who are qualified and prepared for assignments.

Employers enjoy the talent and energy of students from Case, who are eager to make a significant contribution to the organization. Employers consistently comment that they are amazed at how well prepared Case students are not just in the rigors of science but also in their dedication to the job.

Students in co-op get to make sense of studies as they apply classroom theory to the practical aspects of engineering, science and business. Co-op lets them learn more about their majors, discover their likes and dislikes, explore career options, meet experienced people in

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Peter Lagerlof, Associate Professor of Materials Science and Engineering, spent the summer as a visiting professor at The Graduate School of Frontier Sciences, University of Tokyo. Lagerlof worked with Yuichi Ikuhara (visiting professor at Case, 1991-1993) and others on "Interfaces and Physical Properties of Sapphire (single crystal Alumina)". Dr. Fumiyasu Oba of the Ikuhara/Yamamoto Research Group came to Case in August to work with Dr. Frank Ernst in Materials Science and Engineering.

John Lewandowski, Professor of Materials Science and Engineering, presented one of the Keynote Lectures at ICF-10, the Tenth International Congress on Fracture. In addition, he gave an invited presentation at the International Conference on Bulk Metallic Glasses II in Taipei, Taiwan in March 2002.

Wei Lin, Associate Professor of Electrical Engineering and Computer Science, was invited to give a keynote address entitled "Control of Nonlinear Systems by Non-Smooth but Continuous Feedback: the State of the Art" at the 4th Nonlinear Control Network Workshop: Nonlinear and Adaptive Control, held in Sheffield, England, June 25-28, 2001. He will also serve as the Vice Program Chair, Invited Sessions for the 41st IEEE Control and Decision Conference to be held in Las Vegas, December 10-13, 2002.

C.C. Liu, Professor of Chemical Engineering, and **Mehran Mehregany**, BFGoodrich Professor of Engineering Innovation, announce the formation of the Center for Micro and Nano Processing. The Center, built on the strengths and reputations of the Electronics Design Center and Microfabrication Lab, adds new research capabilities in nanofabrication that follow the trend of miniaturization to the atomic level.

Benham Malakooti, Professor of Electrical Engineering and Computer Science, was invited by the National Academics/National Research Council to serve as a member of the Engineering Panel for the Ford Foundation Program.

Roger Marchant, Professor of Biomedical Engineering, was awarded a new NIH RO1 grant of $950,000 direct for four years for his project "Drug Delivery in Restenosis".

Simon Ostrach, Wilbur J. Austin Professor of Mechanical & Aerospace Engineering and Pollak Distinguished Lecturer, presented a series of three lectures on space research and the thermocapillary flow experiments done on the USML 1 & 2 missions to the Departments of Aerospace Engineering and Mechanical Engineering at the Technion in Israel last December.

Hunter Peckham, Professor of Biomedical Engineering, has been elected a member of the National Academy of Engineering (NAE). Election to the Academy is one of the highest professional honors for an engineer. He will be inducted into the Academy in October 2002 at the NAE's annual meeting in Washington, D.C. In March 2002, Professor Peckham gave an invited talk entitled "Re-Engineering the Paralyzed Nervous System" at the National Academy's 7th Symposium on Frontiers of Engineering, in Irvine, California. Professor Peckham received a two-year $2,683,670 grant from NIH for his project "Development of Networked Implantable Neuroprostheses". Peckham directs the Cleveland FES Center, whose partners in the renowned Cleveland medical community include University Hospitals of Cleveland, MetroHealth Medical System and the Cleveland VA Medical Center.

Stuart Rowan, Assistant Professor of Macromolecular Science and Engineering, received a five-year $580,000 NSF Career Grant for his project "Development of Novel Organic/Inorganic Hybrid Oligomer Architectures."

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Photos by Mike Sands; Clix; courtesy of NASA; Case Alumni Association

their fields, and get in-depth knowledge about their industries. And having references from the "real world" doesn't hurt when the real job hunt starts at graduation.

Real Time in the Real World

When we say "real world" we're not kidding. Students worked at Rolls Royce and Ford in Germany, and Mettler/Toledo in Switzerland. Here in the states, students get time at Fortune 500 companies and top government research sites all over the country. "I was assigned to a challenging project that would help draw Philips Medical Systems closer to the release of its very own CT scanner. I worked with a great group of people, and saw several technological breakthroughs that look very promising. With the help of our team in Haifa, Israel, our new scanner was released about a month ago," says Harry Angelo Gray, a future mechanical engineer in the Class of 2003. Gray worked for Hank Novak at Philips.

"Our employer base has grown from day one. Once an organization hires one Case engineer, they're usually impressed and return the following year for more students," says Mary Rose Tichar, director of the program. "This year's top co-op employer of the year, Philips Medical Systems, is a truly special partner. Philips has been the top employer for the past three years. In fact, since 1995 Philips has hired 43 students for co-op." People like Hank Novak, Tammy Young and Phil Macero make it all possible. "Case co-op is a viable platform for Philips to employ and utilize the skill set and talent of each individual student," says Phil Macero, Director of Operations at Philips Medical Systems in Cleveland. "Co-op also provides a springboard for those qualified students to explore career opportunities in a very diverse environment."

For John Mayer, future mechanical engineer and Class of 2003, life wouldn't be the same without co-op, "In my co-op experience with Philips, I had the opportunity to work on the various engineering aspects of designing and producing medical imaging equipment. Philips does an excellent job of integrating Case students into every aspect of the engineering process. I got to work with a group of intelligent and highly motivated engineers, designers and managers. Working in co-op has been a great experience for me. I highly recommend it!"

For more information on co-op at Case, call (216) 368-5119 or visit www.oceea.cwru.edu.

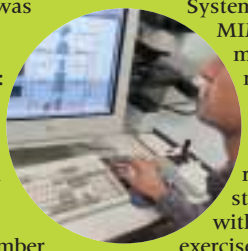
CO-OP EMPLOYEERS

Top 10 Co-Op Employers 2001-2002

Company	Students
Philips Medical Systems	16
IBM (RTP, NC)	15
Codonics	9
Invensys-Foxboro	9
General Electric Lighting	9
Goodyear Tire & Rubber	8
IBM (Endicott, NY)	8
Rockwell Automation	7
Royal Appliance Mfg.	7
Swagelok	7

Yoram Rudy, Professor of Biomedical Engineering, received the 2001 Biomedical Engineering Society (BMES) Distinguished Lecturer Award last October. His lecture, delivered at the annual BMES scientific meeting, was entitled "Computational Biology in the Integration from Genetics to Function: Examples from Rhythm Disorders of the Heart". In addition, Dr. Rudy was elected to deliver the Ueda Memorial Lecture to the Japanese Society of Electrocardiology in September 2001. Dr. Rudy also presented an invited lecture at a meeting in the Netherlands in June 2002, celebrating "100 Years of Electrocardiography". The presentations described work in Dr. Rudy's laboratory that uses computational biology to relate genetic mutations to rhythm disorders of the heart and sudden death.

Cenk Sahinalp, Assistant Professor of Electrical Engineering and Computer Science, received a five-year $330,000 NSF Career Award, "Algorithmic Methods for Large Scale Genome Analysis."



Gerald M. Saidel, Professor of Biomedical Engineering, was awarded $11.8 million over five years from NIH to head a team developing the Center for Modeling Integrated Metabolic Systems (MIMS). The MIMS Center will mathematically model and simulate metabolic systems in response to stresses associated with hypoxia, exercise, dietary and drug inputs.

Robert F. Savinell, Dean and George S. Dively Professor of Chemical Engineering, received a $400,000 grant from Honda to elucidate mechanisms of conductivity in PBI/acid electrolytes for fuel cells.

Chih-Jen (Jackie) Sung, newly promoted to Associate Professor of Mechanical and Aerospace Engineering, received a five-year $375,000 NSF Career Award, "Applications of Reformer Gas to Improve Cold Start Performance of a Homogeneous Charge Spark Ignition Engine."

Chris Weder, Associate Professor of Macromolecular Science and Engineering, won a three-year, $275,288 NSF grant, "Conjugated Polymer Networks."

Edward B. White, Assistant Professor of Mechanical and Aerospace Engineering, won a four-year, $171,000 AFOSR grant, "Turbulence and Rotating Flows," to validate new theories about how surface roughness contributes to laminar-to-turbulent transition on aircraft wings and the effect of surface roughness on drag. This is the first grant awarded for work in the newly rebuilt on-campus wind tunnel.

David Zeng and J. Ludwig Figueroa, both of Civil Engineering, were two of seventeen experts from the United States invited by NSF to participate in the International Symposium on Geotechnical Centrifuge Modeling and Networking, held in Hong Kong, December 2001.

G.Q. Zhang, Associate Professor of Electrical Engineering and Computer Science, presented three talks at the Third Federated Logic Conference in Copenhagen, Denmark in July. Zhang is editor-in-chief of the newly founded Kluwer bookseries, "Semantic Structures in Computation," a forum on domain theory, programming semantics, types, concurrency, lambda-calculi, topology and logic in computer science, and applications in non-traditional and emerging areas.

THE CASE SCHOOL OF ENGINEERING

Leadership Team

Dean
Robert F. Savinell
rfs2@po.cwru.edu

Associate Dean
Research and
Graduate Programs
Joseph M. Mansour
jmm12@po.cwru.edu

Associate Dean
Undergraduate Programs
James D. Cawley
jxc41@po.cwru.edu

Associate Dean
Administration and Finance
Christine A. Ash
caa2@po.cwru.edu

Assistant Dean
Administration and Finance
David C. Hensel
dch2@po.cwru.edu

Assistant Dean
Office of Extracurricular
Enhancements and
External Assessment
Deborah J. Fatica
dxf3@po.cwru.edu

Visiting Committee

Chairman
Visiting Committee
Richard T. Schwarz
Sycamore Partners LLC
via cmw8@po.cwru.edu

Dr. Roger W. Brockett
An Wang Professor of
Electrical Engineering and
Computer Science
Harvard University

Richard P. Case
Commissioner (retired)
President's Commission On
Critical Infrastructure
Protection

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Darden Graduate School of
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Partner
Pearne, Gordon, McCoy
& Granger

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Attorney/Partner
Kahn, Kleinman, Yanowitz
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Operations & Functional
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Continued from Page 5

hosted its first workshop, drawing 80 participants from Northeast Ohio and around the state.

"We're not just looking out across the state. We've got our sights right in our own backyard. The Cleveland metropolitan area is a bustling major city in times of economic change and rebirth. We also want to work within the Cleveland city limits," says Zawodzinski, who hopes to interest kindergarten through high school students in fuel cells and careers in science and engineering.

Zawodzinski notes that northeast Ohio is the ideal hub for the fuel cell field. Two of the area's primary industries, manufacturing and plastics/polymers, are perfect fits for fuel cells, and one of CAPI's missions is to provide additional research to companies already involved in the industry. "We're going to take Cleveland from brown to green," smiles Zawodzinski. "Or rust to green, take your pick."

To make CAPI a leader in cutting-edge energy systems technology, funding is critical. Researchers have already landed $2 million in grants from the federal government and private industry. But, says Zawodzinski, CAPI needs a "war chest" to attract top people and maintain the state-of-the-art lab. "Our ties with industry are critically important in gaining funding," says Zawodzinski. So he's constantly retooling his list of innovative ways to add value to their operations while garnering the necessary funding and support.

Governor Taft has described Zawodzinski as a "catalyst for making Ohio a leading center for fuel cell research and development." With Zawodzinski at the helm, CAPI will no doubt "power up" fuel cell research. Here we go…start your engines!

To find out more about CAPI, e-mail capi@po.cwru.edu or stay tuned for the website.

Biomaterials-Tissue Engineering New at Case

The Department of Biomedical Engineering announces a new undergraduate sequence in Biomaterials-Tissue Engineering starting Fall 2002. The new sequence differs from polymeric biomaterials in its basis in chemical, not macromolecular, engineering. Interested? Contact Professor Ravi Bellamkonda at (216) 368-4195 (rvb@cwru.edu).

The Long and Winding Road

The roundabout route

In 1991, Katie Toth Garmey did the unthinkable to most students. Three years into an accounting degree at Kent State University, she not only decided to switch majors, but transfer to another school as well. "I realized I didn't really like accounting," says Garmey. "I always loved math and chemistry." So she checked out a future in chemical engineering.

A native of the Cleveland area, Garmey looked into engineering programs at the University of Akron and Case Western Reserve. She met with Donald L. Feke, professor of chemical engineering and then associate dean, who convinced her to transfer to Case. "I was transferring under very unusual circumstances, and he didn't even question my reasoning," says Garmey. "Professor Feke was so welcoming and friendly. He had me sold on Case."

That fall, Garmey experienced déjà vu, starting life over as a freshman for the second time. While Case accepted some of her credits from Kent State, Garmey started from scratch in engineering courses. She needed classes in thermodynamics, physical chemistry, distributive phenomena and other core fields.

Ironically, the courses that stand out in her mind aren't engineering-related: they are the two semesters of physical education required by Case. "By the time I took them, I was in my sixth year of college," laughs Garmey. "I felt really old." Still, she ran circles around a lot of the younger students—literally. Garmey joined the track team during her final year at Case, running the 800-yard and 1-mile races.

Three years after she transferred—and thousands of study hours later—Garmey graduated with a Bachelor of Science in Engineering from Case. With a perfect 4.0 grade point average in her chemical engineering major, Garmey had her pick of employment opportunities. Unlike many of her peers, who pursued careers in research, Garmey opted for a less traditional career path. "I liked working with people," she says. "I was never drawn to the typical roles of process engineering or research and development."

In 1994, Garmey accepted a position with Avery Dennison's Roll Label Division in the technical customer service field. Remaining in Cleveland, Garmey combined both her chemical engineering degree and people skills in this job. She interacted daily with corporate customers, recommending label products, performing laboratory testing on products and troubleshooting. "What I liked best," says Garmey, "was that you never knew from day-to-day what the customers were going to ask." She helped clients with problems ranging from simple printer jams to complex label constructions.

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to engineering pays off in the end.

"Case Western Reserve—the name alone has opened a lot of doors for me." – Kate Garmey

Garmey left her position with Avery Dennison in 1999, when she married Brian Garmey and moved to Baltimore. Over the past three years, she's held jobs with the same number of employers, each equally interesting and challenging. "Case Western Reserve—the name alone has opened a lot of doors for me," says Garmey.

Upon relocating to the east coast, Garmey accepted an applications engineering role with a small company called Air Techniques International. She worked hands-on with customers to help develop new products for the company, which manufactures specialized test equipment for air filters.

While with Air Techniques, Garmey attended several industry trade shows, often in niches she never would have thought about pursuing, such as weapons of mass destruction.

A year later, Garmey applied the skills she learned at Case to another job. Working for software developer Campus Concepts, she helped develop a program for college intramural sports directors to schedule sports events. Garmey spent one year with Campus Concepts, completing development of the software package. A hot commodity, she wasn't left unemployed when the project ended.

For several years, Garmey had been pursued by Westvaco (now MeadWestvaco), a producer of packaging, coated and specialty papers. The manager of the engineering department again contacted Garmey in 2001. When she told him she was pregnant and working part-time, "he got off the phone pretty quickly," Garmey says. "I didn't think I'd hear from him again." Garmey underestimated her value. The manager called back and asked if she'd like to work for the company part-time and from home. Garmey eagerly accepted. "It's the best of both worlds when you have a child," says Garmey, who now has a one-year-old son, Connor.

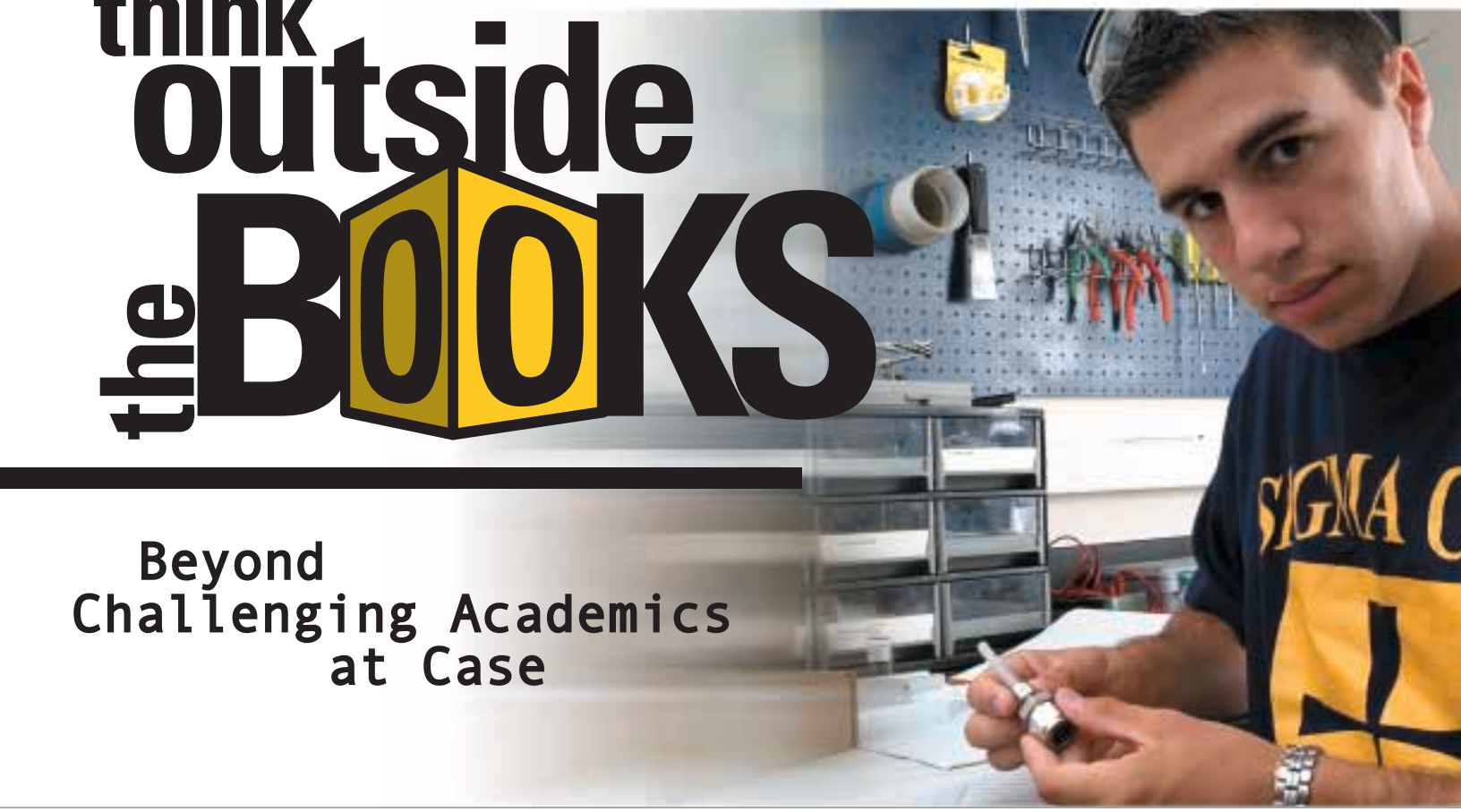
Garmey is part of a 12-employee team at MeadWestvaco developing a new technology in the radio frequency identification field (RFID). Working twenty-four hours weekly, she handles patent and marketing research and will soon oversee a customer trial. Garmey savors working in a small-group environment. "It has the spirit of a start-up with the backing of a large organization," she says.

Garmey anticipates remaining with MeadWestvaco for a while. She enjoys the flexibility of the job, working part-time yet also getting to spend time with her son. Garmey credits CWRU for this ideal lifestyle. "A degree from Case gave me the opportunity to have a flexible job from home," she says. "It also allows me to work in technical fields, but with direct contact with customers." It's a win-win for Garmey—and well worth the extra years of schooling she faced 11 years ago when she transferred to Case Western Reserve.

Photos by Clix

think outside the BOOKS

Beyond Challenging Academics at Case



As a Pittsburgh native, I looked at all of the region's leading institutions when it came time to select an engineering school — University of Pennsylvania, Pitt, and Johns Hopkins among others. I considered Carnegie Mellon, since my dad was an alumnus. But I chose Case to become my alma mater, even though it was 150 miles from home. And I've never regretted my decision. After all, there's more to college than academics.

Because Case is an urban campus in the heart of one of the largest cultural districts in America, there are a multitude of arts groups presenting cutting-edge music, exhibits, films, and plays. And the university community itself offers an array of activities, groups, and opportunities to help students balance academics with the other interests in their lives.

THERE'S MORE TO COLLEGE

For instance, for me, playing football is my release. And because Case is an NCAA Division III school, I knew I would have the opportunity to continue playing football while attending college at a premier research university. So for three hours every day, I forget about everything else—-like tests, papers and work — to concentrate on doing something I absolutely love. In Division III athletics, people participate because they enjoy the game. Players are dedicated to the sport and their teammates, and coaches take the time to not only help players develop their athletic skills, but also their leadership abilities.

As one of the leading research institutes in the nation, professors are constantly searching for students to help out in the research labs. For the past summer, I worked in the Electronics Design Center (EDC), a world-renowned research center specializing in the development of microsensors and microsystems under Dr. C.C. Liu. I kind of fell into this great research opportunity with the help of one of my teammates. Because half of the research staff was leaving to study in London for the summer, he told me that the EDC was desperate for another research assistant. The next day I walked in and found myself with a job in one of leading

Continued on Page 15

students feel a PART of the UNIVERSITY COMMUNITY

microfabrication laboratories in the nation. My research for the past few months focused on creating energy generators for a fuel cell.

Like participation in athletic programs, joining one of Case's 17 fraternities and four sororities can really help students feel a part of the university community. Friendships, and important collegial and professional relationships, develop that can last a lifetime.

Being a fraternity or sorority member at Case means more than just having a great social life. Greek organizations here focus on building leadership and organizational skills to supplement one's academic achievements. As a member of Sigma Chi, I have numerous opportunities for developing my leadership abilities. These skills have helped in my activities and academic work here at Case, and will enhance my career in the future.

At Case, students are expected to produce a high level of quality work. However, the work is not overwhelming if you just recognize what is really important in life. Balance is the key. Academics must be one of your priorities, of course, but outside activities will help you avoid burnout, keep the demands of schoolwork in balance, and ultimately help you succeed in all areas of your life.

My experience at Case has been wonderful, simply because I have recognized there is life outside of academics. I chose chemical engineering as my major for its professional flexibility and limitless career opportunities in the fields of pharmaceuticals, energy, design and consulting.

And I chose CWRU because of the diverse people, the diverse activities and the diverse environment. I have learned to work with people from all walks of life, people with different talents, temperaments, and convictions. Because of this community's diversity and open-mindedness, Case students and faculty have the ability to accomplish some extraordinary things.

John Deitzer is a Dean's List sophomore in the chemical engineering program at Case, a quarterback for the CWRU Spartans, and a member of the Sigma Chi Fraternity.

Photos by Clix

NØ Fries With That

For too many undergraduates, several years of college education still lands a boring summer job at the drive-thru window.

The Electronics Design Center, part of The Center for Micro and Nano Processing, doesn't waste the enthusiasm and originality engineers-in-training can bring to research.

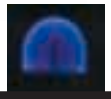
For example, this past summer rising sophomores, juniors and seniors became integral team players on projects to develop hydrogen storage media to run miniature fuel cells, developed programs to use in quality control for tin oxide gas sensors, and developed palladium inks for making miniature pH sensors.

The students also put their problem-solving and teamwork skills to work designing a reaction test chamber to measure the hydrogen released by a reaction of sodium borohydride with water. Sodium borohydride is an environmentally friendly compound that might prove capable of powering fuel cells to run computers, cell phones and other electronic devices.

In addition to research, the undergraduates were trained in conducting routine lab maintenance like chemical inventory.

SICK OF WATCHING STARS? Take a Ride ON THE Vomit Comet!

Regular candle



Regular candle in zero gravity

For anyone who's ever dreamed of being an astronaut, the roller-coaster flight on a KC-135 is a taste of the real thing. Flown regularly from NASA Glenn Research Center in Cleveland, the KC-135 aircraft is a four-engine turbojet (predecessor of the Boeing 707) used to create a roller-coaster type sequence. It flies in a series of parabolas.

And talk about "air time"! As the KC-135 reaches the top of the parabola, cargo (like experiments) and passengers experience a 20-25 second period of weightlessness. Of course, the down side is the 2-g force experienced on the way down. It's no surprise that "greener" researchers affectionately refer to this unusual lab as 'The Vomit Comet'. For the space savvy with a strong stomach, it's the ultimate experiment.

Well, it might not float everyone's boat, but students in mechanical and aerospace engineering at Case can get the chance to fly. It takes a few trips to get used to the sickening whirl of weightlessness. And after awhile it's hard to tell which way is up. But they say it's great to be able to test theories in conditions that, if only for a short time, are nearly the same as in low-earth-orbit spacecraft.

Undergraduate students, graduates, and more than forty scientists and staff at the National Center for Microgravity Research on Fluids and Combustion (NCMR) are lead by the internationally acclaimed Simon Ostrach, also Wilbert J. Austin Distinguished Professor of Engineering at Case (and a veteran of KC-135 campaigns), and chief scientists Iwan Alexander (fluid physics) and James T'ien (combustion). Both Alexander and T'ien are professors of Mechanical & Aerospace Engineering at Case. Administration for the center is housed on the Case campus, while all research is conducted at NASA.

"NASA Glenn Research Center here in Cleveland is a spectacular resource and partner to Case," says Ostrach. "It is one of only fifteen NASA field sites." NCMR is funded by and supports NASA with critical path research in fluids and combustion. In addition to rich contributions to basic science, low gravity research in fluids and combustion is important to designing better space-based systems and to inventing reliable self-sustaining systems for human exploration of space, like advanced life support.

Fluids and fire behave very differently in space. By testing in weightless conditions, scientists can isolate and study the effects of non-gravitational forces on fluids and flame. For example, knowing how flames behave in the absence of gravity is crucial for the design of fire safety systems to use in space.

Not only does NCMR carry out its own experiments on the KC-135, it also supports and assists researchers from all over the U.S. by flying their experiments. Glenn Research Center's mission is to support space experiments on the International Space Station. To do so, it houses the low-gravity facility, a 500-foot deep shaft that provides five seconds of weightlessness (experiments only, no riders!) and a smaller two-second drop tower.

To find out more about NCMR, visit ncmr.org.

Photos courtesy of NCMR, NASA

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CASE ADVANCED CAPI POWER INSTITUTE

TIIME To Branch Out:

The BioScience Business Launch Competition

TIIME—-The Institute for the Integration of Management and Engineering—-broke ground last year with its one-of-a-kind master's degree in engineering AND management (MEM). MEM differs from similar programs because of the seamless integration of coursework. MEM classes are taught jointly and cross-functionally by professors from two nationally ranked schools: the Case School of Engineering and the Weatherhead School of Management. Students experience a "team learning" environment, and benefit from TIIME's partnerships with industry. This winning combination can be completed in only one calendar year, so students are able to jump-start their careers.

Besides innovative teaching, TIIME conducts research and acts as a conduit for transferring technology to the workforce. Last year, TIIME started an annual business launch competition for entrepreneurs in northeast Ohio. Winners get $50,000 in startup capital, and expert advice from already successful entrepreneurs. NDI Medical won first place in May 2002. Charles Wang, founder, chairman and CEO of Computer Associates International, was on hand to announce competition winners and offer his perspectives on being entrepreneurial.

Capitalizing on that success, TIIME is now partnering with BioEnterprise and the Council of Smaller Enterprises (COSE) in Cleveland to award up to $50,000 in the first annual BioScience Track of the Case-Weatherhead Business Launch Competition. This initiative gives bioscience firms access to both expertise and funding. Contestants for the BioScience Track must be start-ups with high growth potential, involve any area of life sciences (biotechnology, biomedical engineering, medical devices, pharmaceuticals, biorelated-software, medical services, etc.), and be located in, or willing to relocate to, northeast Ohio. Winners will be announced on December 9th, 2002. For more information on BioScience and TIIME, visit http://www,tiime.cwru.edu.

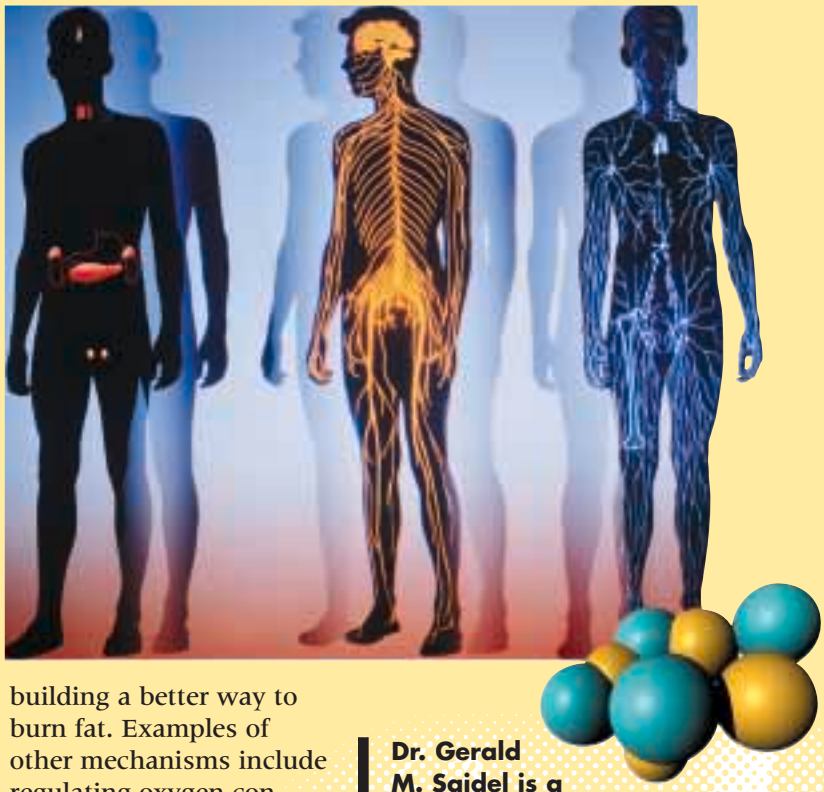
GROPING THE ELEPHANT

We've all heard the parable of the blind men and the elephant. Each gropes a different part, and by the limits of what he can reach each concludes the elephant is something different. It's a wall, a rope, a snake. John Godfrey Saxe summed up the story's moral this way, "The disputants... rail on in utter ignorance... and prate about an elephant not one of them has seen!"

Hoping to diagnose human response more than elephants, Jerry Saidel is tackling ignorance on the biological front. Saidel leads a team of nine researchers from Case Western Reserve University, Cleveland State University, University Hospitals of Cleveland, and Rainbow Babies and Children's Hospital who will develop computer analyses of cellular metabolism, the processes by which food is converted into energy.

"Unlike research that's already out there – studying drug and exercise effect on one organ like the heart, liver, brain or muscle – we're bringing together specialists in each of those four areas to predict the integrated effects of each organ or tissue on the other organs and whole body metabolisms. It's the whole elephant of metabolism and stress testing," says Saidel. The National Institutes of Health were so impressed with the team's holistic approach that they recently awarded him with an $11.8 million grant. The grant will establish the Center for Modeling Integrated Metabolic Systems (MIMS) at Case.

"Think of the liver as the body's factory," says Marco Cabrera, associate director of MIMS. "That's where most metabolism takes place. One mechanism we will analyze is how a diet rich in carbohydrates or fat can affect liver metabolism at rest and during exercise." Said in simple English, they're building a better way to burn fat. Examples of other mechanisms include regulating oxygen consumption in muscle during exercise of varying intensities, allowing the brain to function optimally with intense exercise and reduced oxygen delivery, and protecting the heart with certain drugs when cardiac blood flow and oxygen are reduced.



Dr. Gerald M. Saidel is a professor in the Department of Biomedical Engineering and director of the MIMS Center. Contact Dr. Saidel at gms3@po.cwru.edu.

Dr. Jerry Saidel

Fast Fact Clip

STRENGTH ACROSS DISCIPLINES

THE NATIONAL RESEARCH COUNCIL PLACES CASE IN THE TOP ONE-THIRD IN THE NATION RATING ALL ENGINEERING PH.D. PROGRAMS COMBINED.

Dr. Marco Cabrera

Photos by Mike Sands

Education : Research : BUSINESS

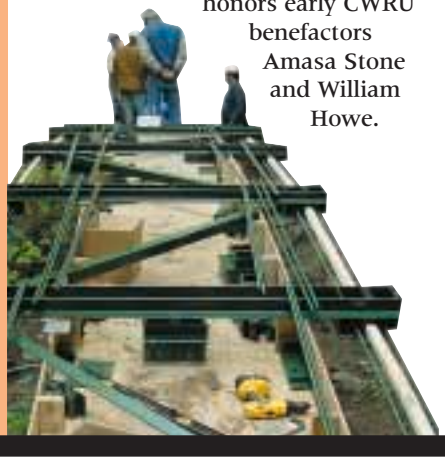
Drawing on a wealth of local executive expertise, the Case School of Engineering's Corporate Relations Committee is now open for business. Under the leadership of Charles "Bud" Koch, Charter One Bank chairman and CEO and CWRU trustee, the committee will expand and strengthen Case's corporate partnerships.

Visiting committee members John Morley and Frank Linsalata were instrumental in securing Mr. Koch's participation. Mr. Koch will serve alongside a select team of local and national business leaders, including Joseph Keithley, Keithley Instruments chairman and CEO and CWRU trustee, Thomas Seitz (CIT '70), president of Consumer Products at Sherwin Williams, and Karen Sweeney, managing partner of Turner Construction.

The Corporate Relations Committee expects to reinforce Case's already strong ties to the corporate community and to build a protocol for interchange.

"Case School of Engineering graduates are really top-notch."
— Dale Mikol, GE Lighting Division Campus Coordinator for Recruiting

The **American Society of Civil Engineers** awarded the Case Western Reserve University student chapter a Letter of Honorable Mention for its outstanding activities in 2001. The Letter makes CWRU the best student chapter in Ohio. In spring 2002, undergraduate civil engineering students in the advanced structural analysis class designed, fabricated and built a 14-meter Howe-Stone truss bridge at the university's research and recreational property, Squire Valleevue Farm. The design honors early CWRU benefactors Amasa Stone and William Howe.



UPCOMING EVENTS

October 11 Neural Prosthesis Seminar, "Intraoperative Sarcomere Length Measurements in Normal and Spastic Human Muscle," by Richard Lieber, 8:30-9:30 a.m. in Crawford Hall Room 13. For more information, call 800-666-2353.

October 17-18 CSE Visiting Committee Meeting

October 21-22 CWRU Fall Break (undergraduate)

October 27 Connect with CWRU (open house for prospective undergraduates, for more information visit www.cwru.edu/ugadmis/openhouse.htm.)

November 11 Spring registration begins

December 11-18 Finals

December 11 TIIME BioScience Business Launch Competition Awards

January 13 First day of classes

January 30 Inauguration of President Hundert

February 16-22 National Engineers Week

March 10-14 Spring Break

April 4 CWRU Research ShowCase 2003 (university-wide research day. For more information, visit www.cwru.edu/menu/showcase/.)

May 1-8 Finals

May 11-17 Intel International Science & Engineering Fair in Cleveland (featuring Case's "Power Packed Day" with tours in portable power)

May 18 CWRU University Commencement

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Senior, Michigan State University

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Case Western Reserve University
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