Engineering

Penn State

The Magazine of the Penn State College of Engineering

Summer 1998

Engineering plugs into Penn State's World Campus

Penn State

Engineering Conferences

Modern Bearing Technology
University Park
June 22–26, *Advanced Course for Scientists and Engineers*
August 10–12, *Introductory Course for Engineers*
August 13–14, *Advanced Topics in Statistical Theory & Methods of Application*
November 12–13, *Advanced Topics in Vibration and Noise*
Dr. Tedric Harris
Presented in conjunction with the American Bearing Manufacturers Association, these courses are designed for engineers and others with technical backgrounds who need specialized knowledge of the bearing industry.

Wastewater Biology
July, Harrisonburg, VA
August, Ithaca, NY
October, University Park, PA
Plus various Canadian locations
Michael Gerardi
This workshop presents modules on a biological approach to operating wastewater treatment plants, teaching participants to recognize and correct conditions causing plant operational or upset problems.

Computational Methods in Stormwater Management
July 27–29, University Park
Dr. Thomas Seybert
This short course is for engineers and planners who want to upgrade their skills in microcomputer methods for hydrologic analysis and hydraulic design of stormwater facilities. Topics covered provide comprehensive tools for stormwater management planning, detention facility design, and subdivision planning.

Modern Protective Structures
July 13–17, University Park
Dr. Theodor Krauthammer
This course, by internationally-renowned experts, will give engineers, architects, and safety and security managers fundamental background information and relate it to the performance and latest design requirements for hardened facilities.

Physical Plant Operation and Maintenance Series
July 13–August 5, University Park
Jim Myers
This series for facility managers, engineers, and maintenance personnel, consists of four, three-day modules. Participants may choose any number of modules: Electrical Systems and Maintenance, Boiler/HVAC Water Treatment, Central Boiler Plant Operation, and Air Conditioning Maintenance and Repair.

Statistical Energy Analysis
July 20–22, University Park
Dr. Gary Koopmann
This course explains how statistical energy analysis can be used to describe complex vibrating systems, thereby simplifying the calculation of response estimates and transfer functions. The course starts with basic statistical energy analysis, then moves to application examples.

Project Management
July 20–22, University Park
Dr. Ravi Ravindran
This course for engineers and other professionals will introduce a collection of concepts and tools for successfully planning, managing, and evaluating projects.

Corrosion Short Course
July 26–31, University Park
Dr. Barbara Shaw
Co-sponsored by the College of Earth and Mineral Sciences, the Penn State Corrosion Center, Gamry Instruments, and Molecular Imaging, this course features morning lectures on corrosion fundamentals and afternoon laboratories on commonly used experiments to assess corrosion.

Rotary Wing Technology
August 10–14, University Park
Dr. Barnes McCormick
This course for engineers presents a comprehensive introduction to rotor craft technology. The well-recognized lecturers will cover: Aerodynamics, Dynamics, Stability and Control, Acoustics, and Structural Design.

1998 Rural Intelligent Transportation Systems Conference
August 30–September 2, University Park
Michael Patten
Presented in cooperation with ITS America, this conference will concentrate on the technical and socioeconomic issues of rural transportation systems. Conference theme: "Enhancing Rural Safety and Mobility."

Advanced HEC-RAS
September 21–25, University Park
Dr. Arthur Miller
Participants are assumed to be familiar with the computer program. Topics: incorporation of GIS data into the model; scour computations at bridges; modeling of hydraulic structures including advanced bridge techniques and culvert design; and a one-day field trip to develop field data.

Advanced Modeling in Applied Computational Electromagnetics
September 28–30, University Park
Presented in conjunction with the Applied Computational Electromagnetics Society, this symposium offers twelve sessions on computational electromagnetics.

Molecular Beam Epitaxy (MBE) Conference
October 4–7, University Park
Dr. David L. Miller
Sponsored by the American Vacuum Society, this conference will cover MBE topics including: advances in growth techniques, hardware, and instrumentation; deposition of new materials; MBE for production; and real-time measurement and control.

Vibration Control
October 13–17, University Park
This short course, for engineers and applied scientists concerned with reducing structural vibrations and their effects, emphasizes principles and physical insights with a minimum of mathematics—to understand new developments and to acquire efficient tools for addressing practical problems.

Smoke School
Fall '98: Sessions in McKeesport, Allentown, & University Park, PA
Vern Irwin
This lecture/laboratory course covers the regulation and behavior of visible emissions (plumes) from industrial processes. Each participant's ability to evaluate plumes will be tested, using a smoke generator. Those who pass will be certified in accordance with EPA Method 9.

1998 Pennsylvania Traffic Engineering and Safety Conference
December, University Park
A statewide conference to improve transportation professionals' skills.

Registration

To register by phone or to request a conference brochure and registration form, call 1-800-PSU-TODAY (1-800-778-8632).

Note: Preregistration is encouraged because the University may cancel or postpone any course or activity due to low enrollment or other unforeseen reasons.

Additional information about these and other engineering conferences can be found on the World Wide Web at the College's Continuing Education Web site:
http://www.engr.psu.edu

You may also contact Engineering Continuing Education directly at: **Phone:** (814) 865-7643
Fax: (814) 865-3969
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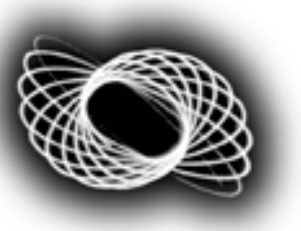

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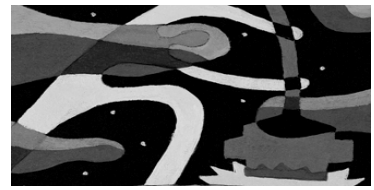


EDITOR'S NOTE:

From time to time, we receive questions about who receives subscriptions to this magazine, so here's the scoop.

Engineering Penn State is mailed to all Penn State College of Engineering alumni for five years after graduation, as well as to all donors to the College, and College graduates who are members of Penn State's Alumni Association. We also mail it to industrial partners, colleagues, and friends.

You can maintain your free "subscription" by making an annual donation to the College of Engineering or by maintaining your Penn State Alumni Association membership—and we encourage you to do both! You may also have *Engineering Penn State* mailed to you free of charge by having your name put on the Engineering College Relations' mailing list. To do so, please e-mail your name and address to Jane Harris at: jharris@engr.psu.edu.

Readers may also find an electronic version of *Engineering Penn State* on the College's Web site under "News & Media" at **http://www.engr.psu.edu**

We look forward to hearing from you, and hope you enjoy reading about the research and activities in the College today.

Lani Clark

Wing it!

—with improved design software

Undergraduate students in aerodynamics at Penn State now get to wing it more often. Thanks to an aerospace engineering graduate student, designing aircraft wings is just a mouse click away.

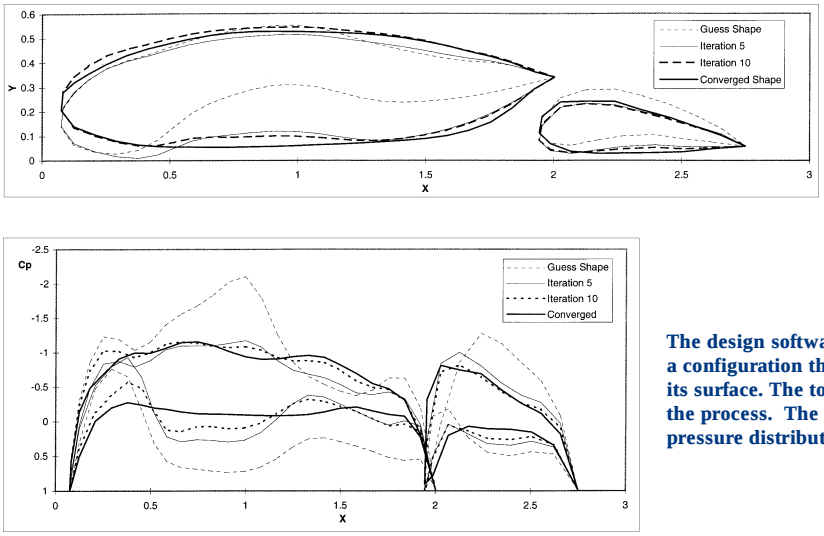
Daniel P. Baker, a graduate student originally from Collegeville, PA, is currently pursuing his master's degree in aerospace engineering. For his undergraduate honors thesis in the University Scholars program, Baker combined his engineering and computer skills to improve wing design software to give students the opportunity to design their own wings.

His work was completed under the guidance of his adviser **George Dulikravich**, associate professor of aerospace engineering, and with funding from a NASA Langley graduate research fellowship facilitated by Dr. John Malone, deputy director of research at NASA's Langley Research Center.

Baker's software program, called Aerodynamic Inverse Design 2D (AID2D), is an extension of a design software package that was originally developed by **Norman Foster** (Aero MS '95), one of Dulikravich's former students. The aerodynamic inverse shape design software runs on IBM personal computers and allows for on-screen drag-and-drop mouse controlled commands.

Currently, students are using AID2D to design airfoil models, two-dimensional representations of wings, as a part of their aerodynamics classes in aerospace and mechanical engineering and in engineering science and mechanics.

"The students are designing airfoils and testing them in given conditions, without ever building the actual airfoil," says Baker. "A typical aerodynamics design problem asks the students to design an airfoil model that will have desired surface pressure distribution when used under the given set of flight conditions."



The design software allows a guessed shape to be modified into a configuration that achieves a desired pressure distribution on its surface. The top screen shows evolution of geometry during the process. The bottom screen shows plots of the surface pressure distributions for the shapes above.

Before this software was developed, the student designer was unable to change the data during the design or see the design.

"Previous airfoil design software was difficult to use because it required large amounts of data about the airfoil and did not display the shape of the airfoil," says Baker. "The designer had to trust that the numerical answer would produce the correct airfoil design."

Another former problem was that the surface pressure on a wing used to be found from a given airfoil shape, but the appropriate airfoil shape that produced desired surface pressure distribution could not be found easily.

Baker's software solves these problems because students now use the graphically interactive AID2D to draw an airfoil shape using the mouse and modify the design by clicking and dragging on the drawing. The computer program then calculates the distribution of surface pressure acting on the wing, modifies the wing shape iteratively, and displays this information and the airfoil shape on the screen.

Dulikravich and his students are currently developing similar software, not only for airplane wing design and optimization, but also for automated aerodynamic design of compressor and turbine rotor blades, magnetically levitated train shapes, and advanced hypersonic cruise missiles.

Baker presented his paper, "A Graphically Interactive Design Environment for Multi-Component Airfoils," at the 36th Aerospace Sciences Meeting and Exhibit in January 1998, in Reno, NV. With the same paper, he won the regional AIAA Student Paper Competition last year. ■

Dr. Dulikravich can be reached at (814) 863-0134 or by e-mail at ft7@psu.edu

—Emily Lorditch (GEOG '98), science writing intern

New center to push digital information to new frontiers

A new center in the College of Engineering will tackle challenges in the transmission, storage, transformation, switching, and networking of digital information.

The Center for Information and Communications Technology Research (CICTR) is headed by **Mohsen Kavehrad**, W.L. Weiss Professor of Electrical Engineering.

"The focus of the ongoing work at CICTR is the design of broadband communications networks with fiber, wireless, twisted-pair copper, and/or coaxial cable access ports enabling telecommunications companies to offer many new broadband services, such as multimedia, to business and residential users," Kavehrad said.

The CICTR, with industrial partners such as Lockheed Martin, Ameritech, TeleBeam, and TRDC, is researching a number of issues facing the communications field:

- broadband access network systems incorporating technologies such as local multipoint distribution system (LMDS) and code-division multiple access (CDMA), which will be used in digital phones and home services;
- the future of both wireless multimedia systems and multidatabase designs, as well as improving the quality of service in mobile computing;
- optical high-speed networking and personal communications systems (PCS); and
- wireless local area networks (LANs) which have a wide range of applications—from ships and airplanes to office environments.

"The explosive growth in Internet applications such as the World Wide Web demonstrates the tremendous increase in bandwidth that the coming world of multimedia interactive applications will require from future networks," Kavehrad said. "This requires new manageable network architectures that are designed to evolve smoothly from today's networks."

The CICTR is supported through memberships of industry and government partners and can be found on the Web at **http://cictr.ee.psu.edu/.**

"The next several years will prove interesting as we wrap up the industrial revolution and the information age rapidly begins. No longer will it be necessary to travel around the world for business meetings or to wait for stock prices that may be hours old. The CICTR is working on the future technologies now," Kavehrad said. ■

Dr. Kavehrad can be reached at (814) 865-7179 or by e-mail at mxk40@psu.edu.

Materials research partnership formed

Penn State, along with four other regional universities, has formed a partnership with PennDOT to create the PennDOT/Academic/Industry Materials Partnership. The five-university consortium, which also includes Lehigh University, Drexel University, the University of Pittsburgh, and Howard University, will conduct materials-related research and development to improve the transportation infrastructure in Pennsylvania. **Paul Tikalsky**, professor of civil and environmental engineering, is the project manager and principal investigator of the $1.4 million cost-sharing research initiative.

Dr. Tikalsky can be reached at (814) 863-5844 or by e-mail at tikalsky@psu.edu.

Elusive micrometeorites may come from dawn of solar system

The year 1998 is quickly proving to be the year of the meteor. Reports of a possible collision with a celestial object in the next century flooded the news last winter, while two major motion pictures about an interstellar collision, "Deep Impact" and "Armageddon," are playing in theaters this summer.

"Earth will be hit by a large object at some point," said **John Mathews**, professor of electrical engineering and director of Penn State's Communications and Space Sciences Laboratory. But Mathews said large objects aren't the only thing the inhabitants of Earth need to think about.

Millions of incredibly old, minute, previously undetected invaders enter the Earth's atmosphere every day and until recently, no one has been able to track, count, or investigate them, Mathews said.

These micrometeorites are so small that even when they disintegrate in the atmosphere, they are presently only recordable at high resolution using the very sensitive 430 megahertz radar system at Arecibo Observatory in Puerto Rico.

"Various radars and radar telescopes have always seen micrometeorites and generally considered them noise," Mathews said. "It has only been with recent technology that we can observe these micrometeorites at extremely high velocity resolution."

One reason to look at meteors is the expected peak of the Leonid Meteor Shower in 1998 and 1999. Both the U.S. Air Force and NASA are concerned with an increase in potential damage to satellites and spacecraft. Historical pictures of the Leonids show a sky painted with multiple meteor trails, indicating that the visible meteors were numerous.

"The worry is potential damage to our space system infrastructure, such as communications, weather, and global positioning satellites," Mathews said. "It's thought that a few satellites have already been damaged or destroyed in orbit by debris."

While Mathews and his collaborators observed the Leonid Shower from Arecibo in 1995 and 1996 and plan to observe the Leonids every year until 2001, observations suggest that these micrometeorites are not part of the cometary debris streams that cause meteor showers.

Using Arecibo's powerful sensors, Mathews and his team were able to plot the orbits of many micrometeorites.

"They're raining in from the outer solar system," he said. "We hypothesize that some of the particles come from the beginning of the solar system."

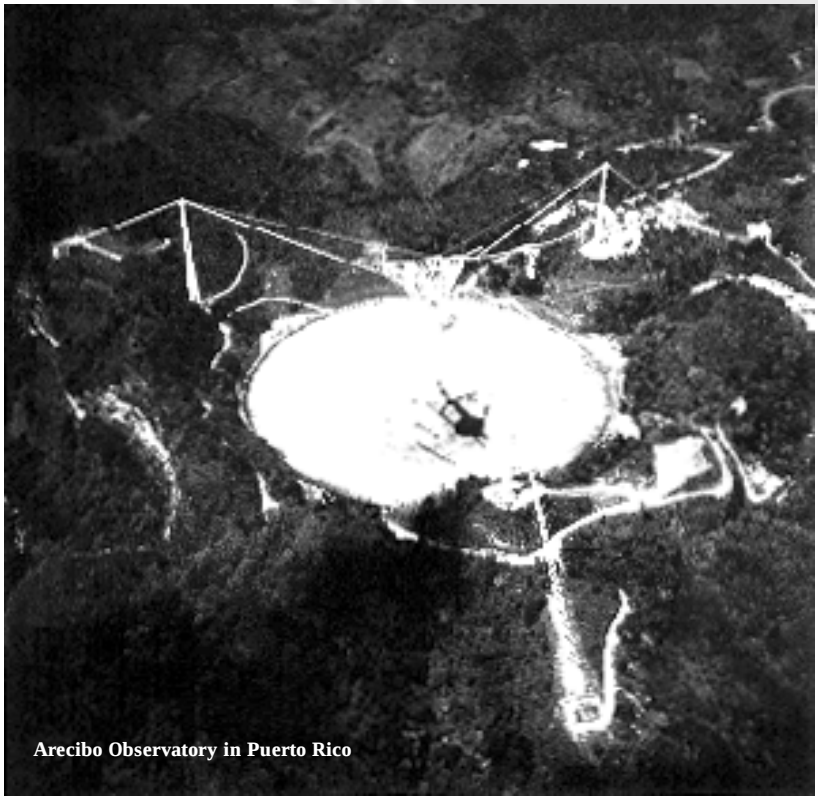
One clue leading to the team's hypothesis is the fact that the micrometeorites' orbits do not come close to the major planets or come from the asteroid belt. Because the micrometeorites' orbits leave the solar system, Mathews believes the particles may have existed since the creation of the solar system but never became part of any planet.

Mathews and his team are also searching for why micrometeorites are visible for a very short time as they enter the planet's atmosphere.

"The interaction between the particles and the air before the particles burn up or disintegrate is very interesting and not understood," Mathews said. "Air molecules numbering only one percent of the molecules in the particles are apparently sufficient to destroy the micrometeorites." ■

—A'ndrea Messer, Curtis Chan

Dr. Mathews can be reached at (814) 865-2354 or by e-mail at jdm9@psu.edu.



Arecibo Observatory in Puerto Rico

Penn State, PennDOT forge $15 million agreement

Penn State and the Pennsylvania Department of Transportation (PennDOT) have signed a five-year, $15 million agreement through which the University's Pennsylvania Transportation Institute (PTI) will conduct research, education, technology transfer, and management programs for the transportation agency.

As part of the contract, PTI will assist PennDOT in assembling and managing focused teams from Penn State and other educational institutions and will serve as administrative manager for PennDOT subcontracts with universities and colleges.

The contract, known as the "University-Based Research, Education and Transportation Program," is under the direction of **James H. Miller**, associate professor of business logistics, Smeal College of Business Administration, and **John M. Mason**, professor of civil engineering and associate dean for research, College of Engineering. Both are PTI affiliates.

Miller said, "We are delighted to formalize, through this contract, what has been a growing relationship between Penn State and PennDOT. It is a recognition of the value that both organizations perceive from our close relationship."

Bradley L. Mallory, secretary of the Pennsylvania Department of Transportation, said, "This cooperative research agreement will provide the vehicle that will move technology from university classrooms and laboratories onto Pennsylvania's roads, railways, rivers, and airways. The academic heritage and world-class researchers at these institutions of higher education will help PennDOT build a new Pennsylvania."

"Transportation is an increasingly important link to the Commonwealth's ability to compete in international markets. Penn State and the other educational institutions that work with us will support the state's economic interests by delivering research and educational programs that will increase the safety and mobility of our road and transit systems." Mason said.

"We will be developing mechanisms to access the best ideas and the best people, for example, to offer training on best practices for road maintenance and improving highway safety. We'll be identifying researchers to study the application of advanced technologies in surface transportation, sustaining a cost-effective infrastructure, and new construction material analysis."

Currently, teams are being formed involving personnel from Bucknell, Drexel, Cheyney, Lafayette, Lehigh, University of Pittsburgh, University of Pennsylvania, Villanova, and West Virginia University, as well as Penn State, to investigate applications of advanced technologies to commercial vehicle transportation, guide rail testing, development of advanced training for PennDOT professionals, and other projects.

PTI, led by Director **Bohdan Kulakowski**, is celebrating its thirtieth year of operation in 1998. It has provided broad-based idea development, research, and formal and informal education, including selective and focused in-house training, for PennDOT throughout those thirty years. Over the past five years, through a series of contracts with PennDOT, PTI has worked to strengthen and build the transportation agency's partnerships with colleges and universities throughout the nation. PTI's response last year to PennDOT's request for proposals for the University-based Research, Education and Technology Transfer Program led to the current contract.

PTI's affiliated programs and centers include the Bus Testing and Research Center, the Center for Intelligent Transportation Systems (CITRANS), the Crash Safety Research Center, the Pennsylvania Local Roads Program-LTAP, the Mid-Atlantic Universities Transportation Center (MAUTC), and the Northeast Center of Excellence for Pavement Technology.

Until his recent appointment as associate dean, Mason served as director of PTI's Transportation Operations Program and of the CITRANS. Miller is current director of MAUTC, which is a five-university consortium and one of fourteen centers in the nationwide University Transportation Centers Program (UTCP). Since 1990 MAUTC has served as the national clearinghouse for the UTCP. ■

—Barbara Hale

Artful engineering—stretching the definition of technology

What would you do if a sculpture in a museum moved as you walked past?

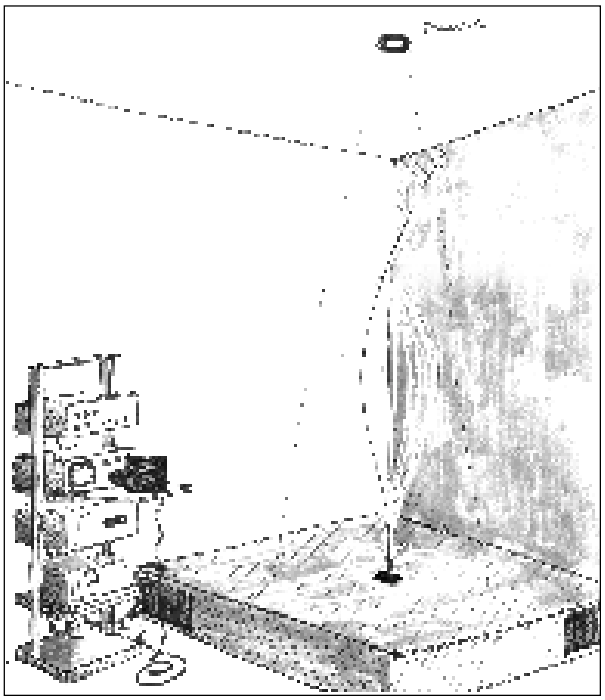
Visitors at an engineering lab in the basement of Hammond Building faced that reality recently, as a slender, seven-foot fiberglass rod seemed to come to life, twitching and wiggling in the air, and making sounds as they passed. Once the spectators realized, however, that they were causing the activity, they stopped to play, explore, and experiment to see just how their movements became translated into motion and sound.

Joe Cusumano, associate professor of engineering science and mechanics, and his students have been developing such kinetic sculptures to illustrate abstract scientific and technological concepts to the general public.

"Engineers and scientists don't do a good enough job of tackling the challenge of explaining the theory behind new products we develop," Cusumano says. "Everyone focuses on the hardware, or 'product' if you will, but behind new products are years of experimentation and abstract theorizing."

In the system described above, the flexible rod moves when excited by ultrasonic motion sensors which pick up movements as people pass. The movements cause the sensors to create a variety of vibration patterns (in the form of voltages), which are amplified and translated by a linear actuator into different motions of the rod. Sounds are simultaneously generated by strain gauges at its base.

Developed by Cusumano and his graduate student, **John Zolock** (EMch MS '97), this sculpture is but one of the intriguing projects from *Vis Viva**, an experimental collaboration between art and engineering designed to explore the boundary between the two seemingly disparate fields.



Cusumano's illustration for a publicly displayed kinetic sculpture, consisting of a single fiberglass rod about 10' high, and driven by an actuator hidden in the base. Wave forms are projected in real time onto the base from a projector in the ceiling, and sounds would come from speakers in the base corners (right side of illustration was cropped). Sensors, amplifiers, and video camera are on the rack to the left.

About *Vis Viva*

Cusumano, and **Tim Jackson**, new media coordinator at Penn State's Center for Academic Computing, formed *Vis Viva* in 1995 to design and build engineered "art systems" that blur conventional distinctions between science, art, and technology. Their projects range from paintings that change with varying light levels to machines that draw.

"The purpose of the systems we make is to create multi-sensory experiences for the viewer," Cusumano says. "We are looking beyond an 'Oh wow!' experience though—we want people to see, hear, and interact with objects that will educate them about a complex technological event or idea: about how sensors and actuators work together to create motion, for example, or about basic principles and concepts of nonlinear dynamics."

Many ideas for *Vis Viva* projects have been explored in Art 497, Experiments in Art and Engineering, a studio art course developed and taught by Jackson.

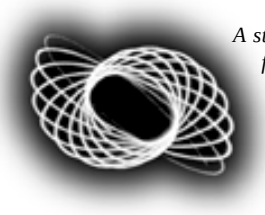
**Vis Viva* is Latin for "living force" and is the name given by the 17th-century philosopher and mathematician Gottfried Wilhelm Leibniz to what later became known as kinetic energy.

Undergraduate honors thesis students in the Department of Engineering Science & Mechanics have developed *Vis Viva* projects as well. Because much of the *Vis Viva* experimentation takes place along side more conventional, funded engineering research, there has also been considerable interaction with, and input from, graduate students working in Cusumano's nonlinear dynamics laboratory.

Taking it to the public

In the summer of 1997, Cusumano was awarded an Osher Fellowship at San Francisco's Exploratorium, a museum of art, science, and human perception. Because of his work with *Vis Viva* and his expertise in mechanics and nonlinear dynamics, the Exploratorium asked him to help them create publicly-accessible displays of complex and chaotic phenomena.

Cusumano created another kinetic installation, this time consisting of two chaotically vibrating aluminum beams. As the beams fluttered and occasionally collided, they created an ambient sound environment that filled a portion of the cavernous museum, attracting



A still image captured from the projected video of a kinetic sculpture showing the dynamics of a whirling rod.

curious onlookers. Viewers would then see wave forms, representing the positions and velocities of the beams, projected in real time onto a large viewing area approximately ten feet on a side behind the sculpture.

"I wanted to create a large-scale oscilloscope without all the knobs," Cusumano says. "The mathematical idea of state space is central to modern dynamics, and I wanted to convey some idea about how dynamicists relate this abstraction, as represented by the projected wave forms, to actual, physical dynamical systems. The wave forms provide a graphical representation, rather than mathematical formulas, for the museum audience—people who haven't had calculus, let alone two semesters of differential equations!"

Student involvement has been an integral part of *Vis Viva*. At the Exploratorium, Cusumano was accompanied by an undergraduate honors student and senior thesis advisee, **Mary Andrews** (ESci '97), and Zolock. In addition to their other duties, Andrews and Zolock worked with high-school-age student interns at the museum, and were given rave reviews by the museum staff, both for their teaching abilities and for their efficacy as role models for kids thinking of careers in science or engineering.

Vis Viva has exhibited a number of other works throughout the country. Exhibitions of luminous paintings and "drawing systems" have been held at Inventure Place, the National Inventors' Hall of Fame in Akron, OH, and the Bellevue Art Museum in Seattle, WA. Currently, two drawing machines developed by Jackson and associate Ron Avillion, a State College sculptor, are now on exhibit at the Icehouse Gallery in Phoenix, AZ. Additional exhibitions are being planned for Chicago, New Orleans, and New York City.

"It is through exhibitions at museums and galleries that we have the potential to make the biggest impact," Cusumano explains. "This is our 'service' work for Penn State's mission—helping to educate the public through these interactive displays. We want to stretch peoples' minds, to have them think about and experience phenomena they might otherwise not encounter. At the same time, our work encourages people to think about the humanistic and cultural components of science and technology." ■

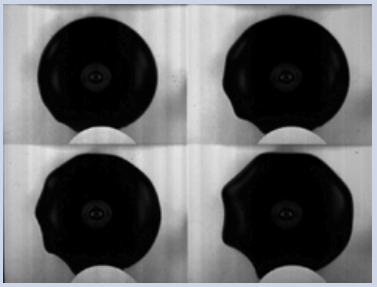
—Lani Clark

Joe Cusumano can be reached at (814) 865-3179 or by e-mail at jpc@crash.esm.psu.edu.

In the laboratory

The researchers in Cusumano's laboratory use ideas from nonlinear dynamics, a general mathematical theory used to describe and analyze processes which evolve over time, to model a variety of phenomena, ranging from standing waves in high-speed tires, to the flow of groundwater, to the stability of human locomotion.

Cusumano explains: "In my lab we are primarily concerned with taking ideas from dynamical systems theory and seeing how they can be applied to real experimental systems. We use the theory to both develop new experimental techniques and to formulate explanatory models which capture all essential phenomena, but which are as simple as possible."



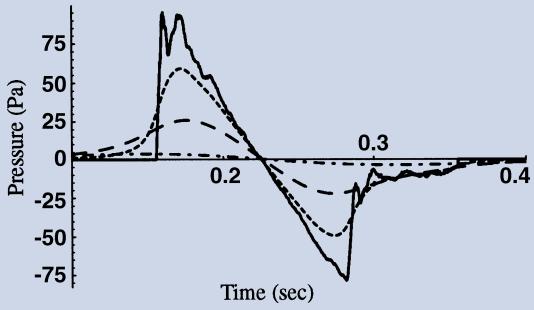
This sequence of photos shows the development of a standing wave in a tire as it passes a critical speed. The researchers in the nonlinear dynamics lab learned the cause of the standing wave and how to suppress it, making higher speeds possible.

Sound waves—
new methods simulate sonic boom ocean penetration

There is significant interest in developing an American supersonic transport (SST) airplane to fly over the Pacific beginning early in the next century, like the SST Concorde has been doing successfully for twenty years over the Atlantic. Such a plane would cut the length of flights from the United States to the Far East from twelve or thirteen hours to four or five, a most desirable goal for frequent business flyers.

However, as these planes fly faster than the speed of sound, they "drag" behind them a fifty- to seventy-mile-wide shock wave—the "boom" you hear as the plane passes. This continual shock wave will be dragged across the Pacific with them each time they fly. How much of the sound generated by such shock waves enters the water and how far does it penetrate? Is it loud enough to harm or annoy marine life, particularly the whales and other mammals which dwell near the ocean's surface?

No one knew these answers until several Penn State graduate students and their adviser, **Victor W. Sparrow**, associate professor of acoustics, developed computational techniques for simulating the interaction between sonic booms and the ocean. And in a wonderful stroke of luck last summer, their simulations were confirmed as accurate.



Waveforms calculated underwater from a surface-measured F-15 double-peaked wave at varying ocean depths. The solid line = 0 meters; short dashes = 4m; long dashes = 16m; and dash/dot line = 64m. The horizontal axis is time in seconds, the vertical axis is pressure in pascals.

SST passenger flight

Judy Rochat, an acoustics doctoral candidate, and Sparrow developed a simulation technique to compute the penetrating sonic boom noise for both simple and complex ocean surfaces, corresponding to calm and rough seas. Using their new technique, called a *finite difference method*, they found that a complex wavy ocean surface only slightly augments the underwater noise from a sonic boom. That is, wave peaks in rough water might increase the penetrating sound pressures by 5 to 7% over a flat calm sea—an increase that is not significant on a decibel scale.

They developed a second complementary technique, the *boundary element method*, to simulate the amount of noise that will be heard at differing depths. This showed that the faster the plane was flying, the deeper the noise from the sonic boom would penetrate the water. They also were

able to determine that the millions of air bubbles near the ocean surface would not affect the sound levels at all.

In a case of discovery favoring the prepared mind, Sparrow heard a report last summer from a Canadian research team that was measuring ambient ocean noise as part of a project unrelated to his. A supersonic aircraft just happened to pass overhead as they were taking underwater measurements. The noise produced by the aircraft was an annoyance to the Canadians but a gift to Sparrow and Rochat: They were able to confirm that the simulations developed through their computational techniques closely match actual ocean observations.

Sparrow says, "One would have had to spend millions of research dollars to arrange an expedition to make the underwater sonic boom recordings that the Canadian researchers got by chance."

In the Classroom

Vic Sparrow has created a new graduate course for the Graduate Program in Acoustics since he's been at Penn State on computational acoustics, and greatly revised another on nonlinear acoustics. Computational acoustics is taken by most acoustics grad students because of its importance for future employment, and is offered through the summer program in acoustics as well.

According to *The Journal of the Acoustical Society of America*, (the proceedings of the 131st ASA annual meeting, 1996) Penn State's course in computational acoustics is "perhaps the first such course in the United States."

Supersonic military maneuvers

The sonic boom that Rochat investigated is a relatively simple shock wave known as an N wave because of its shape. It is formed when a plane flies in a fairly straight line, like a passenger plane, faster than the speed of sound. Entirely different shock waves form from military fighter planes as they practice maneuvers at supersonic speeds, speeds faster than the speed of sound. The waves are more complex and behave differently.

A second graduate student, **Tracie Ferguson** (Acous MS '97), who is now working for Boeing, studied the penetration of complex shock waves into the ocean. She developed a computational technique for predicting the underwater noise signatures from these complex shock waves. Her work showed that the sonic booms from fighter plane maneuvers will penetrate the water to a greater extent than the more simple N-wave shocks.

Answering sponsors' questions

"What we've learned from these projects," said Sparrow, "is that the whales and marine life hear the noise from supersonic airplanes, but it is not loud enough to harm them. Where whale behavior has been studied as part of some other acoustical studies, researchers saw that the whales were curious about new sounds, swam over to investigate their source, then went on their way.

"Tracie's work, however, shows that biologists and environmentalists need to study the impact of the sounds generated by the complex shock waves from supersonic fighter plane maneuvers. These complex shock waves penetrate the ocean much farther and more loudly than the N waves. We've provided them the tools they'll need for additional assessment."

Using these new computational tools, engineers will be able to tell aircraft designers what whales and fish will hear before new planes are built. As a result, the aircraft designers and manufacturers should be able to minimize effects in the range that the biologists indicate may be problematic for marine life.

"We have completed our work on this project," Sparrow adds. "We've answered the sponsors' questions—and that is a good feeling."

—Barbara Hale, Lani Clark

This research was supported, in part, by grants from the National Aeronautics and Space Administration Langley Research Center and the United States Air Force Materiel Command. Additional information can be found on the Web at: ***http://www.acs.psu.edu***

Dr. Sparrow can be reached at (814) 865-3162 or by e-mail at sparrow@helmholtz.acs.psu.edu

Logging on to learning—technological advances give distance education new direction

Distance education isn't a new concept by any stretch of the imagination. For years, students have turned their homes and offices into their own private classrooms, taking courses through correspondence. Penn State has remained a pioneer in this field, offering one of the nation's first correspondence study programs as early as 1892.

Leaps in technology are changing the way distance education students learn. A new initiative called Penn State's World Campus propels the traditional correspondence course into the information age. Some of the University's most popular undergraduate, graduate, and continuing professional education programs are becoming available through the World Wide Web, computer conferencing, video, and other media.

One of the first programs in the World Campus curriculum is the Noise Control Engineering Program, a noncredit certificate program from the College of Engineering's Graduate Program in Acoustics.

The Noise Control Engineering Program, whose development was funded in part by the Alfred P. Sloan Foundation, is aimed at preparing engineers to pass the Institute of Noise Control Engineering (INCE) certification exam, said **Courtney B. Burroughs**, associate professor of acoustics and senior research associate at the Applied Research Laboratory, who is serving as the lead faculty member for the program.

"The Sloan Foundation gave us the seed money to develop an interactive way of learning," Burroughs said.

To deliver noise control engineering to students in far away places, he said curriculum developers turned to some of the latest technological advances, including multimedia, electronic mail, and the Internet.

High-tech learning

Four eighteen-week courses make up the noise control engineering curriculum. Burroughs said the program uses a combination of independent study and collaborative, interactive learning experiences. He said each course requires teams of three to five students to complete group assignments, which they can do via the Internet.

The Noise Control Engineering Program allows students to learn as a group in a "virtual learning community" while letting them study independently. Unlike correspondence courses which can be taken at any time, registration for classes in the program is offered on a periodic basis, similar to the way a course is offered on a semester-by-semester basis on campus. Because students work collaboratively on projects, they must complete the course according to an eighteen-week schedule but can study and do work at their discretion.

Burroughs said, "It's the first time we've done something that is asynchronous. It used to be we had to get students to a central place off campus to participate in a video conference. But now, the students are all over the country. They don't have to be at the same place at the same time."

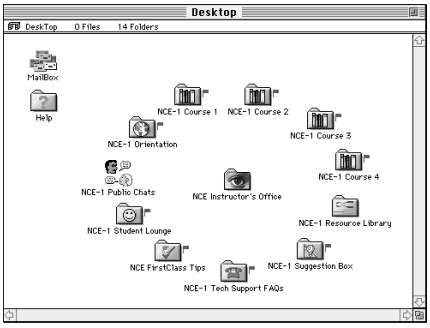
"These courses are group based. Traditional distance education courses

are individual and independent learning," said **Thomas Iwinski**, an instructional designer with the Center for Academic Computing (CAC). "Here they're not learning in isolation, but in a community. The students go through the schedule and work with each other."

To accomplish this, the Noise Control Engineering Program relies on SoftArc's FirstClass communications software. FirstClass offers e-mail, computer conferencing, real-time text chat, and file transfer protocol (FTP) capabilities, said **Bill Rose**, an instructional designer for Distance Education.

Rose said that students new to noise control engineering go through an orientation using a videotape followed by print-based tutorials, where they are introduced to the software and curriculum setup.

Using FirstClass, students enter the virtual learning environment. On the screen desktop, an icon for the instructor's office sits in the center surrounded by a dozen other icons, including ones for lessons, public chatrooms, technical support, and even a resource library equipped with handy items such as a calendar, key equations, and mathematical conversion factors.



A student's view of the FirstClass desktop. Each icon represents a computer conference that meets a particular communication need within the course.

The desktop also has a mailbox for e-mail and a help section.

Students simply use the computer's mouse and click their way through the units within each lesson folder. Students working on a particular unit have the ability to talk to one another through conferencing where they can post questions, answers, and suggestions to each other.

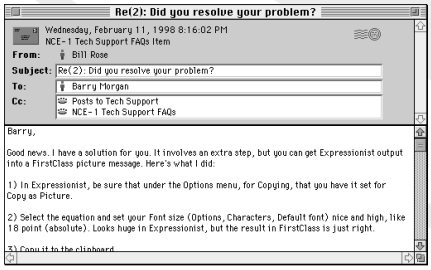
"FirstClass allows us to page through threads of discussions that begin with original messages, followed by the replies, and the reply to those replies," Rose said. "It's the learning community idea in action."

Rose said the e-mail, chat, and conferencing capabilities support a great deal of student-to-student and student-to-instructor interaction.

"I spend as much time one-on-one with students in this program as I do in the normal classroom," Burroughs said. "I'm enjoying the relations that I've developed with the students and watching the interaction that goes on between the students."

Giving students sights and sounds

The creation of the Noise Control Engineering Program began simply with



Here, a student gets an answer to a technical support question.

the College's acoustics faculty members writing lessons for the program's curriculum. Animations were then created by **Victor Sparrow**, associate professor of acoustics, with interactive animations constructed by **Andy Mayers**, instructor in the College of Engineering. Then Iwinski combined the animations, sounds, and digital photographs with lessons on a CD-ROM.

"We stitched all the different pieces together," Iwinski said. "It is a very complex project since the material is mathematically dependent."

Iwinski said the greatest challenge was combining the many facets of the program, including the individual learning activities, interactive features, and graphics. The addition of sound and video files in the program gives it an additional dimension that traditional classroom lectures may lack.

"They can see and hear the results of their work," Iwinski said. For example, students can use the computer to manipulate sound files or combine graphs.

Virtual instruments

To successfully offer a program in noise control engineering, the curriculum designers needed to create a method where students could learn course material without having access to expensive equipment normally found in a class laboratory.

To solve this dilemma, **Gerald Lauchle**, professor of acoustics, and research assistant **Dean Capone** created an interactive virtual sound-level meter that could be incorporated into the course.

"We needed a virtual sound-level

Continued on next page

meter that could be put on the CD-ROM and used," Lauchle said. He said the computerized version of the instrument is nearly identical to the real thing.

Capone used LabVIEW, a graphical programming language, to simulate the real thing. The virtual sound-level meter had to meet strict criteria to be considered effective.

"There's a national standard for sound-level meters we had to meet," Capone said. "which has a long list of requirements that outlines what a sound-level meter must do."

Building a sound-level meter on the computer rather than a real one also presented some unique challenges.

"We had to convert equations into software rather than into circuits," Capone said.

The computer version of the sound-level meter is identical to the real thing, and comes packaged with the course materials on the CD-ROM.

"We can use this LabVIEW-based meter to simulate experiments," Burroughs said. He added that other instruments, such as a spectral analyzer will also be created so that students can perform a wide variety of virtual measurements that will supplement the overall learning experience.

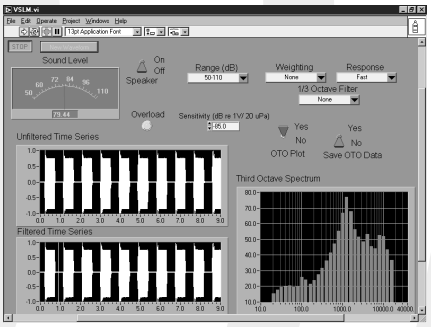
Launching the program

The initial Noise Control Engineering Program course, Basic Noise and Vibration Control, started in February 1998 with a class of ten students.

"At first, I was not sure if this type arrangement would work for me," said **Mike Bahtiarian** (ME '85), who works for a consulting engineering firm and was one of the first to enroll in the program. "However, to take this type of course on-site would require a great commitment of time and money.

"I enrolled in the program to augment my professional 'on-the-job education.' I am hoping this course will fill in the gaps and give me additional theory behind the engineering I perform every day."

Burroughs agreed, saying that the program creates a cost-effective way of on-the-job training without having to send employees away to get educated. He said the first noise control engineering course will be offered again in August, while the second of the four courses, Intermediate Noise and Vibration Control, will have its debut offering in January 1999.



User interface of the interactive virtual sound-level meter.

"The students are really enthusiastic about this," Rose said. "A student in Seattle was well aware of Penn State's reputation in noise control engineering. She was excited to be a Penn State student while living in Seattle!"

While calling students to check software and systems compatibility, Rose said he has heard many similar compliments.

"It is great to hear someone say, 'You're making a huge difference in my life.'" ■

Dr. Burroughs can be reached at (814) 863-3015 or by e-mail at cbb2@psu.edu. More information on the Noise Control Engineering Program can be found on the World Wide Web at http://www.worldcampus.psu.edu, by calling (800) 252-3592, or by e-mail at psuwd@psu.edu.

Penn State's World Campus

The World Campus makes some of Penn State's most highly regarded graduate and continuing professional education programs available "anytime, anywhere" through the World Wide Web, e-mail, and other computer-based technologies. On-line professional development programs for engineers are available in:

- Reliability Engineering
- Engineering Electromagnetics
- Fundamentals of Engineering
- Noise Control Engineering
- Power System Analysis

The courses are developed and taught by Penn State College of Engineering faculty.

For the most up-to-date information about engineering programs offered through the World Campus, visit: **http://www.worldcampus.psu.edu**, or e-mail: psuwd@psu.edu.

Campaign Committee members support graduate students

Three College of Engineering Campaign Committee members have pledged more than $700,000 to endow graduate fellowships, Dean David Wormley announced this spring. The three gifts to the University's forthcoming campaign were received from **James E. Marley**, committee chair, **Fred A. Breidenbach**, and **Frank Gabron**, and their families.

"These commitments from our Campaign Committee members will profoundly enhance the College," said Wormley. "Endowed fellowships for our graduate students will help make us much more competitive in attracting our nation's top engineers to Penn State. The generosity and leadership of our campaign volunteers are extraordinary demonstrations of support for Penn State, and we greatly appreciate all that they do for the College of Engineering."

James E. Marley, Chairman of the Board of AMP Incorporated, and his wife Judy pledged $500,000 for the James E. and Judy A. Marley Graduate Fellowship in Engineering. Their fellowship is designated to recognize and support outstanding graduate students who have been admitted to the College of Engineering.

Jim is a 1957 aerospace engineering alumnus, a 1985 Outstanding Engineering Alumnus, a 1994 Penn State Distinguished Alumnus, and Engineering's 1993 Honorary Lecturer. Judy graduated from Penn State Harrisburg with a bachelor's degree in humanities in 1992 and is the owner of Crumbs & Company, a retailer of cookies and cookie jars. The Marleys have generously supported the College in the past, have three adult children, and reside in the Harrisburg area.

Frank Gabron and his wife, Mildred, have donated more than $107,500 for the Gabron Family Graduate Fellowship in Mechanical Engineering to honor the memory of Professor **George M. Dusinberre**. Dusinberre was a professor of mechanical engineering from 1948 to 1960, and was

Gabron's friend and mentor. First preference for this fellowship shall be given to students who intend to pursue a career in industry and are interested in the field of heat transfer.

Frank earned a master's degree in mechanical engineering from Penn State in 1955. Retired as chairman of the Helix Technology Corporation, Frank is a 1987 Outstanding Engineering Alumnus and a 1989 Penn State Alumni Fellow. In addition, he was awarded the PSES Distinguished Service Award in 1991 when he served as the College's Keen Professor of Entrepreneurship in Engineering. Prior to this current graduate fellowship, the Gabrons established two undergraduate scholarships and another graduate fellowship in the College of Engineering. Mildred is an alumna of Lasell College. The Gabrons live in Hollis, New Hampshire, and have one son.

Fred Breidenbach and his wife have established the Fred A. and Susan Breidenbach Graduate Fellowship in Engineering to support and recognize students exhibiting academic excellence in the College of Engineering. Like other University endowed fellowships, the Breidenbachs' pledge of $100,000 will be invested, with a portion of the income used annually to support graduate engineering students.

Fred is a 1968 industrial engineering graduate and also earned an M.B.A. from Xavier University in Cincinnati. He spent 25 years in General Electric's engine and aerospace sectors, starting as a management trainee and spending his last five years

as a GE officer. In 1993 he joined Gulfstream Aerospace Corporation as the President and Chief Operating Officer, and in 1997 established his own consulting company. He is on the Board of Directors of Kaman Corporation and was named a 1991 Outstanding Engineering Alumnus. Susan is a 1969 alumna of Millersville State University and taught Spanish and French prior to raising the couple's two sons. The Breidenbachs live in Hilton Head, South Carolina. ■

Need-based fellowship in electrical engineering

A Penn State electrical engineer and retired business owner and his wife recently pledged $100,000 to endow the Luther B. and Patricia A Brown Graduate Fellowship. The fellowship will provide funds for graduate students in electrical engineering who need help meeting school expenses.

Luther Brown is a 1959 electrical engineering graduate who worked in industry for several years before forming his own company. He and Patricia are lifetime members of the Alumni Association and enjoy sailing, traveling, and Nittany Lion football games. They have three grown children, one of whom, Tim, is a Penn State alumnus and engineering professor in Colorado. Tim encouraged the Browns to establish the fellowship. In his experiences with his students, he's found that graduate students have a harder time finding funds for their education than undergrads. ■

Penn State ranks last among the Big Ten universities in the number of graduate fellowships funded from central university sources. Increasing the College's funds for graduate student support through endowed fellowships is one of the goals of the upcoming capital campaign.

Joe Paterno presented McMurtry with an autographed football at his retirement, saying, "There's an awful lot of people who think the world of you George. I'm delighted that you will now have more time to help me with the football team!"

"It's been a really great ride…"

George J. McMurtry, associate dean emeritus for administration and planning and professor emeritus of electrical engineering, retired in March after more than thirty years at Penn State.

McMurtry served the College of Engineering as associate dean for eighteen years, working under five deans—starting in 1980 with Nunzio J. Palladino, through Wilbur L. Meier, John A. Brighton, Carl Wolgemuth (acting), to the current Dean David N. Wormley. He also served as acting dean of engineering in 1987-88, prior to the appointment of John Brighton.

"I couldn't have asked for a better group of deans," he said in an interview in March. Each one contributed very significantly to the growth and reputation of this College. I've enjoyed my relationship with them and have been proud to have served them."

McMurtry's biggest challenges, he said, have involved allocating the space fairly to meet the needs of the growing faculty and adapting to and providing computing capabilities for the College.

"It's been a really great ride, because the College has changed so much since 1980 when I joined the administration. In addition to Engineering's physical growth, its professional reputation has grown, so that today we are truly recognized as a major national force in engineering education.

"I find it especially satisfying that we have been able to balance this growth—that our graduate and research programs have grown and improved along with undergraduate education. We have worked hard to maintain quality in all three areas.

"I don't think it is often that you can be part of a growing organization like this and be able to feel the satisfaction of the growth—*as it happens*. It is a wonderful feeling to be able to recognize it as it's happening, rather than looking back and thinking, 'Hey, that was good!'"

"Our alumni have made a positive difference in my job and in the College," he said, reflecting on his years at Penn State. "Their professional contributions have significantly enhanced the College's reputation. In addition, my wife Margaret and I often remarked what a privilege it's been to meet our College's Distinguished Alumni and Outstanding Engineering Alumni. These graduates are prominent and extremely successful people, who represent our College and University well. A common thread among all of them is that they are genuinely nice people—and this says a lot for the College, I think."

McMurtry has a long history of service both to the University and the State College community. He was honored with the 1984 University-wide Barash Award for his nineteen years of coaching local baseball teams from the pee-wee level through the American Legion league, eighteen years of State College School Board service—six as president, and ten years' work for the local United Way.

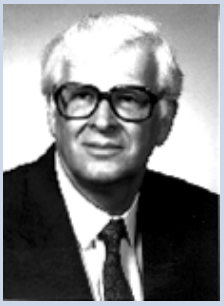
McMurtry received his B.S. from the U.S. Naval Academy, served four years in the Navy before entering graduate school, and retired from the Naval Reserve with the rank of Commander. He earned a master's from Notre Dame and a doctorate from Purdue, both in electrical engineering. He worked as a project engineer in General Electric's Electronics Laboratory for several years before coming to Penn State in 1967. ■

Did you know…

- Penn State ranks 4th in the nation: "Most Efficient National Universities" (providing a quality education while spending relatively less)
- Penn State ranks 7th in the nation: "Best Undergraduate Engineering Programs" among public universities
- Penn State ranks 9th in the nation: "Top Graduate Schools of Engineering" among public universities

Source: *U.S. News & World Report*, 1998

Duda elected to National Academy of Engineering



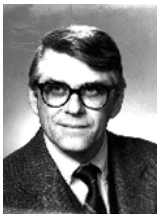
J. Larry Duda, professor and head of the Department of Chemical Engineering, was elected to membership in the prestigious National Academy of Engineering (NAE) this year. He was selected for this honor for his research on molecular transport in polymers and on tribology, and for leadership in engineering education.

Election to membership in the NAE is among the highest of the professional distinctions that can be accorded an engineer. Academy membership honors those who have made "important contributions to engineering theory and practice," and who have demonstrated "unusual accomplishment in the pioneering of new and developing fields of technology." Membership in the NAE totals 1,941 U.S. citizens and 155 foreign associates.

Two professors honored with "distinguished" rank

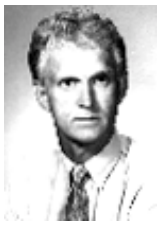
Gary H. Koopmann and John M. Tarbell were selected to receive the title of distinguished professor, University President Graham Spanier announced in March.

"We award the 'distinguished' title to a very limited number of outstanding professors in each college," Spanier said, "in recognition of their exceptional records of teaching, research, and service to Penn State. Our University's stature and reputation are enhanced by the presence of these faculty, and we commend their dedication and commitment."



Gary H. Koopmann, distinguished professor of mechanical engineering and director of the Center for Acoustics and Vibration, is a man of remarkable depth and breadth. His undergraduate students rate him highly for his mentoring and commitment, and his graduate students are in exceptional demand by industry and academia for their excellent training and skills.

Koopmann is well-known internationally for his pioneering research in noise control and acoustics which has made a substantial impact across numerous technologies. A distinguishing character of his research is his unique ability to formulate and apply new acoustic theories to engineering problems. His service to the College, University, and community shows a deep concern for others through his support of diversity, internationalization, and world peace.



John M. Tarbell, distinguished professor of chemical engineering, has provided important and valuable service at all levels of the University for more than twenty years. He teaches several difficult core undergraduate chemical engineering courses, and students consider him one of the department's top teachers.

Tarbell's biomedical research in fluid mechanics problems associated with blood flow places him among the top investigators in the United States in this field. He is known internationally for his work in blood flow turbulence and cell damage associated with artificial hearts, experimental biofluid dynamics, and arterial mass transport. He recently received a Whitaker Foundation Award to establish a graduate program in Biomolecular Transport Dynamics. ■

Larry Burton named associate dean

Larry C. Burton, professor and head of electrical engineering, was appointed associate dean for administration and planning for the College of Engineering effective April 1.

As associate dean for administration and planning, Burton is responsible for budget and finance, human resources, space and facilities, computing, and strategic planning for the College of Engineering.

Burton has served as the head of Penn State's Department of Electrical Engineering since 1990. Before coming to Penn State, he held faculty positions at Texas Tech, the University of Delaware, and Virginia Tech. Burton also has extensive industrial and consulting experience, and worked for companies such as Leeds & Northrup Co. and Ford Motor Co.

Burton received his Ph.D. in physics from Penn State and his B.A. and M.A. in physics from Temple University. He is vice president of the National Engineering Department Heads Association and holds memberships in the Institute of Electrical and Electronics Engineers (IEEE) and the American Society for Engineering Education (ASEE). His research interests include semiconductor devices and electronic ceramics. ■

Johnson wins two national awards

Saundra D. Johnson (CE '86) director of the College of Engineering's Minority Engineering Program (MEP), received the Golden Torch Award from the National Society of Black Engineers for MEP Director of the Year. This is the first year the Golden Torch Award has been given; it recognizes the accomplishments of distinguished African-American engineers and technical professionals.

Johnson also received the award for Outstanding Contribution by Minority Program Administrator from the National Association of Minority Engineering Program Administrators. This award recognizes individuals who have made exemplary contributions to the minority engineering effort.

"Two words describe the results of Saundra's considerable talents and industrious efforts: collaboration and community," said **Robert N. Pangborn**, associate dean for undergraduate studies. "Her uniqueness lies in her ability to work with others—her colleagues, industrial and alumni partners, students, and faculty—and to assemble the resources, energy, and good ideas to achieve her goals."

Johnson has served as the College's director of MEP since February 1994. Before coming to Penn State, Johnson worked as an engineer for Bechtel Power Corporation.

"Through her dedicated efforts, a very positive climate has been created for underrepresented students which has directly led to positive results in increasing numbers of underrepresented students in the profession," said Engineering Dean **David N. Wormley**. "Students have frequently said that her advice and counsel, encouragement, and recommendations have been instrumental in their success and entering the engineering field."

Saundra Johnson can be reached at (814) 865-7138 or by e-mail at sdjdo@engr.psu.edu.

1998 PSES faculty and staff awards

These awards are given annually to honor outstanding teaching, research, advising, and service in our College. Award recipients were nominated by their respective departments and selected by colleagues and representatives from the Penn State Engineering Society (PSES), an alumni constituent organization and sponsor of the awards program.

Outstanding Research
- David A. Edwards, associate professor of chemical engineering
- Jerzy Ruzyllo, professor of electrical engineering
- Bernhard R. Tittmann, Schell Professor of engineering science and mechanics
- Robert C. Voigt, professor of industrial and manufacturing engineering

Premier Research
- Randall M. German, Brush Chair Professor of engineering science and mechanics

Outstanding Advising
- John M. Cimbala, professor of mechanical engineering
- Lee D. Coraor, associate professor of computer science and engineering
- Arya Ebrahimpour, associate professor of engineering, Delaware County Campus
- John Sokol, associate professor of engineering, Fayette Campus
- William Thompson, Jr., professor of engineering science and mechanics

Outstanding Teaching
- Eric R. Marsh, assistant professor of mechanical engineering
- James Rehg, assistant professor of engineering, Altoona College
- Dhushy Sathianathan, associate professor of engineering design and graphics
- Jeffrey L. Schiano, assistant professor of electrical engineering
- Pingjuan Werner, assistant professor of engineering, DuBois Campus

Premier Teaching
- Paul H. Cohen, professor of industrial and manufacturing engineering
- Gita Talmage, associate professor of mechanical engineering

Staff Award
- Nancy L. Boal, staff assistant VIII, Civil and Environmental Engineering
- Francine Cauffman, staff assistant VIII, Electrical Engineering
- Sheila L. Corl, staff assistant VIII, Aerospace Engineering

Distinguished Service Award
- Warren F. Witzig, professor and head emeritus of nuclear engineering

Lawrence Perez Memorial Student Advocate Award
- Peter J. Shull, assistant professor of engineering, Altoona College

*Additional information about these faculty and staff award winners can be found at **http://www.engr.psu.edu** under News and Media, News Releases.*

President's Perspective

by Susan Schall

Wow! Two years have flown by fast. It seems only yesterday that **Tom Bathgate** (AE '70) passed the PSES leadership gavel to me. PSES has accomplished much during the last two years:

- We endowed both the PSES Faculty and Staff Awards and the PSES Undergraduate Student Scholarship with the proceeds from the PSES Annual Golf Classic.
- We participated in the planning and celebration of the College's Centennial with an Alumni College Week, the burial of a time capsule, dedication of Lake Perez at Stone Valley, and a commemorative coin and history book.
- We welcomed five new department heads and several new faculty to the College of Engineering.
- And, we gave out two Student Leadership Awards to graduating seniors who contributed significantly to service organizations at University Park and in the State College community.

Our work is not done, however. The faculty, staff, and students of the College of Engineering need our continued involvement and support. Faculty need alumni guest lecturers, case studies, and industry design projects. Students need mentoring, job networking, and co-op placements. Student professional organizations need practicing engineers as speakers, panelists, facilitators, and sponsors.

Over the years, PSES has brought alumni, faculty, and students together to meet these needs. We have done this with the active involvement of alumni like you. Please pick up the phone and call Cindy Jones at (814) 865-9031 to get involved today. I believe you will find, as I have, that it is very rewarding.

On June 5th, I turned the PSES leadership gavel over to **Tom Skibinski** (CE '76). Tom has been an active member of PSES since 1990, serving on the Student Recruitment Committee. In 1993, he was elected to the Society's Board of Directors. Tom is Vice President of Civil/Environmental Engineering at Quad Three Group, Inc. in Wilkes-Barre, PA. He earned his master's in business administration from the University of Scranton. Tom is also a member of Penn State's Alumni Council. Congratulations Tom!

On a personal note, I would like to thank the Board of Directors for the opportunity to lead such an outstanding group of Penn State Engineers. I would also like to thank Cindy Jones and the College staff for all the behind-the-scenes work they do to help pull everything together.

I hope to see you soon at Penn State!

Susan O. Schall

PSES

The Penn State Engineering Society is the alumni advisory arm of the Penn State College of Engineering.

PSES means:

- Interaction with students, faculty, and engineering alumni.
- Awareness of and support for meeting the academic and professional needs of students.
- Active involvement with the College and the University.

A note to recent graduates:
You are now a member of PSES! We welcome your participation, so please call me to find out how to stay involved with the College of Engineering.

For more information, contact:
PSES
c/o Cindy Jones,
e-mail: cjjdo@engr.psu.edu
101 Hammond Building
University Park, PA 16802
Tel: (814) 865-9031
Fax: (814) 863-4749

Thanks, Susan

The PSES Board of Directors, committee members, and College of Engineering staff wish to thank **Susan Schall** for her dedication and service to the Engineering Society.

As president, vice president, and an active member of several committees, she has contributed countless hours of her time and energy to implementing new programs and activities for PSES.

During her tenure the Student Service Award has become a reality, new Affiliate Program Groups have been initiated, the Constitution has been revised, and the committee structure has been revitalized.

The good news is we're not saying "goodbye" to Susan. In her role for the next two years as immediate past president, we know that Susan will continue to be an active Board member. And, she will continue to be a vital participant in the Society for many years.

So, it is not "goodbye," but "thanks," Susan, for your hard work and your enthusiastic involvement in PSES, the Industrial Engineering department, and the College of Engineering. ■

PSES supports students for service and scholarship

For the second year, the PSES Award Selection Committee has chosen a recipient of the PSES Student Leadership Award. The 1998 award winner was **Jason Spiegler**, a senior in mechanical engineering from Richboro, PA.

Jason was chosen for his exemplary leadership and service accomplishments such as:

- co-founder of Engineering Leadership Development Unlimited (ELDU), which involves Leadershape®, Engineering Action Center projects, a speaker series, and scholarships;
- a member of the Engineering Undergraduate Student Advisory Committee, and the Executive Steering Committee of the Engineering Leadership Development Minor (EDLM);
- and his representation of Penn State in a Johnson & Johnson (McNeil Consumer Products Company) diversity project.

Jason, a member of the Skull & Bones Honor Society, studied abroad in Todi, Italy, in 1995.

A special recognition plaque and $500 cash award was presented to Jason before the May 1998 graduation ceremonies at Penn State.

The PSES Award Selection Committee was composed of **Susan Schall**, **Tom Skibinski**, **Will Kresge**, **Dick Bloss,** and student member, **Marie Yingling**.

At the PSES Board meeting in June, members approved the newly established **PSES Endowed Student Scholarship.** This scholarship, made possible by proceeds from the annual PSES Golf Classic, will reward engineering students for scholastic achievement and provide needed financial assistance. The endowment, which will continue in perpetuity, will use a portion of the annually-accrued interest to help qualified students pursue their dreams of earning an engineering degree at Penn State.

We encourage all alumni who wish to help deserving students to direct their annual giving to this Scholarship so the endowment will continue to grow. Please do so by specifying "PSES Student Scholarship Endowment" on a check or pledge form. ■

6th Annual PSES Golf Classic—mark your calendars now!

The 6th Annual PSES Golf Classic will be held Saturday, September 26, 1998, at the Penn State Blue Course. Tee-off is at 9 a.m. All proceeds will benefit the PSES Endowed Student Scholarship.

The Golf Classic will be held the day after the fall PSES Board and Committee meetings, so why not make it a long weekend at University Park? Come to the meeting on Friday, September 25, and join other alumni for a day of service and interaction with the College; then stay over for the golf tournament and a delicious barbecue lunch. It's a scramble format, so novice golfers are welcome!

Check our website at **http://www.engr.psu.edu/www/coe/alumni/golf.stm** for more information! ■

Special congratulations

The Electrical Engineering Affiliate Program Group (APG) was awarded the 1998 APG Achievement Award by the Penn State Alumni Association. The award was presented during the Alumni Council meetings in April and was given in recognition of the group's outstanding programs and alumni involvement. Congratulations to President **Mark Wharton** (EE '71) and to all the active members of SPSEE! ■

Thanks and happy retirement, Don!

Don Ruth has been a member of the PSES Board of Directors since 1992. He is known for his near-perfect attendance at meetings, and for his diligence in tackling any and all Board activities, from revising the Constitution to establishing a new, endowed student scholarship.

Don is a person we could always count on to complete any assigned task with care and diligence. He will be missed!

Don and his wife, Thelma, plan to retire soon and, perhaps, find a new home away from Pennsylvania. We wish both of them a long and happy retirement. ■

1998 Alumni Calendar of Events

July 8-12
Central PA Festival of the Arts
August 8
Summer Commencement
September 5
Home football game—SOUTHERN MISSISSIPPI
September 12
Home football game—BOWLING GREEN
September 25
PSES Board and Committee meetings
September 26
PSES 6th Annual Golf Classic, PSU Blue Course
October 17
Home football game—PURDUE
October 20-22
Industrial and Professional Advisory Council (IPAC)
October 31
Home football game—ILLINOIS
November 14
Home football game—NORTHWESTERN
November 28
Home football game—MICHIGAN STATE

In Memoriam

Byron L. Camp (EE '31) died October 18, 1997, from complications caused by a fall. Retired as head of the IBM testing laboratory in Chapel Hill, NC, Camp was a resident of Bainbridge Island, WA.

Harold Stanley Seip (EE '47) recently passed away. Retired from Bell Communications in Livingston, NJ, Seip is survived by his wife, Lucille, and two children, Linda and Brad.

Aeronautics expert **Mary L. Ilgen** (Aero '48) of Cypress, CA, died October 8, 1997. She was 70. The PA native's fervor for flying machines began at an early age. At age 16, Ilgen was installing radio equipment on World War II combat planes. One year later, she enrolled in Penn State's aeronautical engineering program and became the department's first female graduate.

Her grasp of aircraft technology earned Ilgen deep respect from both faculty and fellow students, who gave her an honorary membership in Tau Beta Pi, a traditionally male national engineering honor society. Shortly after graduating, Ilgen began her career at the Douglas Aircraft Company (now McDonnell-Douglas, a division of Boeing) in Santa Monica, CA. There, she made major contributions to the design and development of Douglas' DC-model airplanes—some of the world's most common passenger and cargo aircraft. A McDonnell-Douglas press release in response to Ilgen's death said, "She became one of a few elite members of our industry who made our current jet age possible."

Ilgen retired as principal staff engineer in 1991. A life member of the Alumni Association, Ilgen was named a Distinguished Alumna in 1971 and received the Outstanding Engineering Alumni Award in 1988. She also was a member of the College's Industrial and Professional Advisory Council for six years. Among her survivors is her sister, Sara Ilgen Treftz (SCI '52) who studied pre-med at Penn State. In a 1990 *Penn Stater* article about entering the workforce, Ilgen was asked what quality she looked for when hiring new employees. Having transformed a previously male-dominated industry, Ilgen responded, "I look for people to be capable of growing." ■

—by Jason McGarvey (LAS '97) *The Penn Stater Magazine*, January/February 1998, reprinted with permission.

Alumni Online

Get connected!

Who? Alumni volunteers with Engineering faculty and students

Why? The College students, faculty, and staff need your expertise

When? At your convenience

Where? At Penn State or your job/home location

What? Speak to student groups
Instruct a class
Provide design project case studies
Advise a student design team
Mentor a student (by e-mail or phone)
Host a student at your job site
Host a group tour of your company
Recruit high school students
Hire co-ops or interns
Seek faculty for research partnerships
Speak to faculty groups
Be a contact for relocating alumni

How? Register on-line, or contact Terri Russillo

Intrigued? Learn more at **http://www.engr.psu.edu/alumnionline**

Alumni On-Line
Terri L. Russillo, Program Manager
243 Hammond Building
University Park, PA 16802-1401
Phone: (724) 443-2791 or (814) 863-1032
Fax: (724) 443-2268
E-mail: tlruss@engr.psu.edu

Class Notes

1950s

Bernard P. Miller (Aero '50), special assistant to the president for Lockheed Martin Telecommunications, retired in March 1998 after serving Lockheed and its predecessor company for more than 29 years. Miller's plans for retirement include consulting work in satellite communications.

Robert M. Tinstman (AE '50) is director emeritus of Austin Crime Stoppers, Inc. In September 1997, the group joined forces with local law enforcement in releasing an aggressive new effort to deter criminals in the Austin, TX, area: the Rapid Reaction Reward and Special Strike. "These two new concepts should take advantage of public awareness and focus attention on criminal acts that have unusual significance to the people of Austin and Travis County," states Tinstman.

1960s

A. Barry Seymour (CE '66) was recently promoted to general partner at Black and Veatch, a global engineering/construction firm. Seymour, based in the firm's Detroit, MI, office, is the northeast regional manager, infrastructure business, responsible for client relations, project performance, fiscal management and business development for four environmental offices in a 14-state region. Seymour and his wife, Barbara, are the parents of Douglas and Jennifer.

James M. Rebel (Aero '67) is assistant program executive officer (tactical aircraft) for systems engineering at the Naval Air Systems Command (NAVAIR). As part of the base realignment and closure process, NAVAIR was recently moved from Arlington, VA, to St. Mary's County, MD. He lives in Alexandria, VA.

1970s

David J. Meyer (ME '78), along with three partners, has formed Pathfinder Engineers LLP, an engineering/architecture firm specializing in mechanicals and mechanical engineering, energy management services, and facilities architecture to industry. A certified women-owned business enterprise, the firm is located in Rochester, NY.

1980s

Henry W. Hudson IV (AE '80) is senior vice president of marketing and business development at Bala Consulting Engineers of Wynnewood, PA. Hudson is responsible for directing marketing and sales at Bala's Philadelphia and Princeton offices. With 20 years of local and national experience in the design and construction industry, Hudson was formerly vice president at Bovis Construction Corporation in Philadelphia. He holds an MBA from Villanova and resides in Wayne, PA, with his wife and two children.

Mark D. Weidhaas (BCET Harrisburg '83) and his father, **Ernest R. Weidhaas**, professor emeritus of engineering graphics at Penn State, wrote the seventh edition of *Residential Architecture: Design and Drafting*, published by Delmar Publishers of Albany, NY.

Ann Kyper Reynolds (AgE '84) is staff engineer with CET Engineering Services, based at the firm's Huntingdon, PA office. Reynolds recently received her professional engineer certification.

Joe Jackovitz (ME '86) is on a two-year assignment as senior project engineer for Mack Trucks in Brisbane, Australia. Jackovitz's responsibilities include the introduction of North American products into the Australian market place.

Eileen M. Collins (CE '88) married Robert Pauletta in December 1997. Collins Pauletta manages the incident management section in the newly-created ITS division at PennDOT's Bureau of Highway Safety and Traffic Engineering, Central Office.

Gregory L. Leonard (ME '88) is senior mechanical engineer with Respironics, Inc. Leonard and his wife, Stacey, are the parents of Samuel Everett. The family resides in Oakmont, PA.

1990s

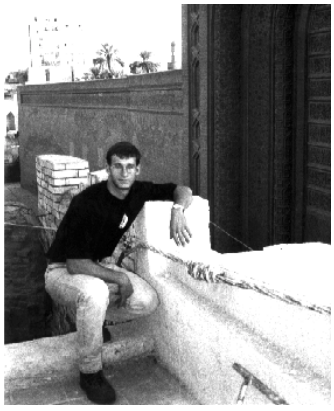
Duane Harnish (EE '90) is senior software product engineer for Fisher-Rosemount Systems. Harnish and his wife, **Jennifer Kuehne Harnish** (LIB '88), reside in Austin, TX.

Amy Litwiler (IE '92) was named Engineer of the Year by the Broome County Chapter of the New York State Society of Professional Engineers. A senior industrial engineer with Corning, Inc., she is active with the Society of Women Engineers and is president of the local chapter of the Institute of Industrial Engineers. Litwiler spends a great deal of time promoting the field of engineering to young people and to the community.

James Weber (AE '94) is a construction project engineer for the Dick Corporation. In October 1997, Weber married Rebecca Spencer (BUS '93), a systems analyst with AT&T. The Webers live in Pittsburgh.

Rashid Bell (ChemE '94) married Tanisha Agee in March 1998. Bell is a technical engineer with Procter & Gamble and resides in Maryland.

Tales from Iraq



LT. Justin D. Wolf (ME '95), 24, U.S. Air Force, is one of the youngest U.N. inspectors in Iraq. The son of a grain farmer and a nurse in southern PA, he turned down West Point at the suggestion of his older brother, a pilot, and opted for the Air Force Reserve Officers Training Corps. Originally stationed at Hill Air Force Base in Utah, he heard about UNSCOM and, he says, beat down the doors to get in. Last fall he put together a team to inspect ten percent of Iraq's missiles at random and to verify that they had not been altered to extend their range. He assumes that his hotel room in Baghdad is bugged but says he has been "treated like gold by Iraqi citizens." His only ugly encounter took place when he tried to photograph the guitar players at a Baghdad restaurant. "Haven't you taken enough pictures of Iraq?" an irate customer demanded. But Wolf, still single, cheerfully admits that he also is treated with suspicion back in New York when the subject of his job comes up. Women invariably ask, "Now *really*, what do you do?"

—reprinted with permission from *U.S. News & World Report*, February 9, 1998

1998 Outstanding Engineering Award Winners

Since 1966 the Penn State Outstanding Engineering Alumni Awards have honored 181 engineering graduates who have reached exceptional levels of professional achievement. We congratulate them on their expertise, achievements, and success; and value their example, dedication, and loyalty.

This year's Outstanding Engineering Alumni are (seated from left):

William H. Colwill (ME MS '72, PhD '75)
Vice President for Marketing, American Hydro Corporation

John J. Brennan (NucE MS '65)
Chairman and CEO, ICT Group Inc.

Joseph J. Wisnewski, FAIA, P.E. (ArchE '69)
President, Wisnewski Blair and Associates, Ltd.

Janet B. Cunningham, P.E. (CE '80)
President and CEO, JBC Associates, Inc.

John H. Hollenbach (ChE '78)
Strategic Planning Advisor, Exxon Company, International

Harry L. Bell (EE '48)
Retired Assistant Division Manager, Hughes Aircraft Company

John C. McKeown (Aersp '65)
Deputy Head, Aircraft Systems Engineering, U.S. Naval Air Systems Command

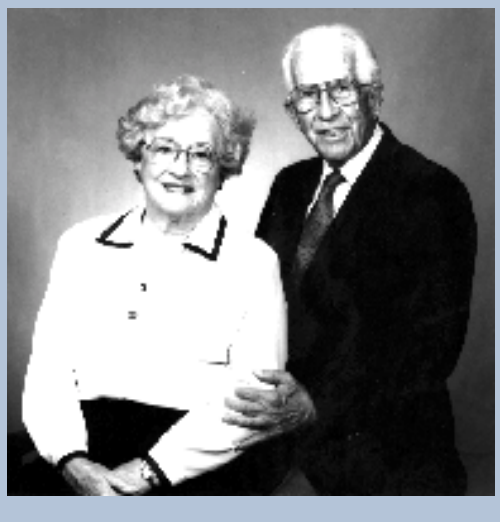
Standing:

Dean David N. Wormley

Harold J. Marcus (IE '49)
President, American Villages, Inc., Hal Marcus, Inc.

Larry E. Kittelberger (CSci '70)
Vice President and Chief Information Officer, AlliedSignal Inc.

David M. Brewer (ESci '59)
Retired Vice President, Compatible Systems, Amdahl Corporation



We are delighted to thank William E. (EE '36) and Wyllis Leonhard for their extraordinary commitments to the College of Engineering for the coming Capital Campaign, which total $6,313,767. The Leonhards have the distinction of being the number one donors for this College, and their level of giving creates a benchmark of philanthropy for the future.

Steel structure connects with students

It's the gift that keeps on giving.

Two groups of engineering students, one studying concrete and the other studying structures, combined their efforts to erect a steel connection structure behind Sackett Building this spring.

Using steel donated by Milton Steel, Inc., of Milton, PA, students in **Paul Tikalsky**'s Concrete and Aggregates (CE 482) class designed and built the foundation for the steel connection structure, while students in **Jeff Laman**'s three steel structures courses erected the structure.

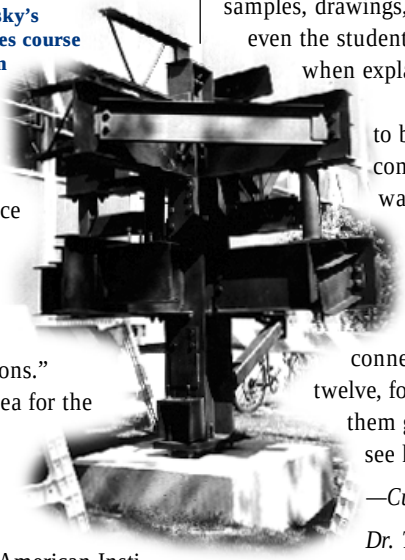
The construction of the sculpture gave the students valuable experience in civil engineering and teamwork, said Tikalsky, an associate professor of civil engineering.

"They're learning on a full-scale structure that isn't critical to our infrastructure like a building or bridge," he said. "The learning experience is in designing, planning, and constructing a building component, while still in school. The critical item is that the seniors will need to make sure the bolt holes are exactly where they need to be within a hundredth of an inch. If they locate the bolts incorrectly, the structure won't fit."

Meanwhile, Laman's students prepared the raw steel, by sandblasting, priming, and painting, before erecting the structure.

Laman, an assistant professor in civil engineering, said the structure will continue to serve as a learning tool long after the students who originally put it together have left the University. Laman said the steel connection structure will be an integral part of the way he teaches students how steel buildings are put together.

"It illustrates about forty commonly found connections in steel building design," he said. "Part of the importance in having students understand connections is that the vast majority of failures occur at the connections."



Students in Paul Tikalsky's Concrete and Aggregates course work on the foundation for the steel connection sculpture behind Sackett Building.

Laman said the idea for the structure, which was dedicated on May 7, came from an article published in "Steel Education" from the American Institute of Steel Construction that featured a similar structure at another university. He said about twenty-five universities around the country use steel connection structures to help teach students.

"I thought, 'Penn State needs one of these,'" he said. Laman then turned to officials at Milton Steel. "They decided it was something they could do using just scrap from other jobs."

Laman said he is often limited in what he can show students in a classroom. Frequently, he has to rely on samples, drawings, transparencies, or even the students' imaginations when explaining connections.

"I want my students to be thinking about connections when they walk past it every day. It's a much more effective learning experience to assign them to analyze connection number twelve, for example, and let them go out, feel it, and see how it works." ■

—Curtis Chan

Dr. Tikalsky can be reached at (814) 863-5615 or by e-mail at tikalsky@psu.edu.
Dr. Laman can be reached at (814) 863-0523 or by e-mail at jlaman@psu.edu.

The steel connection sculpture, which was dedicated on May 7, waits for its finishing touches in late April.

Park Forest Middle School students built and tested bridges made of recycled materials during a day-long program led by MEP and WEP undergraduates in April. After having lunch on campus, the group also toured the Breazeale Reactor and hit the Creamery for a cone before heading home.

Civil engineering student takes different road to success

While most Penn State students begin their undergraduate careers at University Park or a Commonwealth location, **Martha Gross** (CE '98) started her Penn State studies in Germany.

Martha's father, an Air Force officer, was sent to Germany in 1992 when Martha was fourteen. The family was used to moving wherever the service assigned him, and when the order came to go to Germany, Martha, who had always wanted to go overseas, was ecstatic.

Rather than attending high school on the military post, Martha and her older brother chose home schooling through correspondence courses sponsored by their old high school in the United States.

Jeff Laman, assistant professor of civil engineering, and Martha discuss the load sensors in the pendulum used for impact tests.

"We were learning things like calculus and differential equations without a teacher," Martha recalled.

Traditionally, children of American servicemen overseas return to the U.S. for college after graduating from high school. But Martha wanted to stay in Stuttgart with her family and began her undergraduate studies through independent learning.

"What was attractive about Penn State is that the distance education program courses on the transcript are the same as if you took the course in the classroom," she said. Martha said many other institutions considered distance education courses as inferior to classes offered in a traditional classroom environment. In fact, some schools she had considered attending refused to transfer credits she earned through Penn State's distance education courses.

Beginning during her time in Germany, she took fourteen courses through the University's distance education program, including English, calculus, differential equations, chemistry, engineering mechanics, and music. In addition, Martha is one of the first Penn State students to receive scholarship money for independent studies.

"My brother and I were pursuing this as a real college program," she said.

Taking courses through independent learning is not as easy as it sounds, Martha said. Self-discipline was one of the first lessons she learned in her independent learning career.

"It took me several months to realize that no one would set my deadlines for me," she recalled.

At the end of her first year, Martha began looking at colleges to attend that would accept the credits she earned through Penn State. **Jerry Goff**, coordinator of advising and promotional projects for the University's Department of Distance Education, convinced Martha to visit Penn State during the Engineering Open House in April 1995.

"That was the first time I stepped foot on the Penn State campus," she said. "But the visit pretty much made up my mind."

Martha entered Penn State as a sophomore University Scholar and was later accepted into the Integrated Undergraduate-Graduate Degree program, which allows her to use some of the same credits for her bachelor's and master's degrees. Martha has accumulated numerous honors including memberships in Tau Beta Pi, Chi Epsilon, and Phi Kappa Phi honor societies. In addition to being appointed to Penn State's Civil and Environmental Engineering Student Advisory Council, she is a student member of the American Society of Civil Engineers and the American Concrete Institute.

Martha was the civil engineering department's student marshal at graduation in May, and has won a student Fulbright grant to pursue a master's degree in civil engineering. She will return to Germany in the fall to study at the University of Stuttgart and plans to learn more about bridge rehabilitation through research in the field of structural concrete.

Many U.S. roads and bridges have aged to the point where they will soon need to be rebuilt, she said. In Germany she expects to learn much from the country's internationally acclaimed research in structural analysis and material science, major components of America's much-needed infrastructure rehabilitation effort. Martha plans to return to Penn State in the spring 2000 semester to complete her degree.

"I'm looking forward to both the cultural and educational experiences coming up in Germany," she said. "Ever since I left Stuttgart in 1995, I've wanted to return." ■

—Curtis Chan

Trying to bridge the gap

Snap! Crackle! Pop!
Those were the agonizing sounds of tiny wooden bridges relenting under pressure during a bridge building contest sponsored by the Envisioneers engineering student group.

On a quiet February Saturday afternoon in the Kunkle Activities Center, students and faculty took on the challenge of constructing a bridge to reunite the fictional town of Shady Gulf, a tiny hamlet with the misfortune of being divided by a deep gorge.

The goal of the contest: To build the most efficient foot-long bridge using only glue, fishing line, and popsicle sticks. Efficiency was defined as the ratio between the weight of the maximum load sustained by the bridge and the weight of the bridge itself.

Like true engineers, many of the participants showed up just for the challenge. But others stuck around for an ice cream cone.

"The going rate for a bridge is a Ben & Jerry's ice cream cone," said **Bob Meier**, a mechanical engineering sophomore and the coordinator of the event. He said all the participants received coupons for Ben & Jerry's ice cream cones. "The draw should be the fun and design, but the ice cream cone helps," he laughed.

For more than three hours, people quietly pieced together their spans, the silence occasionally punctured by the "ouch!" of someone burning themselves with the hot glue gun.

What emerged as the finished products came in all shapes and sizes. Some structures looked vaguely familiar, like a bridge we may have crossed on our last trip. Others were outright strange and innovative. When the time came to test the spans, the weights were broken out, the bridges broken down.

As each bridge straddled Shady Gulf's deep gorge, weights were slowly piled on, forcing a creak or groan when structures bent and bowed under the pressure. A final "snap!" was heard before the bridge collapsed, often dragging a model house or tree from Shady Gulf with them into the abyss.

In the end, it was a professor, not a student, who walked away with the top honors.

Doug Schmucker, assistant professor of civil engineering, built a bridge that held 250 lbs. per pound.

Schmucker said he thought being a professional engineer might be a handicap when he started the contest.

"Because I've been a civil engineer for such a long time, I may not think of some of the more creative solutions the students may think of," he said. "A lot of these students did a nice job with their bridges." ■

—Curtis Chan

Participants in a bridge building competition sponsored by the Envisioneers constructed spans from glue, fishing line, and popsicle sticks. The structures were then put to the ultimate test with weights stacked on top.

Engineering student wins Young Scientist Award

Vijayakumar Venugopal, a doctoral candidate in engineering science and mechanics, won a Young Scientist Award from the International Union of Radio Science. In addition to the award, Venugopal was invited to the union's electromagnetic theory symposium in May in Thessaloniki, Greece.

Venugopal's research is under the direction of **Akhlesh Lakhtakia**, professor of engineering science and mechanics, and centers on optical responses of sculptured thin films.

"I'm looking to stay in academia or in a research position," said Venugopal about his career aspirations. "But my first choice would be to look for a faculty position."

Venugopal holds a degree in naval architecture from the Indian Institute of Technology in Madras, India, and an M.S. in engineering science from Penn State. He is the winner of the 1997 Xerox Research Award for research accomplishments by a master's student. Venugopal holds memberships in the Institute of Electrical and Electronics Engineers' Antennas and Propagation Society, the Lasers and Electro-Optics Society, and the American Vacuum Society. ■

The Last Word—
World-Class Engineers

by David N. Wormley, dean

Engineering education will be of significant importance to the country's future in both human and economic terms as we enter the next century. To prepare our graduates for this future, we have made—and are continuing to make—substantial changes in engineering education at Penn State.

Over the past six years, we have evaluated and systematically re-engineered our curriculum with assistance from the National Science Foundation-supported ECSEL coalition of seven universities, and with the assistance of the Leonhard Center for the Enhancement of Engineering Education. As a result of this work, our College has already begun implementing many of the pedagogical changes recommended for large research universities by the Boyer Commission in their report, *Reinventing Undergraduate Education: A Blueprint for America's Research Universities,* released in April.*

The changes we have implemented include: introducing design into the first year; integrating engineering problems into basic mathematics and physics courses; integrating communication skills into the curriculum; and establishing industry-driven capstone design projects in the senior year. These innovations have had a significant influence on our students and their capabilities as they enter the engineering profession, and will provide a strong foundation for us to make additional changes that will be necessary for the curriculum in the future.

Recently ABET, the organization which accredits engineering programs, significantly altered its requirements to accommodate the changes occurring in engineering curricula that are needed to produce students prepared for the global realities of the future.

With the strong support and assistance of the Leonhard Center Advisory Board, we have determined that our engineering curricular objective for the 21st century should be: **To develop graduates who will become world-class engineers**. In the future, we will evaluate and measure the success of our curriculum with respect to its ability to achieve this goal.

A world-class engineer will be:

- Solidly grounded in the fundamentals
- Technically broad
- Versatile
- Effective in group operations
- Customer oriented
- Aware of the world

As we evaluate our curriculum's capacity to develop graduates who have world-class engineer characteristics, it is clear that while we have already accomplished a great deal, there is more to be done.

A paradigm shift is required in which we introduce significant professional and life skills into the curriculum while maintaining an emphasis on fundamental knowledge and key engineering processes. We must educate students more strongly with respect to the questions of, "Why? What is the context? What are the alternatives?" We must more actively engage students in their own educational process, introduce active learning coupled with real-life engineering experiences, and increase students' ability to work in teams and understand

the context of their work. We must increase opportunities for student/faculty contact and explore opportunities to more fully engage industry and alumni in our educational efforts.

Our challenge will be to incorporate these elements into our curriculum *while still making it possible for students to earn a baccalaureate degree in engineering in four years.*

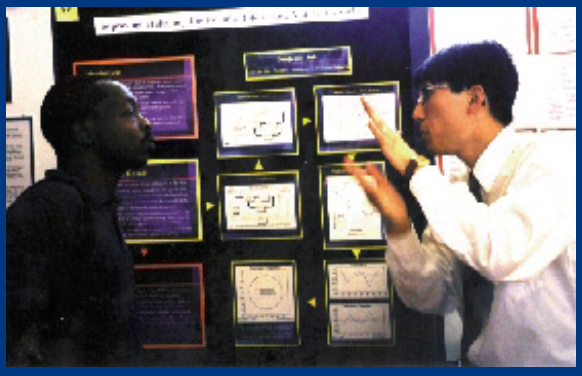
The Boyer Report concludes that research universities, like Penn State,

> *"should turn out graduates who are well on the way to being mature scholars, articulate and adept in the techniques and methods of their chosen fields, ready for the challenges of professional life or advanced graduate study. Research universities have unique capabilities and resources; it is incumbent upon them to equip their graduates to undertake uniquely productive roles."*

To which we add, roles as world-class engineers.

Producing graduates who will become world-class engineers is a formidable task with many dimensions. However, it is one that we undertake eagerly, knowing that our alumni and friends in industry will strongly support our efforts. With all of us working together, we believe that we will, in fact, be able to produce graduates who will be world-class engineers. ■

*The full text of the Boyer Report is available on the Web at **http://notes.cc.sunysb.edu/Pres/boyer.nsf.** Also, a more complete article on the changes in our undergraduate program appeared in the Winter 1998 issue of *Engineering Penn State*, on page 12. This issue can be found on the College's Web site, under News & Media at **http://www.engr.psu.edu**.



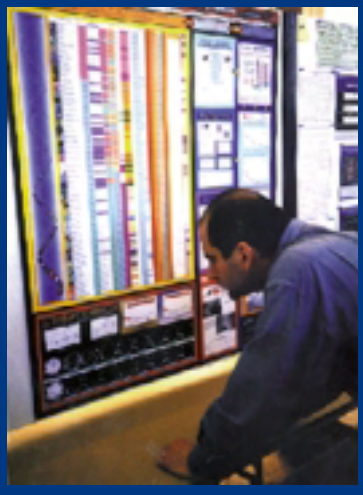


Exhibit spotlights engineering graduate research

More than 150 Penn State graduate students, including 25 engineers, presented their work at the 13th annual Graduate Research Exhibition on March 27-28 in the Hetzel Union Building Ballroom. Engineering topics ranged from evaluating noise produced by tires on pavement to studying the effectiveness of pathogen removal technologies *(pictured, bottom right)*. Dongwook Suh, a doctoral student in mechanical engineering *(pictured, bottom left)*, received an honorable mention for his research on "Improving Trajectory Control of a Robot using Neural Networks."

PENNSTATE

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