$20 Million Campaign for New Building
ECE Calendar 2005

2005 January

21  Purdue on the Road  Seattle, Washington
22  Purdue on the Road  Los Angeles, California

February

4–6  Purdue on the Road  Naples, Florida
24  Homeland Security Panel  West Lafayette, Indiana
    Purdue on the Road  Atlanta, Georgia
25  Distinguished Engineering Alumni Awards  West Lafayette, Indiana
    Purdue on the Road  Dallas, Texas

March

4  Purdue on the Road  Cincinnati, Ohio
5  Purdue on the Road  Detroit, Michigan

April

3  National Rube Goldberg Contest  West Lafayette, Indiana
16–17  Springfest/Gala Weekend  West Lafayette, Indiana
16  Engineering Gala Brunch  West Lafayette, Indiana

May

5  Purdue on the Road  Indianapolis, Indiana
13–15  May Graduation  West Lafayette, Indiana

August

6  August Graduation  West Lafayette, Indiana
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On the Cover:
Exciting plans to increase ECE facilities and infrastructure by 40 percent are under way. Starting with the $20 million Wang Electrical and Computer Engineering Building, to be located in Discovery Park, innovative facilities will set the stage for leading-edge learning and discovery. For more on the bricks-and-mortar phase of a future marked by preeminence, turn to our cover story on page 10.

Cover design: Swapnil Mathkar
On Friday, November 19, the Board of Trustees approved the appointment of Vladimir P. Shalaev as the Robert and Anne Burnett Professor of Electrical and Computer Engineering. Shalaev is among the 102 named or distinguished faculty at Purdue.

“Vladimir Shalaev is a scholar preeminent in his field. He attracts major research grants as well as the very best students and faculty,” says Mark Smith. “Professors such as Shalaev are essential to our strategic plan.”

Shalaev specializes in nano-photonics, nonlinear optics and spectroscopy, mesoscopic physics, quantum electronics, and optoelectronics. He came to Purdue in 2001 from New Mexico State University, where he was the George W. Gardiner Professor of Physics.

He has authored and edited four books, 13 invited book chapters, and more than 200 research papers. He is a Fellow of the American Physical Society, a Fellow of the Optical Society of America, a co-editor of the Elsevier Book series “Advances in Nano-Optics & Nano-Photonics,” co-editor of Applied Physics B-Lasers and Optics, and chair of a topical group of the Optical Society of America’s Optical Science Division.

ECE Programs Move Up in Rankings

U.S. News and World Report 2005 America’s Best Undergraduate Engineering Programs

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“Perfect Lens” Not Possible

Better Imaging Systems Feasible — Emil Venere

Researchers at Purdue University and the Massachusetts Institute of Technology have completed a mathematical analysis showing that it isn’t quite possible to build a so-called “perfect lens,” but the underlying theory still makes it feasible to design better imaging systems.

A perfect lens would be able to focus light more narrowly than conventional lenses, making it possible to etch finer electronic circuits and create more compact and powerful computer chips. Such lenses also might lead to better fiberoptic communications systems and more precise medical imaging technologies.

Researchers have now shown, through rigorous mathematical analysis, that a perfect lens is not possible, says Kevin Webb, a professor of electrical and computer engineering at Purdue.

“It may be possible to build a better imaging system, but it could never be perfect,” says Webb. “That’s the bottom line.”

The findings were detailed in Physical Review E, an online journal published by the American Physical Society. The paper was written by Webb, Purdue engineering doctoral student Ming-Chuan Yang, MIT doctoral student David Ward, and Keith Nelson, a professor of physical chemistry at MIT.
Congratulations to Saurabh Bagchi, Michael Capano, and William Chappell, award winners in Round 6 of the 21st Century Research and Technology Fund. The Fund received 135 proposals this round. Of these, the Fund’s board approved 18 awards totaling $22.4 million. The 21st Century Fund has awarded more than $132 million in grants to 103 projects since its inception in 1999.

Project Title: **Advanced Substrate Design for High-Frequency Systems in a Package**

**Principal Investigator:**
William Chappell (left), Purdue

**Partners:**
Delphi Electronics and Safety
CTS Microelectronics
Omega Wireless Solutions
Nexaura Systems
DuPont Microcircuit Materials
Triangle Park

This project is for the commercialization of high frequency, vertically integrated circuits to create ultra-compact, low-power radios, specifically for the next generation of automotive components such as satellite radio receivers.

“Delphi Electronics has long been the expert in low frequency radios and circuits,” says Chappell, assistant professor of ECE. “Satellite TV and front-looking and rear-looking radar for collision avoidance are part of the emerging generation of technology in the automotive industry. Purdue’s expertise in high-frequency research is filling in Delphi’s skill set.” Chappell continues, “The 21st Century Fund is a non-traditional source of funding used in this case to further advance the outstanding Indiana tradition of innovation in the automotive electronics industry.”

Project Title: **Preparative Mass Spectrometry Using Ion Soft-Landing**

**Principal Investigator:**
John Campbell, Prosolia

**Partners:**
Prosolia • Graham Cooks, Purdue • William Chappell, Purdue • Detector Technologies
Bioanalytical Systems • INCAPS • Inproteo

A new family of mass spectrometers for protein separation, identification, and collection based on ion soft-landing will be developed. The resultant products will meet critical needs in the areas of proteomic research and drug discovery. Commercialization of the technology will lead to increased efficiency and purity in the preparation of biological species that are similar in chemical nature, while maintaining the molecules’ bioactivity.

“This award provides funding to transfer basic advances in mass spectrometry from Purdue to regional chemical companies,” says Chappell. The Purdue portion of the project is predominantly led by the analytical chemistry de-
partment, specifically renowned scientist Graham Cooks. Chappell continues, “The electrical engineering role in this sensor development will be precision fabrication utilizing techniques traditionally used for electronics applications, but applied to the chemical domain.”

Project Title: **Silicon Carbide Electronic Devices for Automotive Systems**

Technical expertise combines with vast commercial markets in this 21st Century Fund project. “Purdue’s role in the partnership is absolutely essential,” says Michael Capano, associate professor of ECE. “We provide the expertise necessary to help Delphi Electronics and Safety in Kokomo realize their business objectives.” The funds will be used to conduct a collaborative study into the feasibility of adapting conventional silicon processing equipment to the high-volume fabrication of silicon carbide (SiC) electronic components for the automotive industry.

“This award provides funding for the transfer of SiC materials and device technology from Purdue to Delphi Electronics and Safety,” says Capano. “Along with this transfer of knowledge, there is the very real prospect that Delphi Electronics and Safety will be able to manufacture SiC parts for automotive systems. New, high-paying jobs in the state would be created to support this activity.”

**Indiana 21st Century Research and Technology Fund Objectives**

- To increase the capacity of Indiana institutions of higher education, Indiana businesses, and Indiana nonprofit corporations and organizations to compete successfully for federal or private research and development funding.

- To stimulate the transfer of research and technology into marketable products.

- To assist with diversifying Indiana’s economy by focusing investment in biomedical research and biotechnology, information technology, and other high technology industry clusters requiring high skill, high wage employees.

- To encourage an environment of innovation and cooperation among universities and businesses to promote research activity.
The combined sewer overflow (CSO) problem is an important challenge facing most major U.S. cities in the Midwest, West Coast, and Northeast. The EPA has mandated that it be rectified, at an estimated expense of $45 billion.

“In these cities, storm and sanitary sewers are connected and get overloaded during storm events,” says Saurabh Bagchi, assistant professor of ECE. “In such cases, the municipalities divert the excess flow into an open stream or river, thereby compromising the water quality and posing a significant public health threat.”

This team plans to develop, deploy, and test a wireless sensor network that can be used to monitor and control CSO events in South Bend.

“This project offers an exciting opportunity to see the technology on RF antennas and robust communication middleware that we have been developing at Purdue being put to use in a harsh physical environment to solve a very real problem,” says Bagchi.
Ray Sokola Stresses Innovation That Matters

ECE Lecture Series Features Outstanding Leaders in Engineering — Mary Lundstrom

On October 14, students, faculty, and members of the general public gathered in Fowler Hall, Stewart Center, to hear Ray Sokola, corporate vice president and chief technology officer of Motorola. Speaking from personal experience, Sokola stressed the importance of perseverance for engineers with visionary ideas. He cited his work that began in the 1970s developing cell phone technology at Motorola as a prime example of the persistence necessary to carry innovation from obscurity to widespread acceptance.

The appreciative audience included students enrolled in ECE 400, the undergraduate seminar. ECE 400 student Nathan Smith says, “Mr. Sokola did a spectacular job communicating the concepts of ‘relevant innovation’ in our field. He gave an enthusiastic, detailed explanation of his extensive patent and hands-on experience with Motorola’s latest-greatest cell phone.”

As Sokola spoke, Smith noted many classmates nodding in agreement. Clearly, Sokola had connected with the ECE students. Smith says, “I left the talk with goose-bumps of excitement about our technical future—and wondering where I could buy one of those phones.”

Tom Talavage, professor and ECE 400 instructor, adds, “The ECE Distinguished Lecture Series provides the opportunity to learn from individuals like Ray Sokola who, through a combination of hard work and intelligent application of knowledge, have achieved the degree of success to which we believe the majority of our students aspire.”

Ray Sokola is corporate vice president and chief technology officer for Motorola’s Integrated Electronic Systems Sector since January 2003. Previously he was senior vice president and general manager of the Telematics Group within Motorola’s Automotive Communications and Electronic Systems business. In this role Sokola was responsible for the evolution of both the technological and business development of the company’s telematics organization.

Sokola also held positions in the Personal Communications Sector, the Ceramic Products Division, and the Components Products Group. He earned 16 patents in radio frequency filtering, three of which earned Patent of the Year at Motorola. Sokola has a bachelor’s degree in electrical engineering from the University of Delaware.
CWSA Holds First Workshop
Leaders Gather to Discuss Wireless Future

The Center for Wireless Systems and Applications (CWSA) is proud to announce its first annual workshop, “Wired for Wireless.” Held on November 18 and 19 at Purdue, the conference enabled leaders in the wireless field from government, industry, and academia to gather to discuss current research and technology trends in wireless systems and their applications. Topics ranged from RF-devices and systems and physical-layer communications to networking issues. Cutting-edge applications included sensor networks, transportation, security, and e-Stadium, a “living lab” in which the latest in wireless technology is deployed for use by football fans in Purdue’s Ross-Ade Stadium.

CWSA builds on Purdue’s existing strengths in engineering, sciences, management, and technology while fostering strong collaboration with industry.

The workshop’s presentations and panel discussions addressed advanced wireless technology, the business case for wireless systems, and government policies that affect the wireless industry. The informal atmosphere encouraged interaction among those attending, from graduate students to industry leaders.

“This workshop brought together all the interesting research being done at Purdue in wireless systems and applications,” says Ed Delp, Silicon Valley Professor of Electrical and Computer Engineering and workshop coordinator. “People attending the workshop had a chance to see how Indiana is part of the large and exciting ‘wireless future.’”

The workshop was sponsored by the interdisciplinary Center for Wireless Systems and Applications. Purdue is investing $7.27 million over five years to establish the center. CWSA builds on Purdue’s existing strengths in engineering, sciences, management, and technology while fostering strong collaboration with industry.
The Philip F. Bagwell Lecture Series was launched on September 8, 2004. The lecture series provides an annual opportunity for the faculty of ECE to gather to recognize their commitment to pioneering scholarship and to celebrate the memory of Bagwell, an associate professor in ECE at the time of his death from cancer in 2002.

Krannert Auditorium was filled to capacity for the series’ inaugural speaker, Nobel Laureate Herbert Kroemer. A professor of electrical and computer engineering and materials at the University of California—Santa Barbara, Kroemer discussed his current research and the future possibilities of negative refraction, an emerging field in electrical engineering and nanotechnology. In 1963, he proposed the concept of the double-heterostructure laser, the central concept in the field of semiconductor lasers. That work led to his Nobel Prize in physics in 2000.

“The thoughtfulness of this event reflected the essence of what Phil was, and was a wonderful way to keep alive all the things he valued most,” says Suneeta Kercood, Bagwell’s widow.

Bagwell Endowed Lectureship Fund Drive

To support the $50,000 Bagwell Endowed Lectureship Fund Drive, please contact Margarita Contreni. Phone her at 765-496-6453 or e-mail mcontreni@purdue.edu for a pledge envelope.

You may also simply specify your intentions in a letter with your donation. Please address it to Phillip F. Bagwell Endowed Lectureship, c/o Margarita Contreni, Purdue University, School of Electrical and Computer Engineering, 465 Northwestern Avenue, West Lafayette, IN 47907-2035.
Integrating photonics with nanotechnology, developing humanoid robot prototypes, and establishing wireless sensor network testbeds are a sampling of a vast array of step-into-the-future discoveries ahead for ECE at Purdue.

“A whole new wave of projects now beginning is about to forever change ECE,” predicts Mark J. T. Smith, ECE head and Michael J. and Katherine R. Birck Professor of Electrical and Computer Engineering. “Pushing the boundaries has been our hallmark since 1888. This century, we’re extending them dramatically.”

Hailed as a new world standard in research and educational facilities, the multi-facility, multi-disciplinary park debuted in 2004, with construction slated to continue throughout the decade.

A $5 million lead gift from Patrick Wang (BSEE ’72, MSEE ’72, HDR ’04) is kicking off the building campaign as ECE moves forward on the bricks-and-mortar phase of a future that will be marked by unparalleled preeminence.

“This new building, which we’re appropriately naming the Wang Electrical and Computer Engineering Building - Discovery Park...
Engineering Building, is one critical component in our steps toward preeminence,” Smith says.

“Attracting top faculty, increasing the number of professors from 70 to 100, and recruiting top-tier students are equally vital parts of the equation,” he says. “It takes each one to achieve the others, and it will take every one of them to reach our goal.”

**A Facility for Preeminent Learning and Discovery**

“This new building will take us to the next level,” says Robert Pierret, ECE professor, who compiled the academic program statement on the new facility. “It’s much more than space, a key consideration. It’s quality, well-configured space.”

One example of the possibilities in ECE’s new, expanded infrastructure: greater opportunities for work in wireless circuits. “New facilities will provide laboratories for fabrication and theoretical analysis of high-frequency circuits and sensors,” says William Chappell, assistant professor in electrical and computer engineering. “Wireless circuits will become ubiquitous, and higher frequencies of operation will be utilized. That will make electromagnetic analysis more important and the practical applications of electromagnetic principles more prevalent. In the new building, we’ll have space to measure antennas and set up wireless sensor network testbeds.”

That’s only the beginning. Another area of great excitement is nanophotonics, which promises to bring revolutionary impact to present-day electronic and optical technologies, says Vladimir Shalaev, Robert and Anne Burnett Professor of Electrical and Computer Engineering. “Our goal is to fully integrate photonics with nanotechnology.” The photon is the ultimate unit of information: unmatched speed and data packaged in a signal of zero mass. “Recent advances now enable us to mount a systematic approach toward full system-level integration,” Shalaev continues. “Bringing new faculty into this area, possible with the new ECE building, is critical for our ultimate success.”

Expanded and enhanced facilities also will be key for C. S. George Lee, ECE professor. His work centers on developing humanoid robots that capture human characteristics such as motor learning and control, and instantiating these characteristics in coordination and control algorithms in the robot. “The many imaginative applications include homeland security tasks—humanoid robots equipped with high-tech sensors performing tasks, such as patrolling airports and sensing poisonous gas—as well as search-and-rescue missions and de-mining operations,” he says. “The new ECE building will provide a collaborative research environment for faculty and students to work on multidisciplined research.”

Joining Lee in enthusiasm for the new building is alumnus Jeff Fisher (BSEE ’80), executive vice president for worldwide sales for NVIDIA. “This is a facility for the future,” he says. “You have to invest in the future. And you have to maintain your investment. We’re making an investment today to see that payoff in the future.”

**Increasing Space by Phases**

Plans are to increase ECE’s space by at least 40 percent within the next several years. That will come with the first phase of the new facility and additional space to become available in the MSEE Building. ECE also will continue to occupy the current EE Building. The new building will be expanded in phases, over time, and ultimately bring most faculty and students together in a single location. The new learning space will include labs with front-facing workstations, lockable storage rooms, video security, and raised floors. Interaction space, upgraded research infrastructure, additional offices, and various centers are also planned. These include an energy sources and systems research complex, a large computer engineering consultation and testing lab, and a center for engineering communications, among others, Pierret says.

“We want to do great things, and this new building will give us the facilities to do them,” he believes.

**Raising Funds by December 2006**

The timeline calls for raising $20 million by December 2006, then proceeding with architectural plans for the new building’s first phase.

For Wang, the new building means an expanded promise. “People throughout the world enjoy the benefits of the education and research being done at Purdue. I hope my gift can help to encourage more international involvement with the university,” he says.

Alumnus Jack Shaw (BSEE ’62, HDR ’98), another enthusiastic supporter of ECE’s drive to the future, believes that maintaining a superior education system is a responsibility alumni should feel for young people, Purdue, and the United States.

“We need to make sure Purdue stays up with the times, even ahead of the times,” Shaw says. “It’s fundamental to teaching our young people what’s important to make our country go forward.”
Patrick Shui Chung Wang’s lifelong passion for Purdue University began when the 17-year-old left China for West Lafayette, Ind., in 1968. The chairman and chief executive officer of Johnson Electric, the world’s largest manufacturer of micro-motors, has been waving the Boilermaker flag ever since, most recently by contributing $5 million for the new Wang Electrical and Computer Engineering Building.

At Purdue, Wang earned both bachelor’s and master’s degrees in electrical engineering in 1972, then headed to his father’s business, the Johnson Electric Group, founded in 1959 to make motors for model race cars. The younger Wang brought along new product and marketing ideas, and soon developed a handheld hairdryer motor for Conair, the company’s first U.S. customer. Four years later, Wang became director of the company, then managing director in 1984 when he listed the company on the Hong Kong Stock Exchange. In 1996, he was named to the top post.

Today, Johnson ships 2.5 million motors a day, with annual revenues topping $37 million. The motors are used in automobile components, home applications, power tools, business equipment and personal products—everything from power windows to hairdryers. The company employs 32,000 at production plants in China, Thailand, Italy, and Mexico, and at engineering centers in China, Italy, Japan, Germany, and the U.S.

Besides the engineering he mastered at Purdue, Wang says he learned valuable interpersonal skills from the diverse student body. “That helped me in my later days in management.” The need for both is especially critical today, he says.

“Skills and connections are the two most critical attributes for the new age,” Wang says. “Purdue has a proud heritage of nurturing highly-skilled human talents in various domains.” Now, with his gift to ECE, he hopes to help the school and alumni connect in renewed ways.
I would like to extend my thanks to you, alumni and friends of the School of Electrical and Computer Engineering, for your generous gifts of time, talent, and financial support. Pledges have reached $76.7 million halfway through our five-year campaign to raise $128.3 million. This represents 60 percent of our goal as part of the Campaign for Purdue. Our goal includes $20 million to construct a world-class ECE facility. So far, we have raised $7.3 million of that amount.

As we strive to reach preeminence, it is gratifying to have so many who are so willing to invest in our future. It is an exciting time in the proud history of our program. It simply would not be possible without you.

Mark J. T. Smith
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Stephen Kaiser
William Kaiser

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Sachin Yadav  
Dale Yagelski  
Yi-Yian Yin & De-Ying Yang  
Evan Yoder  

* Deceased
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Corporate Matching Gifts

**Up to $100**

Bell Industries Incorporated  
Brodd Builders  
Carpet Warehouse  
Chicago Nuclear Corporation  
D S Enterprises  
Dance at Fun Acres  
Dayton Foundation  
Depository Incorporated  
Depot Annex/Gift & Hobby Electronics Shop  
J & J Management Consultants LLC  
Jarrett Real Estate  
LRH Enterprises, Incorporated  
Pilotcon  
PRT Incorporated  
Quickspace Technologies Incorporated  
R & J Enterprises  
R & S Welding & Fabricating Incorporated  
Redwood Financial Group  
Sigma Delta Consulting, Incorporated  
Topline Distributors

**$100,000 +**

General Electric Company

**$50,000 to $99,999**

International Business Machines

**$10,000 to $49,999**

Advanced Micro Devices Incorporated  
Agilent Technologies Incorporated  
American Electric Power Company Incorporated  
Boeing Company  
The DIRECTV Group Incorporated  
ExxonMobil Corporation  
Ford Motor Company  
Hewlett-Packard Company  
Lockheed Martin Matching Gift Program  
Lucent Technologies  
Motorola Incorporated  
Northrop Grumman Corporation  
Raytheon Company  
SBC Communications Incorporated  
Texas Instruments Incorporated

**$5,000 to $9,999**

Alcoa Incorporated  
Bank of America  
Caterpillar Incorporated  
Cummins Incorporated  
Delphi Corporation  
Eli Lilly & Company  
Intel Corporation  
ITT Industries  
Owens-Illinois Incorporated  
Practo & Gamble Company  
Verizon

**$1,000 to $4,999**

Accenture Limited  
AT&T Corporation  
Avaya Incorporated  
BP PLC  
C D Spangler Foundation  
ChevronTexaco Corporation  
Cinergy Corporation  
DaimlerChrysler Corporation  
Dow Chemical Company  
Entergy Operations Incorporated

**$500 to $999**

Exelon  
General Motors Corporation  
Harris Corporation  
Honeywell Hometown Solutions  
Honeywell International  
Johnson & Johnson  
Johnson Controls Incorporated  
Lexmark International Incorporated  
Lincoln National Corporation  
National Semiconductor  
Philips PACE  
QUALCOMM Incorporated  
Rockwell Automation  
Royal Philips Electronics N.V.  
Seagate Technology  
Shell Oil Company  
Sony Corporation  
Sprint Corporation  
Sun Microsystems Incorporated  
Tellabs Incorporated  
Temple-Inland Incorporated  
Tyco International Limited Company  
Whirlpool Corporation  
Wisconsin Energy Corporation

**$250 to $499**

Adobe Systems Incorporated  
American Standard Incorporated  
Analog Devices  
Bandag Incorporated  
BridgeStone/Firestone Incorporated  
Cadence Design Systems Incorporated  
Cisco Systems Incorporated  
Davidson & Associates Incorporated  
Dominion  
Goldman Sachs and Company  
Goodyear Tire & Rubber Company  
Guidant Corporation  
MidAmerican Energy Foundation  
NiSource Incorporated  
Progress Energy  
R. R. Donnelley & Sons Company  
Rockwell Collins Incorporated  
Science Applications International Corporation

**$100 to $249**

3M Corporation  
Ameren Corporation  
Armstrong Holdings Incorporated  
Automatic Data Processing Incorporated  
Ball Corporation  
Becton Dickinson & Company  
Brown-Forman Corporation  
Carlisle Holding Corporation  
Coca-Cola Company  
Cooper Industries Incorporated  
CPI Corporation  
Delta Foundation MG Program  
Dow Corning Corporation  
Duke Energy Corporation  
Eaton Corporation  
First Data Corporation  
First Data Western Union Foundation  
FMR Corporation  
Focal Financial Services Incorporated

**Up to $100**

Alliant Energy  
Alliant Techsystems  
Baxter International Incorporated  
Biomet Incorporated  
Bristol-Myers Squibb Company  
Charles Schwab  
Corning Incorporated  
Datascope Corporation  
Deloitte & Touche  
Ernst & Young International  
GlaxoSmithKline PLC  
International Paper Company  
Kemper Insurance Companies  
May Department Stores Company  
Merck & Company Incorporated  
Mueller Company  
Northeast Utilities Service Company  
Oracle Corporation  
Pernod Ricard USA  
Phelps Dodge Corporation  
Silicon Laboratories Incorporated  
United Technologies
When an undergraduate engineering student rides nuclear submarines to measure acoustical signatures, it’s not hard to imagine him someday as a researcher-of-interest to a few three-letter government agencies. What began under the ocean has led to success over the years for Ed Delp, Silicon Valley Professor of Electrical and Computer Engineering.

Delp, with signature expertise in image processing, is quick to share credit for his highly-acclaimed research with the 13 graduate students working in his laboratory. “My results are obviously the output of great graduate students,” says Delp.

The Video and Image Processing Laboratory (VIPER) uses state-of-the-art technology to digitize, store, process, stream, and display digital video and images. From medical imaging to military surveillance platforms, the VIPER team has developed novel technologies for an array of futuristic applications. — Sally Bond

Continued on next page.
Unique Imaging Applications

More than 1.2 million women are diagnosed with breast cancer each year. Annual x-ray mammograms play a well-known role in early detection. While computer-aided diagnosis typically focuses on tumor identification, Delp and his colleagues are taking a new “normal detection” prescreening approach. Their goal is to free physicians to focus on actual cancer cases.

“Preliminary results on over 20,000 mammograms are encouraging,” reports Delp, who is also a professor of biomedical engineering. “We’ve developed a unique algorithm that creates a more efficient and powerful computer imaging technique.”

Image processing also opens possibilities in applications such as hand-held communication/camera devices. If you took a picture of an unknown building on campus, for example, you could be assisted by the Location Aware Image Database (LAID) being developed in collaboration with fellow ECE professor Yung-hsiang Lu. Your picture would be sent through a wireless network to a central database that analyzes and identifies the picture and provides a thumbnail image and building description.

“You can have an ‘OnStar® on steroids’ feature with image-enhanced navigation that offers not only map location like many GPS-type navigation systems but also visual feedback and instruction,” says Delp. Growing out of an ECE 495 Mobile Communications Project class, this research with Lu and undergraduate students uses a screen in the car to display pictures of nearby buildings and an accompanying narrative to either orient lost travelers or enlighten sightseers.

Delp’s research group also has worked for over ten years with C-SPAN, the TV network. Newly-developed tools analyze closed-caption information from the C-SPAN archives located in the Purdue Research Park and provide timelines of talk time used by individual guests and moderators. The Purdue researchers use these boundaries for automatic program segmentation in C-SPAN archived DVDs.

VIPER researchers working with IBM will create automatic speech recognition for the C-SPAN closed-caption transcript. “Closed-captioning is a difficult area to automate, and nobody quite knows how to do it yet,” says Delp. “But so far our progress includes successfully combining voice analysis and face recognition to index the content of congressional hearings.”

Protecting and Validating Content

Congress as well as various U.S. government agencies regularly solicit Delp’s expert testimony on watermarking technology. Delp is a recognized authority in digital watermarking, which embeds unobtrusive signals to identify the image or document owner and prevent or deter illegal activity. “He is THE ‘godfather’ of our research community in watermarking,” says Benoit Macq of the department of electrical engineering of Université Catholique de Louvain in Belgium who has worked with Delp for more than seven years. “In my extensive watermarking collaborations with him, Ed shows an outstanding feel for new paths in watermarking and video coding research.”

Delp works with the government on anti-counterfeiting and on anti-terrorism, to deter terrorists from communicating through hidden messages. “It’s very important to have the national Watermark Evaluation Testbed, located at VIPER, to evaluate watermarking techniques. It’s all about protecting and validating content.”

Delp and his colleagues also use complicated modeling for error concealment over noisy channels such as the Internet and have helped advance video compression techniques. “One movie on uncompressed video would probably require 20 DVDs,” states Delp. “But video compression techniques essentially delete parts of the video without affecting viewability. We’re looking at new models of video compression such as low complexity video that could be used for surveillance.”

In a 21st Century Research and Technology Fund project for surveillance applications, Delp is collaborating with IUPUI, Notre Dame, Thompson Multimedia, Delco, and the Naval Surface Warfare Center. “The video compression technique in Hollywood is very complex and costs hundreds of thousands of dollars, but you can play it back on a $49 Wal-Mart console. We’re reversing that,” says Delp. “We want to compress it with a simple device and use a complex device to play it back.”
Airborne military surveillance platforms that cannot handle computational complexity could be paired with a well-powered ground station. Low complexity encoding would simply compress the surveillance video and send it to the base station for a more complex and secure decoding.

**Beneficial Engagement**

Delp’s success is not limited to research. He recently received the 2004 Wilfred “Duke” Hesselberth Award for Teaching, his fourth teaching award. He also engages undergraduates in research through Engineering Projects in Community Service (EPICS), where he oversees watermarking and image content analysis technology for archiving oral history interviews at the Tippecanoe County Historical Association.

Delp has another goal, to “engage the state” by grooming PhD students for higher technology jobs in Indiana. “Professor Delp has expanded the scope of our lab in video compression and video processing,” reports Billy Beyers, senior corporate technology advisor (retired) for Thompson Consumer Electronics, Indianapolis. “We are pleased to have had three of Ed’s former graduate students join us. They are all excellent contributors.”

Ed Delp is not a passenger on nuclear submarines these days. He is a driving force in a research community that recognizes his multifaceted achievements in digital video and image processing.
Professor Jan Allebach’s collaborative research has fueled digital printing technology.
A Decade of Image Processing Research
—SALLY BOND

Custom homes, custom plates, custom tailoring…and a custom Wavelinks? Perhaps you would like to read about research related to just your major or department, see pictures from particular student organizations, or get updates on scholarships that you support. Variable data printing that can link a printing press with an office computer for glossy, on-demand, and personalized magazines could be the next big wave in digital publishing, if a team of Purdue researchers, Hewlett-Packard, and the University of Puerto Rico’s collaboration stays high on the image processing crest.

Funded by the Puerto Rican government to help move the country from a manufacturing- to knowledge-based economy, “the goal of the project is to develop tools to more effectively use the Indigo Press liquid toner technology. We could help realize a new office publishing environment,” reports Jan Allebach, Michael J. and Katherine R. Birck Professor in Electrical and Computer Engineering.

Powerful Advances Propel Digital Printing Technology

Digital publishing is a newcomer in a $50 billion-a-year industry where many sophisticated communication tools have already made the leap from graphic designers to average people, transforming our use of printed information. Today’s desktop printer market has given us quality inkjet printers in the $30 range, despite an imaging pipeline through the printer that remains remarkably complex.

Powerful advances in image processing have fueled digital printing technology. The successful rendering algorithms developed by Allebach and company are embedded in virtually every HP inkjet printer sold in the world. Image processing has been a ten-year research focus for Allebach, co-inventor on 11 imaging patents and the internationally recognized 2004 Electronic Imaging Scientist of the Year.

Collaboration Leads to Breakthroughs

A University of Delaware and Princeton graduate, Allebach arrived at Purdue in 1983 to discover the expertise of the Purdue faculty, the talent and motivation of the graduate students, and an environment that fostered collaboration. “I have found it extremely rewarding to bring my graduate students along, get them interested in image processing, and see them develop great careers at all the major manufacturers,” he says. The strong interdisciplinary approach to digital printing research on campus draws nearly 30 graduate students and nine researchers from five academic units.

Allebach and his campus collaborators had their first breakthrough in digital halftoning with their development of the “gold standard” of algorithms for the best binary representation of an image. Their second breakthrough quickly followed with the successful training-based algorithm that mimicked “gold standard” halftone quality but without the computationally intensive (and impractical) requirements. It’s in every HP inkjet printer sold today.

Training- and model-based techniques to develop optimal rendering algorithms have proved integral for many tasks, such as image scaling for inkjet printers. “In four megapixel digital cameras, for example, pixels would cover less than a two-inch square.”

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on the photo paper,” explains Allebach. “With ECE Professor Charles Bouman leading the way, we have invented an innovative technology to get the rest of the pixels by training the algorithm through pairs of low- and high-resolution images. The algorithm infers the missing detail and incorporates it into the high-resolution image.” Every HP inkjet printer sold today includes this algorithm in the printer driver. Bouman is applying the same strategy in additional HP products.

**Staying Connected Through Corporate Relationships**

Research with HP represents Allebach’s longest, most substantial corporate relationship. It reflects a master agreement between HP and Purdue to provide full coverage of the intellectual property. “It allows us to start new projects very effectively without renegotiations,” reports Allebach. “We’re in the business of educating students and creating knowledge, and we need to be able to publish. HP has been very supportive of that mission.”

The U.S. Secret Service has also supported Allebach and his cohorts, Ed Delp, Silicon Valley Professor of Electrical and Computer Engineering, and mechanical engineering’s George Chiu. Allebach’s image analysis expertise, Delp’s communication and watermarking technology, and Chiu’s mechanical control are part of an NSF-sponsored printer forensics project.

The objects of interest are laser printers, notoriously subject to a problem called “banding.” It occurs when gears rotate the optical photoconductor drum at an inconsistent velocity. The team’s newly developed technology for artifact reduction can reduce serious image quality problems but also, coincidentally, can be used to characterize banding and identify which printer operates a particular gear mechanism. Each laser printer has an intrinsic signature—the equivalent of a fingerprint—that can be extracted from its printed documents and used to verify which printer created the forged document. One step further in the printer forensics process is to purposefully embed a subtle extrinsic signature, such as modulations in laser beam intensity, to produce small banding frequencies. Extrinsic signatures create a watermark detectable only through digital processing and provide a foolproof option for checking document authenticity.

“Digital halftoning and rendering are not new issues in image processing. But what constitutes a key problem, such as printer forensics, is always changing,” notes Allebach. “Sometimes, unfortunately, the academic community can be working on problems that are not the most critical issues to address. We have exciting opportunities in ECE to stay connected to real problems and issues.”

**Real-Life Benefits From Research Applications**

Every semester, 50 students engage in research applications through Allebach’s popular ECE 495M Mobile Communications Project. For the past two years, the class has worked with Purdue’s Center for Wireless Systems and Applications on a project for a mental health center south of Indianapolis.

The Assertive Community Treatment model for seriously mentally ill patients calls for specialist teams to track released clients and oversee treatment compliance. “How can team members interacting with clients best communicate with each other and with the treatment center?” asks Allebach. “Our undergraduate students are establishing an all-wireless, all-interconnected database that provides remote access to both pull data down and upload new content. It’s an extremely powerful concept that addresses a real community problem.”

“Jan has a rare ability to cut through red tape to meet the different needs of students, customers, and collaborators,” says Chiu, associate professor of mechanical engineering. “I’ve enjoyed many rewarding collaborations with Jan because he has great ideas. His goal is to do useful research.”

Allebach, who was tapped to determine the commercial potential of DuPont’s recent multimillion dollar image quality technology patent donation to ECE, is always eager to catch the next breaking issue in image processing. Staying connected to real problems, he reminds us, is what he loves most about this field.
Dave Meyer’s philosophy of teaching can be summed up in one word: diversity.

“There’s an emphasis on diversity today, and we need to be aware that it also applies to learning styles,” says Meyer, a professor of electrical and computer engineering. “Different students learn differently. Some get a lot out of a lecture. Others learn more from doing a lab experiment. Some students would rather look at a video—stop it, start it, back it up—than sit in a lecture. My philosophy is that
if we provide different modes of learning, we can better accommodate our diverse students.”

The Challenge to Improve

Meyer has taught in a variety of settings, from lecture halls with hundreds of undergraduates to classrooms with a few dozen graduate students. The most interesting (and challenging) venues are large lecture halls, where he uses video animations to pique students’ interest and wireless technology as he “cruises the aisles” to enhance professor-student interaction. But he’s also not afraid to scribble an “artist’s conception” on the chalkboard whenever necessary.

“I’m always working on ways to improve learning. Rarely will I teach the same course the same way twice,” says Meyer, who did his undergraduate and doctoral work at Purdue in electrical engineering. He also has a master’s degree in computer science.

Online lecture notes and video-taped lectures, including animated PowerPoint slides, are available for students and faculty alike. Meyer also has been working for a decade on a series of “lecture workbooks”—skeleton notes with carefully selected portions left blank for students to fill in during class time.

“I want to maximize the effectiveness of the lecture so that students are engaged but not frantically scribbling to keep up,” Meyer says. “The theory is that as the students are taking notes, information is encoded in their brains. The goal is to make that process as efficient as possible by focusing their attention on key points. In addition to traditional technology-based research in computer engineering and electro-acoustics, Meyer enjoys investigating the interaction between teaching and technology in order to study how students learn. He has studied how different students use his on-line streaming video resources by analyzing usage patterns, with interesting results.

“We got feedback on how long students were watch-

ing a segment, at which points they stopped and started it, and the overall access pattern,” Meyer says. These data were then cross-referenced with the students’ profiles to determine how different personality types utilized information online.

Incorporating his research into the classroom, Meyer has developed a capstone computer engineering class that tasks seniors with building an embedded micro controller system from the “ground up”—encompassing circuit design, printed circuit board layout, software design, and system packaging. Development of professional communications skills is also emphasized.

“Everything I do—using techniques, procedures, tools, research—is to help students learn,” says Meyer. “That is really the bottom line.”

Meyer does have one complaint about his job: “My students don’t make me work hard enough.

“I have lots of office hours, I encourage students to come in, but they don’t take advantage of the opportunity,” he says. “They may think that professors are too busy to talk to them, but most professors enjoy talking to students. I certainly do.”

Awards for Excellence

Meyer’s dedication has earned him no fewer than 17 teaching awards since he began teaching at Purdue in 1982. His awards include three Honeywell Awards and two Dean A. A. Potter Awards for excellence in teaching, both of which are selected by ECE students. National awards include the IEEE Undergraduate Teaching Award, the ASEE Fred Merryfield Design Award for Excellence in Teaching Engineering Design, the IEEE Computer Society Undergraduate Teaching Award, and the Eta Kappa Nu C. Holmes MacDonald Teaching Award, among others.

“It certainly is rewarding to get national recognition for what you do,” says Meyer, “but the student-initiated awards are the most meaningful.”

His favorite award stands on permanent display in the west foyer of the Purdue Memorial Union: the Book of Great Teachers. The Book is actually a plaque engraved with the names of 267 professors, past and present, chosen by their students and peers for their outstanding teaching and scholarship. This honor may be repeated by an individual only once every five years. Meyer’s name was added in 1997.

Meyer also was inducted as a charter member of the Teaching Academy, which honors excellence in teaching at all levels in the university and sponsors
2004 Teaching Award Recipients

**Bill Chappell:** *The Ruth and Joel Spira Outstanding Teacher Award.* In 1988, Joel Spira, founder of Lutron Electronics, initiated an award to be presented to a junior faculty member who has “excelled in teaching and inspiring students” in the School of Electrical and Computer Engineering.

**Ed Delp:** *The Wilfred “Duke” Hesselberth Award for Teaching.* This award for teaching excellence is made possible by a fund established and maintained by the sons of Professor Hesselberth (1907—1985).

**Peter Doerschuk:** *The Motorola Excellence in Teaching Award.* Established in 2002, this award honors outstanding teaching in ECE, as determined by nominations from students enrolled in the ECE 400 senior seminar each semester. The award is presented to the faculty member who receives the highest number of nominations for the academic year.

**Linoy V. Alex, John G. Andrews, Aditya Bansal, Pablo A. Estrada, Wessam M. Hassanein, Samir M. Iqbal, Rouzbeh Jazayeri, Jaebang Kim, Michael R. Maletich, Hassan Raza, Kirk J. Riley, Waseem A. Sheikh:** *The Estus H. and Vashti L. Magoon Award Winners for Excellence in Teaching.* Given annually in memory of Estus H. and Vashti L. Magoon, this award recognizes the contributions of graduate teaching assistants throughout engineering. A 1913 Purdue alumnus, Estus was born in 1892 and received his bachelor’s degree in Civil Engineering. He received an honorary doctorate from Purdue in 1937 in recognition of his achievements. Several years after his death in 1974, Mrs. Magoon established a trust to fund the awards in perpetuity. She died in 1986.

**ECE teaching assistants Min Lu, Michael Maletich, and Linoy Alex** were honored for their teaching accomplishments at the campus-wide Celebration of Graduate Student Teaching.

Faculty-to-faculty mentoring. Founded in 1997, the academy boasts a total of 143 professors chosen for their outstanding abilities in the classroom.

“The academy is a method of recognition,” says Meyer, “but it’s also a method of service, of getting people involved.”

**Continued Dedication**

Meyer continues his winning ways. Most recently he won the William H. Hayt Outstanding Instructor in ECE Award, presented by Purdue’s Eta Kappa Nu chapter in May of 2003.

“I enjoy the personal interaction and the satisfaction of helping students learn the same material that I’m excited about,” Meyer says. “I think one of the reasons that I have been successful is that students can tell if you enjoy what you are doing. And I love what I’m doing.”
Professor Emeritus Keinosuke Fukunaga gained world renown in statistical pattern recognition during his career at Purdue.
As a child, Keinosuke Fukunaga refused to return to an art class because the instruction had no logical reasoning. Language studies also confounded him.

“This was the rule, but there was exception, exception, so I hated that lesson, too,” the Purdue ECE professor emeritus says today.

“But as soon as I went to math class, I could understand everything naturally. My mind works logically.” That set him on a path that led to world renown in statistical pattern recognition.

Similar seeds for the future were nurtured in youth by fellow professor
emeritus David Landgrebe. “I did the soldering bit, building little electric things,” he says. One high school summer he took a television repair course, cementing his interest in electrical engineering. Years later, that interest led to acclaimed achievements in signal theory and representation.

Both shared a passion for practical applications of their work while contributing to their fields, Purdue University, and their students.

Fukunaga: Real-World Challenges

After earning a bachelor’s degree at Japan’s Kyoto University, a master’s degree at the University of Pennsylvania, and in 1962 a doctorate at Kyoto, Fukunaga spent four years at Mitsubishi Electric in Japan. He was recruited to Purdue in 1966 by a professor who heard him present at a New York conference.

By 1973, Fukunaga had been named a full professor and published the landmark textbook, *Introduction to Statistical Pattern Recognition*, still a vital resource in English, Chinese, and Russian. A second edition was released in 1990.

He often left campus during the summers, heading to industry and consulting activities. For more than a decade he maintained a close working relationship with MIT’s Lincoln Laboratory, applying statistical methods to classification of various radar signatures.

“When you go out to industry, talk to people, and work together, you see they have a lot of problems to solve,” he says. “You see what’s most important and that people want solutions. I met people, picked up problems, and had my students find solutions we would publish.”

The work also gave the Fukunaga family experiences in new places, from New Mexico’s deserts to Florida’s tropics.

“He was very persistent,” recalls former graduate student Warren Koontz (PhD ’71), one of about 20 Fukunaga mentored. “He applied constant, gentle pressure. That’s how he got his students to produce. His favorite question was, ‘Anything new?’ He was always accessible and prompt in reading what you’d done and getting back to you.”

Koontz published six papers with his major professor. “The first one was mostly based on his ideas and I did a little of the computer work to run experiments. By the end, I came up with ideas myself, and he’d say, ‘Why don’t you put your name first.’ This put him way out in front in terms of integrity and graciousness.”

“I am not the person who actually works. I’m just supervising,” Fukunaga says of his style. “If I interfere too much, then I’m discouraging students. I was available any time, ready to spend half a day or all day with the student.”

Quality matters. “To produce first-class results you have to select first-class students,” Fukunaga says.

While research was his passion, Fukunaga was an excellent instructor as well, says colleague George Lee, who took one of his courses. “He was a very good teacher because he explained material clearly and carefully and talked about how to apply it to technical problems.”

After 38 years on campus and consulting with industry, Fukunaga now spends his leisure time walking and resting. “I feel most proud of my research accomplishments,” he says. “I had excellent students. I respect them.”

Landgrebe: Interdisciplinary Pioneer

Hailing from Huntingburg, Ind., Landgrebe landed at Purdue more than 50 years ago. After earning bachelor’s and master’s degrees and, in 1962, a doctorate, he joined the faculty.

KEINOSUKE FUKUNAGA

**Education**

BSEE ’53, Kyoto University, Japan

MSEE ’59, University of Pennsylvania

PhD ’62, Kyoto University

**Career highlights**

1953—1966, Mitsubishi Electric, Japan

1966—1973, associate professor, Purdue School of Electrical Engineering

1973—present, professor, Purdue School of Electrical Engineering

Held numerous industry posts.

Consulted extensively throughout his career, including at Massachusetts Institute of Technology, Lincoln Laboratory, 1973—1987.

**Recognition**

IEEE Fellow

**Publications**

Author of *Introduction to Statistical Pattern Recognition*; also published numerous book chapters and dozens of journal articles.

By 1969, he was directing the Laboratory for Applications of Remote Sensing (LARS), which he co-founded in 1966 and oversaw until 1981. There, with personnel topping 120, an interdisciplinary team created space-based technology to observe and manage agricultural resources.

“I’m very impressed with the ability an interdisciplinary team has on a problem,” he says today. “To me, it was sparks flying.”

“We had to learn each other’s languages,” recalls Chris Johannsen, professor emeritus of Agronomy, on the LARS staff. “We were the first to take remotely-
sensed data and analyze it by digital computer. We learned how to make it useful for different disciplines.”

That took leadership, delivered by Landgrebe. “He had a unique way of summarizing what we learned in discussion,” says Johannsen. “He grasped what was going on so everyone could understand and feel comfortable that we were on the same path.”

Landgrebe was a “tremendous example” for John Kerekes (BSEE ’83, PhD ’89), who helped organize the IEEE Geoscience and Remote Sensing Society’s Honorary Workshop for Professor David A. Landgrebe at the NASA Goddard Space Flight Center in 2003.

“He showed examples as application of theory,” recalls Kerekes, one of 25 graduate students Landgrebe guided. “It was exciting to see mathematics used in something I could relate to.”

His professor also demonstrated remote sensing’s benefits, he says. “His contributions in analyzing algorithms were some of the very first, and they provided a model for people to expand on. He’s always been ahead of the community in developing ideas. Five or 10 years later, people realize, ‘Hey, Dave was on to something here.’ He has proven to be a workhorse in collecting satellite imagery used for land cover classification and resource monitoring.”

Landgrebe helped develop the free, web-based MultiSpec software, used by thousands to analyze imagery. Over the years, his research took him to Moscow, Tokyo, Helsinki, Sydney, and other points around the globe. He held industry posts, and he served Purdue as associate dean of engineering, director of the engineering experiment station, coordinator of graduate programs, and ECE acting head.

He’s still working—because he loves it. “I have a problem with people who make a distinction between work and play,” Langrebe says. “I was doing something I thoroughly enjoyed, so I didn’t feel a strong attraction to weekends off or time away. I was having too much fun.”

Looking to the future, Langrebe is still excited. “This field has enormous potential.”

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**DAVID LANDGREBE**

**Education**

BSEE ’56, Purdue University

MSEE ’58, Purdue University

PhD ’62, Purdue University

**Career highlights**

1962—present, Purdue School of Electrical Engineering faculty member

1969—1981, director, Purdue Laboratory for Applications of Remote Sensing

1981—1984, associate dean of engineering and director of Engineering Experiment Station

1986—1989, coordinator of graduate programs, School of Electrical Engineering

1995—1996, acting head, School of Electrical & Computer Engineering

Served on numerous National Research Council and NASA advisory committees. Held posts with Bell Telephone Laboratory, Interstate Electronics, and Douglas Aircraft. Consulted with various industrial and government organizations.

**Recognition**

Life Fellow, Institute of Electrical and Electronic Engineers • Fellow, American Society of Photogrammetry and Remote Sensing

• Fellow, American Association for the Advancement of Science • Life member, American Society for Engineering Education

• Member, Eta Kappa Nu, Tau Beta Pi, Sigma Xi honorary societies • NASA Exceptional Scientific Achievement Medal, 1973


• Distinguished Achievement Award, 1992 • Education Award, 2003

**Publications**

MAKING THINGS

— Mary Lundstrom
with
Korina Wilbert
WORK | Master Machinist Marks 25 Years at ECE
In this wireless, digitized day and age, there is concern that engineering students come to Purdue without enough hands-on experience. To Claude "Chuck" Harrington, master machinist at ECE for the past 25 years, hands-on just comes naturally.

"When I was five years old, my dad bought a new milk separator that arrived one day while he was gone. I took it apart on the front porch, to see how it was made," Harrington recalls. "It took us until 11:00 that night to put it back together, but there were no screws left over."

As a child growing up on a farm in upstate New York, Harrington’s natural curiosity about how things work earned him the nickname “How-come-and-why.” As an adult, his accumulated knowledge and experience have resulted in a career as a master machinist. He has creatively solved problems for faculty and students alike, fabricating tools and equipment to advance research and educate future engineers while doing work that is second nature to him.

**Student Involvement**

Harrington assists students in ECE undergraduate courses as needed. Barrett Robinson, coordinator of undergraduate laboratories and Harrington’s supervisor for the past ten years, says, “Chuck’s talent lies in being able to build on his experience. With his knowledge, it doesn’t take long before the problem is solved.”

In ECE 402, Electrical Engineering Design Projects, students are challenged to use their engineering ingenuity. One semester, students were required to race toy cars through a track and park them in a garage. Through the use of sensors, students guided the cars “blindly” from a computer keyboard to complete the project. Harrington was available to give advice and guidance on fabrication for mechanical components and ensure that the students worked safely.

“It’s of utmost importance that students working in the machine shop treat it seriously,” Harrington stresses. “Safety comes first.”

Harrington has also worked with the students in EPICS on many of their community-oriented projects. One involved adapting tools and other equipment for use by the handicapped. Another dealt with magnetic levitation for a racetrack at a children’s science museum. There was even a laser harp that didn’t work. “The laser sensors had shorted out,” Harrington recalls. Harrington was able to diagnose the problem quickly. The harp played once again.

**A Creative Problem-Solver**

Harrington’s work with ECE faculty takes a different tack. A process has evolved that has led to roughly 20 patents. Harrington is listed as co-inventor along with many ECE faculty members. Harrington isn’t sure exactly how many patents he holds. "My wife takes care of that," he says.

First, Harrington and the professor meet to discuss the goal of the fabrication project. “No decisions are made at this point,” Harrington notes. “We leave that meeting and think about the project for awhile.” Then, they meet again, this time to draw up a prototype.

“I’ve had lots of drawings presented to me on napkins.” Harrington says. “Once a professor came to me with an idea he had while he was traveling. That was the only time I worked from a sketch on the back of a tie!”
Next, he devises a working prototype. As the research continues, additional generations of the original prototype may be fabricated to reflect modifications.

Harrington describes the process more simply. “Modification 9-C.’ That was the first modification I ever did. Whenever we need to try another angle, we call it Modification 9-C.” Harrington adds, “About half of the time, things don’t work. But we don’t fail. We learn.”

Dan Leaird, manager of the Ultrafast Optics and Fiber Communications Laboratory in ECE, says, “We do research. We’re not producing an end product a thousand times. Everything has to be modified.” Leaird continues, “The services of the machine shop and the expertise of someone like Chuck are absolutely critical to getting anything done.”

Harrington serves as a fabricator for some, a consultant for others. “Some people need a person who can get things built,” Leaird says. “I need an expert I can talk to about properties of solids or high-frequency communications.” Harrington often works with extremely expensive custom materials that are very difficult to machine. His skill has saved thousands of dollars over the years.

**A Life’s Worth of Know-How**

To do his job well, Harrington taps his vast experience, plus his knowledge of mathematics, physics, mechanical engineering, electronics, and other fields. “He has a broad range of experience that he brings to the table in terms of solving problems.” Leaird explains. “He understands some of the fundamental problems we have and how we need to make things work.”

Harrington is a master machinist. He is also a certified welder and a certified mold maker. He works with mills, lathes, grinders, drills, and, of course, computers. Perhaps his greatest skill is the ability to pinpoint information when it is needed. A copy of *Machinery’s Handbook*, the “machinists’ bible,” Harrington claims, is close at hand in his research shop/office in the basement of the EE building.

Throughout his life, Harrington has taken a hands-on approach to discovering “How come?” and “Why?” By the time he was 13 years old, Harrington was repairing radios. Prior to coming to Purdue, Harrington worked as an injection mold maker for Rostone Corporation in Lafayette, Ind. In the 1970s, he built satellite dishes for home systems. More recently, “I bought a microwave oven, and my wife Dana was surprised when I didn’t take it apart,” Harrington says. (He had already disassembled several.)

He is a long-time radio amateur, a self-described “hammer” through and through. Characteristically, while on a Caribbean cruise, he could be found in the engine room rather than on deck, his curiosity once again getting the upper hand.

Harrington laughs, “There’s not a day that I don’t mind walking in the shop door. I really enjoy my work.”

Keeping up with ever-changing technology can be daunting. Harrington manages by reading a stack of magazines every month, from *Popular Mechanics* to technical papers written by ECE faculty. His life-long dedication to learning has led Harrington to enlist the help of professors, students, coworkers, and others to achieve success.

Could his insatiable curiosity about how things work be something in Harrington’s blood? A son, David (AAE ’94, Computer Graphics), has followed in his father’s footsteps and also is a machinist. One of Harrington’s grandchildren, seven-year-old Andrew, has already taken apart several lawn mowers. Naturally.
As a founding partner of Foundation Capital in 1995, Bill Elmore is one of the most well-established venture capitalists in Silicon Valley. He has watched, coached, and nurtured hundreds of early-stage companies, helping develop them into industry leaders. His firm is committed to supporting entrepreneurs and their companies, targeting innovative opportunities in telecommunications and networking, Internet infrastructure, and enterprise software. In May of 2001, Foundation Capital closed its $595 million Fund IV.

Speaking of his student years, Elmore says, “The bottom line is Purdue prepared me for what I’m doing now. Without the technical background and the thought process that goes along with that training, I wouldn’t be able to interact with technical people every day in my current career.”

As director and past president of the Western Association for Venture Capitalists and in his role as a director of the National Venture Capital Association, Elmore is actively involved in defining, serving, and representing the interests of the venture capital and private equity industries.

“My Purdue engineering background has been crucial to me as a venture capitalist,” says Elmore.
Gen Fukunaga  
**BSEE ’82, MSEE ’84**  
**Founder and President, FUNimation Productions**

Gen Fukunaga, founder and president of FUNimation Productions grew up in West Lafayette. When he visited Japan in the eighth grade he was surprised at the sophisticated animation there compared to that of the United States.

After earning degrees from Purdue and an MBA from Columbia University, Fukunaga held positions with Andersen Consulting and Tandem Computers. Japanese animation remained on his mind, though.

“Finally, I thought, why not bring Japanese animation to the U.S.,” he recalls. A meeting was arranged with Toei Animation. Their library contained “Dragon Ball Z,” a television series that had been successful internationally, generating over $3 billion in associated revenues. Fukunaga says, “We negotiated with them to acquire the rights for DBZ in limited syndication.”

Today, *TV Guide* reports that DBZ is one of Cartoon Network’s most popular programs. Since 1994, FUNimation has become a major international brand management and home video company. It is involved in producing shows, licensing and merchandising the characters, retailing through its Zstore.com, and distributing home videos throughout the world.

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Jeffrey D. Fisher  
**BSEE ’80**  
**Executive Vice President of Worldwide Sales, NVIDIA**

After leaving Purdue in 1980, Jeff Fisher, intrigued by the high-tech revolution and the lure of California, moved to Silicon Valley. He earned an MBA from Santa Clara University and was recruited by NVIDIA in 1994 when the Silicon Valley graphics chip company was barely a year old. There, he has helped build one of the most successful sales teams in the semiconductor industry.

NVIDIA has reached $1 billion and $2 billion sales milestones faster than any other semiconductor company. More than once, NVIDIA has been recognized as one of the “100 Fastest Growing Companies” in the U.S. by *Fortune*. NVIDIA develops cutting-edge GPUs (graphic processing units) that dramatically enhance the visual computing experience on PCs, laptops, workstations, and other computing platforms. Today, one out of every three PCs and engineering workstations sold is powered by NVIDIA graphics.

“Over the past ten years, NVIDIA has transformed the graphics industry,” Fisher says. “Helping to build NVIDIA into one of the world’s leading technology companies has been the greatest experience of my career.”

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*Continued on next page.*
Roch-Chian Ho
PhD ’75
Founder & CEO, Intertek
Founder & CEO, Amperor

After earning his MSEE from Washington University, Roch-Chian Ho came to Purdue. His eyes were opened to the importance of computer-aided design, where theory and reality meet. “It’s living proof that a theory won’t work unless it works on paper,” he says.

In 1982, Ho returned to Taiwan, where he founded Intertek, involved in the design and manufacture of automated testing systems. After a successful startup period, Intertek entered the desktop and portable power supply business and began marketing products under the name of Amperor in 1987. The primary product offerings at the time were AC-to-DC power supplies, DC-to-AC power supplies, and DC/DC converters.

The company employs over 3,000 people in the United States, the United Kingdom, Taiwan, China, and Singapore. With sales revenues of $120 million, it is a major supplier for Compaq, HP, Scientific Atlanta, and Lexmark. It also makes power supply units for European customers. Ho remains actively involved in defining the new products and exploring new directions.

Hong-Sun Kim
PhD ’90
President, SecureSoft

When Hong-Sun Kim, founder, CEO, and chairman of SecureSoft, was at Purdue, the university’s advanced computer system had a huge impact on him. In fact, Kim says, “Purdue’s computer network, ECN, was overwhelming to me.” During his college days in Korea, he had not seen such systems. “Even though I attended the best and largest university in Korea, computer systems there were not as advanced.”

After completing his studies at Purdue, Kim applied his knowledge and experience to industries in Korea. “Now I am selling high-tech IT products developed by Korean engineers to the U.S.”

SecureSoft, headquartered in Seoul, Korea, is one of the leading Internet security companies in the world. It was listed on the KOSDAQ exchange in Korea in 2001. SecureSoft founded its own corporation in September 2002 in Japan, where it has broad partnerships with prestigious corporations including Marubeni, Fujitsu, Toshiba, NEC Soft, and HP Japan.

“It gives me great pleasure to participate in the advancement of IT industries based on my experience at Purdue,” Kim says.

Joseph Schoendorf
BSEE ’66
Executive Partner, Accel Partners

Joe Schoendorf has been active in the software and telecommunications industries for 37 years, the past 15 as an executive partner with Accel Partners. “You don’t turn a corner from engineer to venture capitalist,” Schoendorf reflects. “There is no corner. Dave Packard, founder of HP, said, ‘If you don’t understand it, you can’t manage it.’ That defines the importance of being an engineer in this field. At the end of the day the directors have the ultimate responsibility for managing the company.”
Recalling his college days, Schoendorf comments, “Think of everything we take for granted today, from fax machines to VCRs to cell phones to personal computers. Not one was invented when I graduated in 1966.

“What I learned of most enduring value at Purdue was the ability to learn. The rate of change in this technology is accelerating exponentially,” Schoendorf says. “Everything I learned about content has been obsolete for many decades. But the ability to learn—that will never be obsolete.”

Edmund O. Schweitzer III

Founder & President, Schweitzer Engineering Lab

While a student at Purdue, Ed Schweitzer loved electromagnetics and boundary-value problems. He recalls, “We were told that ours was the last class to be taught vacuum tubes. We solved load-line problems on a slate board with the V-I characteristics of the 6SN7 tube.”

Schweitzer developed a digital relay as his PhD project while at Washington State University in Pullman. Eventually it led to manufacture of the world’s first all-digital protective relay, revolutionizing the protection industry.

Building on innovations in the electric utility industry begun by his father and grandfather, he founded Schweitzer Engineering Labs to make the transmission of electric power safer, more reliable, and more economical. The company, started in the basement of his home, shipped its first products in 1984.

Today, SEL has more than 800 employees. Sales exceeded $100 million in 2002. The employee-owned company sells to virtually every electric utility in the United States and has customers in 90 countries worldwide.

Edward G. Tiedemann, Jr.

Senior Vice President, Engineering, QUALCOMM

Edward Tiedemann says, “In 1986, Andy Viterbi, who had just started QUALCOMM with Irwin Jacobs, suggested that I join the company.” After Tiedemann had spent several years at QUALCOMM, the initial concepts of CDMA cellular communications were proven, and he became involved in the system design for the CDMA air interface. Tiedemann then assumed responsibility for enhancements to the CDMA air interface design. In 1991 he formed and led a team to pursue standardization of CDMA.

Tiedemann was appointed chair for the group in the Telecommunications Industry Association that was responsible for the CDMA physical layer. This work resulted in the CDMA standard for cellular communications, IS-95. Later, when the U.S. government opened up Personal Communications Systems (PCS), he led the industry work that was responsible for the CDMA PCS standard.

In the mid 1990s, when companies were starting to think seriously about third-generation wireless systems, Tiedemann formed a small team that determined many of the initial technical concepts for third-generation CDMA wireless systems. This led to cdma2000, which was based upon the IS-95 standard. Today, Tiedemann leads QUALCOMM’s worldwide standardization activities and continues as chair of the standards group responsible for the cdma2000 physical layer.
A laser physics business and technology visionary, Donald R. Scifres helped launch a revolution in the optical communication industry. His founding contributions to distributed feedback lasers, high power diode arrays, vertical cavity surface emitting lasers, and more have consistently delivered sophisticated devices to the market.

Scifres received the 2003 IEEE Robert N. Noyce Medal in recognition of his pioneering contributions to the technology and business development of semiconductor lasers. He also received recognition as Eminent Member from Eta Kappa Nu.

Robert N. Noyce Medal

The IEEE Robert N. Noyce Medal was established to recognize exceptional achievements and outstanding contributions to the microelectronics industry. Preference is given to individuals who have demonstrated contributions in multiple areas including technology development, business development, industry leadership, technology policy development, and standards development.
A Lifetime of Achievement

Donald R. Scifres received a bachelor’s degree (1968) from Purdue University and master’s (1970) and doctoral (1972) degrees in electrical engineering from the University of Illinois.

In 1972, Dr. Scifres joined Xerox Palo Alto Research Center, where he studied semiconductor lasers and integrated optics. In 1974, Dr. Scifres and his co-workers reported and patented the first distributed feedback semiconductor injection laser. It became the preferred light source for high speed long distance optical fiber communications. Dr. Scifres also performed pioneering work on integrated optical devices, vertical cavity surface emitting lasers and high power semiconductor lasers for communications, medical, industrial and aerospace applications.

Based on this work, Dr. Scifres co-founded Spectra Diode Laboratories, Inc. (SDL) in 1983. SDL merged with JDS Uniphase Corporation in 2001, where Dr. Scifres served as co-chairman and chief strategy officer until he retired in January 2003. Dr. Scifres then founded SDL Ventures, LLC, an investment firm focusing on early stage investments in the lasers, photonics, fiber optics and microwave communications, and biotech fields.

Dr. Scifres is a Fellow of the IEEE and OSA and a member of the National Academy of Engineering, APS and SPIE. He holds more than 130 U.S. patents and has published over 300 technical articles and book contributions. He has received numerous IEEE awards including the Jack Morton Medal (1985), the LEOS Award for Engineering Excellence (1994), the Third Millennium Medal (2000), and the Robert Noyce Medal (2003). He has also received the OSA Edward H. Land Medal (1996), the APS George E. Pake Prize (1997), and the Rank Prize (2001) from The Rank Foundation of the U.K. He received Eminent Member recognition (2003) from Eta Kappa Nu.

Dr. Scifres has received the E’CA’ Distinguished Alumni Award (1991) and the Engineering Alumni Honor Award (1993) from the University of Illinois, the Distinguished Engineering Alumni Award (1990), the Outstanding Electrical Engineer Award (1992), an Honorary Doctorate in Engineering (2001) and the Governor Robert T. Tiemann Award (2002) from Purdue University, and the Laurin Publishing Company’s Distinction in Photonics Award (1999).
Striking a Balance

Students Successfully Pursue Academics, Interests

Whether playing the trumpet or piloting a plane, the individuals highlighted here have managed to pursue excellence in their academic careers at Purdue while enjoying a wide range of interests. A delicate balancing act for many students, the four have thrived in ECE’s rigorous academic environment and have embraced facets of the larger Purdue community as well.

Young Alum on Academic Fast Track —Russ Brickey

Like many students his age, 17-year-old Chris McNett was looking forward to going off to college this fall. Unlike most, however, the Indianapolis native headed west, to graduate school at Stanford University. Among the youngest students ever to be accepted at Purdue, McNett (BSEE ’03) scored a perfect 1600 on the SAT and officially became a Boilermaker at the ripe old age of 13.

Adding to his accomplishments: A patent for a method of layering sound absorption panels. A private pilot’s license. Four internships at Microsoft.

“Chris was about 12 when his dad asked if I thought he could make it at Purdue,” says Barrett Robinson, coordinator of undergraduate labs in ECE. “I posed the senior design problem for the previous semester [to McNett].” The problem is usually handled by a team of four seniors over the course of the semester. “He mastered most of it within a few minutes,” says Robinson.

McNett “made it” through Purdue—with a near-perfect 3.97 GPA. Eyeing graduate school, at age 16 he added a perfect GRE score to his already impressive list of achievements.

“Purdue was such a neat place,” McNett says of his undergraduate days at the university. McNett spent the past summer completing his fourth internship at Microsoft. He enjoyed living with two other Microsoft interns in downtown Seattle and working on software development for the industry giant. He entered Stanford as a graduate student in computer science this fall.

As for the future, McNett, like most 17-year-olds, is undecided. “I don’t know what I’m going to do. I may start a business or I may go into research,” he says.

Supportive Faculty, SCR Fellowship Highlight Graduate Studies —Russ Brickey

Cassondra Neau (MSEE ’00, PhD ’04) came to Purdue after graduating from Duke University in 1998.

“When I went to college I was considering a major in biomedical engineering,” Neau says. “As I got into the biomedical program I discovered that the part I liked best was the electrical engineering.”

Exploring graduate programs, she chose Purdue. “I found the faculty at Purdue to be very approachable and helpful,” Neau says. “They were willing to talk to a prospective graduate student like me about what I wanted to do rather than how I would fit into a slot they had for me.”

Her graduate work, which focused on device and circuit architecture for scaled technologies, garnered Neau a
Young Alum on Academic Fast Track

— Russ Brickey

She received a research fellowship from the Semiconductor Research Corporation. SRC, a consortium of semiconductor manufacturers, was founded in 1979 to maintain American technological leadership.

Her research involved simulations on predictive devices to explore possibilities for the next few generations of technologies—“what we might see in the next ten years or so,” Neau says.

In addition to her graduate studies, Neau was a volunteer coach for the women’s rowing team and a math tutor for high school students from her local church. She worked for two summers at Motorola on circuitry design. She also attended two SRC student conferences in Texas and Arizona.

“ ‘The conferences were a great opportunity to meet students from other universities and to meet people from industry who are interested in hearing about your work.

“For incoming female students my advice would be to get involved with the Women in Engineering Program,” Neau says. WIEP was the first of its kind in the nation and is a model for similar programs at other universities. “I participated in the graduate mentoring program for several years and found it to be both fun and helpful.”

Purdue’s Renaissance Man — Theron Francis

For Nathan Hall, recent graduate and recipient of the Outstanding Undergraduate Award in ECE in 2004, his time at Purdue was a matter of balance: “I was able to get so much out of my college experience, while at the same time succeeding at one of the most difficult majors at Purdue,” Hall says.

Hall’s path to Purdue was paved by the Lilly Endowment scholarship he received upon graduation from high school in South Bend, Ind. While on campus, Hall served as an officer of Eta Kappa Nu. He participated in HKN’s social events and community service projects, including the society’s voter registration drives and Thanksgiving festivals that support the Salvation Army.

Hall was also on the staff of Purdue’s student newspaper, The Exponent. As a writer and column-
At Purdue, graduate student Hombs’ research into wireless systems rocks, as does his band, Awkward Silence.

Diversity Key to Guitar-Playing Graduate Student — Theron Francis

Brandon Hombs is using the potential of dissonance to overcome interference problems in multi-carrier wireless systems. To support his research, the National Science Foundation awarded Hombs a three-year fellowship, which he recently completed. He plans to graduate in 2005.

This summer, Hombs’ research led him to MIT’s Lincoln Laboratories, where he conducted research on wireless terrestrial communications using multiple antenna systems. Multiple antennas create a “constructive” interference that results in more accurate reception. Hombs compares the system to dialogue in a rich, multi-ethnic society:

“As in social diversity, in which you get different points of view about the same thing, using multiple antennas we get different points of view of the same signal, and we call that diversity.” This diversity, Hombs says, leads to “higher data rates and more robust communication.”

With his NSF fellowship, Hombs was free to attend any of several universities. He chose Purdue, where he also earned his master’s degree. “I knew I would receive strong support from my Purdue professors,” Hombs says. “I’m particularly grateful for the guidance of my adviser, Professor James Lehnert.”

Hombs has also appreciated Purdue’s cultural diversity. At Purdue, he says, there are graduate students from around the globe. “It’s been great to get to know them and their different perspectives on research, on culture, on politics, and on the world.”

In his spare time, Hombs pursues his love of music. He gives trumpet lessons and plays in the University Jazz Band, the Lafayette Citizen’s Band, and the Purdue Symphonic Band. He also plays guitar in his rock band, Awkward Silence.
2003-04 Scholarship, Fellowship, and Award Winners

Departmental Merit-Based Scholarship Recipients

**3M Scholarship**  Landis Huffman

**Allied Signal Scholarship**  Fraz Ahmed, Eric Naglich, Chris Rodgers, Ryan Shartle

**Karl H. Bollenbach Memorial Scholarship**  Christopher Newton

**BP Amoco Scholarship**  Brandon Dickerson

**Class 2002 Scholarship**  Adam Solomon

**Dorothy Digges and Albert M. Wiggins Scholarship**  Andrew Whipple

**Professor El-Abiad Scholarship**  Aaron Replogle, Benny Wing Fei Wong

**FesSENDEN-Trott Scholarship**  Bret Charles Britton, Christopher Coy, Sean Duff, Dimitrios Karabnis, Justin Daniel Lanning, Brian McCammack, Michael Newman, Elizabeth Strehlow, Blake Strouse, Jennifer Tietz

**Giles Morrill Memorial Scholarship**  Bryn Nealis

**William H. Hayt Memorial Scholarship**  Mark Kaehr

**Charles and Anna Holder Scholarship**  Neil Bedwell, Lee Bush, Brent Krumfer, Chad Lau, Carl Obremski

**George Hollister Scholarship**  Ravi Bhavasar, Nathan Hall

**Donald E. Knebel Scholarship**  Joshua Larsen

**Lockheed Martin/Wireless Center Scholarship**  Carl Obremski, Gregory Sutton

**Long Electric Scholarship**  Bryn Nealis, Adam Solomon

**McDonnell Douglas-Boeing Scholarship**  Mary Knox, Siou Lin, Esteban Rodriguez, Jennifer Sharp, Colleen Shea, Catherine Slater, Rachael Voss

**William and Mary Meese Scholarship**  David Bedwell, Clayton Edens, Landis Huffman, Matthew Lehtinen, Seth McAlarney

**Thomas Alexander Prewit Memorial Scholarship**  Aaron Replogle

**Donald Quillin Memorial Scholarship**  Nan Zhou

**Rappaport Wireless Communications Scholarship**  Wonbin Hong, Ki Nyeng Kang, Curtis Watson

**Samuel David Williamson Scholarship**  David Eaton

**Ernest E. Swanbeck Scholarship**  Ammar Bustami, Dimitrios Karabnis

**Tellkamp Scholarship**  Sumit Mehra, Jared Suttles, Brian Sutton


**Industrial Affiliate Scholarships**

**Advanced Micro Devices**  Clive Lopez, Craig Noble, Allan Patterson, Peter Richmond, Edwin Tjandraanegara

**BAE Systems**  Sean Duff, Hsan-yin Hsu

**Cisco Scholarship**  Chad Baker, Rolin Pettway, Brian Stroube

**Convergys Scholarship**  Michael Dorsey, Adrian Hardin, Loulwa Salem

**Gilei-Klark**  Nirav Lad, Raghuram Ramanujan, Ryan Riley, Siddarth Sen, Joel Stubbs

**Lockheed Martin**  Michael Constant, Anthony Eddy, Jason Kaeding, Long-Wei Lu, Matthew Makowski

**Lucent Technologies**  Hasrat Godil

**Motorola**  Afua Bruce, Ryan Hicks, Derrick Kearney, Jose Mendez, Christopher Thomas

**Texas Instruments**  Nur Farahiah Mustaffa, Phyllis Ng, Tera Wong

**Other Scholarships and Awards**

**Angus Sciencegtech Most Improved Student Award**  Adam McNeal

**Eta Kappa Nu Outstanding Sophomore Award**  Adam Beardsley

**Eta Kappa Nu Outstanding Junior Award**  Otto Parson

**Purdue Student Engineering Foundation Outstanding Senior Award**  Nathan Hall

**Purdue Student Engineering Foundation Outstanding Graduate Student Award**  Gilbert Tseng, Estus H. and Vashti L. Magoon Awards for Graduate Teaching Assistants  Linoy Alex, John Andrews, Aditya Bansal, Pablo Estrada, Wessam Hassanein, Samir Iqbal, Rouzbeh Jazayeri, Jaebang Kim, Michael Malteich, Hasan Raza, Kirk Riley, Waseem Sheikh

**Motorola Outstanding Student**  Aldi Haryoprationom

**Motorola Outstanding Graduate Student**  Sungjae Lee

Continued on next page.
Fellowship Recipients

**Andrews and Mary I. Williams Fellowships**
Kirk Bevan, Aaron Cramer, Seunghee Lee, Ethan Schuchman

**Birck Fellowships**
Sorubh Mahadoo, Eduardo Maia

**Chappelle Fellowship**
Aaron Ault

**Cisco/Top Gun Fellowships**
John Leimgruber, Curtis Watson

**Fullbright Fellowship**
Eduardo Garcia, Fabian Perez

**GAANN Fellowships**

**GEM and McDonnell Douglas-Boeing Fellowships**
Tracy Brown, Patrick Carpenter, Kevin Dale, Andreas Garcia, Chanon Jones, Paul Kirby, Carol Smith, Torrey Walker

**Intel PhD Fellowship**
Chris Hyung-Il Kim

**IGERT Fellowships**
James Cale, Brandon Cassimere, Brant Cassimere, Benjamin Loop, Brian McEnany

**David Knox and INAC Fellowship**
Angelica Davila

**Meissner Fellowships**
Hoi Ho Chain, Uday Chettiar

**NSF Fellowships**
Brandon Hombs, Paul Kapur

**Purdue Fellowship**
Alberto Vega

**Purdue and INAC Fellowship**
Adina Scott

**Puskas Memorial Fellowship**
Sorin Bengea

**Ross and RCA-Zworykin Fellowships**
Steven Cauley, Qikai Chen, Amanda Doyle, Mark Krasniewski, Dan Luu, William Nagel, Helena Quixada, Swatee Singh, Sarah Sellke

**SRC Fellowship**
Cassondra Crotty Neau

**Whitaker Fellowship**
John (Brandon) Laffen

Scholarship/Fellowship Facts and Figures

For the 2003-2004 academic year, ECE undergraduate students received 135 ECE merit-based scholarships for a total of $182,250. ECE enrolled 1,140 undergraduate students as of the fall 2003 semester. Some undergraduate students received multiple awards. The number of awards to the number of scholarship applicants (not including eight Fessenden-Trott scholarships) was 68 percent.

For the same year, 52 graduate students received Purdue, ECE, and external fellowships, including new awards and renewals, for a total amount of approximately $2,184,000. In addition, 101 teaching assistantships and 278 research assistantships were awarded. ECE enrolled a total of 522 graduate students as of the fall 2003 semester. Some graduate students received multiple awards.
Editor’s note: The following has been condensed from the keynote address delivered by Jack Shaw (BS ’62, HDR ’98) at the Indiana Technology Summit VI at the Convention Center in Indianapolis on October 1, 2003.

It’s great to be back home in Indiana. I say “home” with feeling. Not only did I grow up and go to school here, but my wife Sue and I own a farm north of Ft. Wayne where we raise Clydesdale horses.

I must confess that there aren’t too many similarities between my horse business and starting up and running high-tech manufacturing companies. Except when I’m out in the barn—with a pitchfork in my hands.

Then I realize how much time I’ve spent as the manager of high-tech businesses dealing with just such everyday chores. Part of every manager’s job description—whether it’s in writing or not—includes “cleaning up after the horses.” That’s certainly true at the half-dozen startups I’ve been involved with as an investor or principal over my career.

Starting Up Hughes Network Systems

Almost 35 years ago, we started the company that’s now known as Hughes Network Systems. Our idea was to create a piece of equipment based on a new technology—digital communications—and sell that equipment to the big phone companies who were just starting to use satellites.

We mortgaged our houses and our kids’ futures for cash. We used a garage as our workspace and laid a piece of plywood across a couple of sawhorses for our worktable. We swept the floor ourselves.

Then we had to explain to our customers just what the heck digital technology was—and why it was better for them than analog. And, of course, God forbid, we had to learn how to actually manufacture the products we were convincing them to buy. We decided we were a new kind of company—a high-tech manufacturing company. The bankers decided we were nuts.

But Hughes Network Systems is still here today, a thousand times bigger than when we started. And we’re still moving up the value chain in high-tech manufacturing. How did we do it? More importantly, how can we all continue to do it in today’s even more difficult times and more competitive environment?

One Key to Success: University Alliances

Today, so much of manufacturing is automated that you can be competitive in Maryland—or Indiana—despite higher labor costs. Manufacturing has to be automated both to lower cost and to ensure consistent high quality. And automation is really knowledge-intensive.

That’s where universities like Purdue come in. They’ve got really bright technology people, great research centers, and thriving networks of supportive alumni. And, they usually can offer favorable licensing policies for just the types of manufacturing breakthroughs that we managers need to stay competitive. Universities have both resources and insights to offer us. But we also need them to help us attract the best engineers and technology people to our companies. It’s been my experience that you can’t get the best graduates—those with an entrepreneurial spirit—unless there’s a good educational system available to them for their continuing education.

Jack Shaw, President and CEO (Retired), Hughes Electronics

Continued on next page.
“Universities have both resources and insights to offer us. But we also need them to help us attract the best engineers and technology people to our companies.”

Another Key: Help from the Public Policy Sector

Another key to high-tech manufacturing success is getting help from the public policy sector in your state. Often, state and local governments don’t understand how mobile our high-tech employees are, how sensitive they are to local income taxes, housing costs, and the like. To lose them is to lose value as well as capability.

And they may not understand how precarious the finances of young high-tech manufacturing companies are. High-tech companies go broke really quickly.

Early one spring, as Hughes Network Systems was growing fast, we realized that we’d need another 100,000 square feet of manufacturing space by the end of the year. Those of us managing the company’s cash flow had to wait to the last possible minute to make sure before giving the go-ahead.

Our state and county officials really helped us. They came up with the idea of a technology corridor in our county and streamlined the approval process for us to build a new building. Partnership with state and local governments is absolutely essential for success.

Indiana’s Fiber Optic Network

Getting help from the state in setting up the infrastructure needed by high-tech companies is also crucial. All the great ideas that engineers have can’t be brought to reality, can’t create jobs, and can’t generate new taxes without the right infrastructure.

Here in Indiana the legislature has passed a bill to finish building the state’s fiber-optic network. That will make it more widely accessible to companies as well as colleges statewide. Creating an information superhighway will help Indiana attract even more high-tech jobs.

Another Key: Focusing on Our Customers

As business managers, what should we be doing to ensure our companies’ success? Learn how to work with our customers to deliver the products they need, rather than the products we want to build.

Technology is the engine that makes the world go forward. But technology also is a scary word to many customers—especially when it comes to high-tech products that keep changing rapidly.

For the first 15 years of Hughes Network Systems, we built cool stuff and went out to find markets and customers. We’ve been a lot more successful over the last 15 years by going out and asking our customers what they want and then coming back and building cool stuff to meet their needs. You cannot be scared if what the marketplace is telling you changes your ideas. It’s really important to build flexibility into your staff, your organization, and your plans.

Stay with things that make sense in the markets you’re in and the competitive environment you are in. But be willing to change everything else.
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You cannot be scared if what the marketplace is telling you changes your ideas. It’s really important to build flexibility into your staff, your organization, and your plans.

Facing Our Global Competition

In today’s economy, that advice goes doubly for the international sector. You can’t be fearful of losing jobs overseas when the labor costs there are a lot lower, while their manufacturing capability and quality may be as high as or higher than yours.

At Hughes Network Systems, we put three subsidiaries in India. Doing so did not cost us jobs at home. Instead, we gained jobs because we made additional sales by being more competitive. And we were able to bring new products to market because we could factor in their low-cost labor to our manufacturing and marketing overhead.

We were also able to successfully split new product development work between our U.S. and overseas facilities. You can do it, and more than that, if you don’t figure it out you will be putting your company at a disadvantage.

None of us can afford to be afraid of global competition. It’s a reality. Based on my own experience, I believe even global competition can contribute to our success here at home.

You hold our future in your hands. The creation of new intellectual property is the engine driving business today, and you are in a unique position to be the fuel for that engine.

Our country’s greatness lies in our principles, our courage, and our passion for freedom. But without technology, we would be hard-pressed to achieve the goals we set for ourselves.

You are very important to your country and your state. Never lose your fire, your curiosity, your passion for the future.

Best wishes for a healthy and prosperous high-tech industry in Indiana.

“Your country’s greatness lies in our principles, our courage, and our passion for freedom. But without technology, we would be hard-pressed to achieve the goals we set for ourselves.”
“We have set our sights high and are implementing our strategic plan to be the recognized leaders in undergraduate and graduate education. Toward that end, we are working hard to establish world-class research centers in our signature areas, build state-of-the-art facilities, and attract to our school the world’s brightest students and faculty scholars to complement the outstanding talent already in place. I believe we are making excellent progress and are well positioned to reach our goal of international preeminence.”

— Mark J. T. Smith

In our next issue of Wavelinks, we will update progress made on the bricks-and-mortar phase of the ECE Building Campaign. New classrooms, new labs, new space to support our drive to preeminence — all thanks to your support.