

2003

EEEK

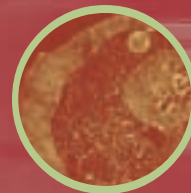
ANNUAL RESEARCH REVIEW

A PUBLICATION OF THE ELECTRICAL ENGINEERING DEPARTMENT UNIVERSITY OF WASHINGTON

Electrical Engineering Kaleidoscope

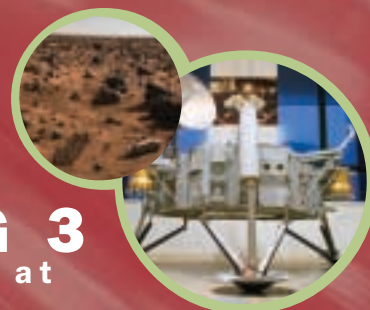


SPRITES over BRAZIL



MAGNETIC fields TO ZAP MALARIA

the SCIENCE OF SOUND



VIKING 3 LANDS at UWEE

PLUS...

EDUCATION...PERSPECTIVES...FACULTY DIRECTORY...MILESTONES & INNOVATIONS...

Growing forward, plowing back

The win/win mission of WRF Capital:

WRF Capital provides seed financing and active professional support to technology-based Northwest start-ups. But unlike any other venture capital company, we plow back a major portion of our gains to the Northwest "seedbed" institutions where so much technological progress originates. That's our program. And it works! WRF Capital currently has 15 active investment projects. Our growing endowment asset base now exceeds \$50 million. And to date, over \$100 million has been earned for or donated to

the research institutions of the Northwest. (Primarily the University of Washington.) WRF Capital: investing and reinvesting in Northwest technological progress.

WRF Capital and Amnis Corporation: David Basiji and Bill Ortyrn had an idea: find a way to analyze cells, proteins and the genetic code with orders of magnitude more speed and sensitivity than currently possible. The capability would be of inestimable value, leading to new life-saving drugs and

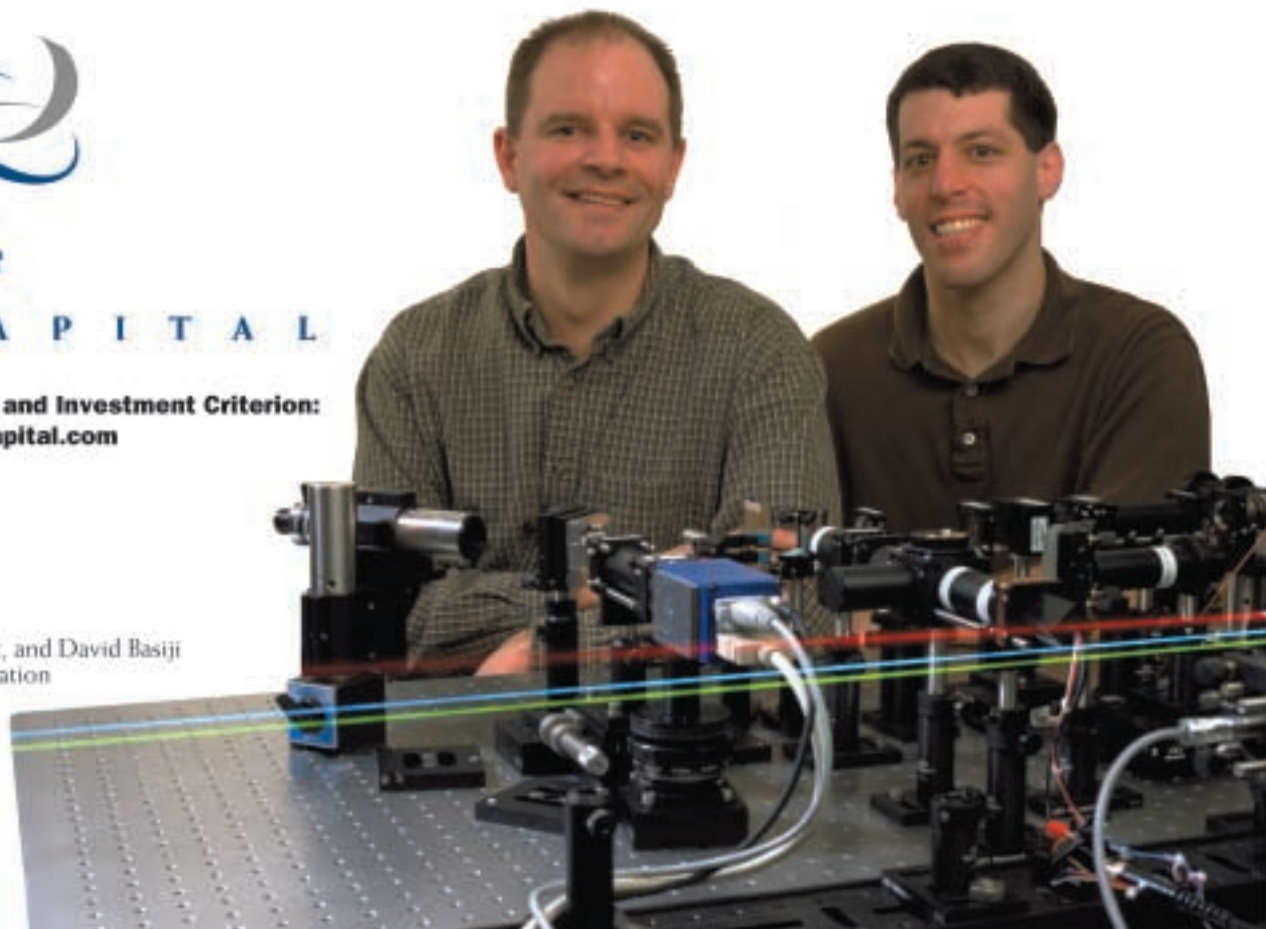
powerful medical diagnostics. By fusing new ideas with the latest technologies in optics, lasers and image processing, they knew it could be done. Then WRF Capital, in association with Stratos Product Development, stepped in to help them found Amnis and finance the development and prototyping of their device and process. The Amnis *ImageStream* will be a giant step ahead for science. The investors will profit. And so will the research institutions of the State of Washington.



W R F
C A P I T A L

Information and Investment Criterion:
www.WRFCapital.com

Bill Ortyrn, left, and David Basiji
Amnis Corporation



2003 EEK

ANNUAL RESEARCH REVIEW

RESEARCH...

SPRITES Over Brazil	...2
Robotic HANDS in Space	...3
Antarctica 1964-1965/Antarctica 2003	...4
SIZE MATTERS: New Micro Technologies	...5
MICRO FALLINGWATER	...5
Magnetic Fields to Zap MALARIA	...8
The Science of SOUND	...9
The Mars GRAVITY Biosatellite Project	...10
VIKING 3 Lands in UWEE	...11
Next Generation PHOTONICS	...12
World's First PASSIVE RADAR INTERFEROMETER	...13
Researchers at UW Accelerate IMAGE COMPRESSION by 450 Times	...13
Approaching BORG —Melting Human & Machines	...14
Algebraic SYSTEMS THEORY and DNA Structure	...15
LIFE ON A CHIP Continues	...16
Talking TREES	...16

EDUCATION & OUTREACH...

F.I.R.S.T. Again	...6
ROBOTS + KIDS = Fun & Learning	...7
ROBOT Reality TV	...7

RECOGNITION...

EE Alumnus Awarded University's HIGHEST HONOR , Inventions Scheduled for Permanent Display at Smithsonian	...17
SINCLAIR and GENEVIEVE YEE Honored for Community Service Work	...17
EE Students Take FIRST PLACE in Phase 1 of SiGe IC Design Challenge	...18

PERSPECTIVES...

Riding the WAVE	...19
------------------------	-------

DEPARTMENT UPDATES...

FACULTY Directory	...20
MILESTONES	...22
CONSTRUCTION Progress	...24



WELCOME to EEK2003

The back cover sets the tone for our upcoming centennial year. In 1909, on the site of what became the "new" UW campus, the Alaska-Yukon Exhibition celebrated the Gold Rush. Now we are participants in a new technological "gold rush," as evidenced by the diverse research activities of the department. This third annual edition of EEK contains a sampling of these efforts.

It has been an exciting year for the EE department. More research, more faculty and more space—despite a challenging state budget situation. Highlights of the year: ABET accreditation success; \$22.5M in external funds in 2001-2002 (450% increase from \$5M in 1998-1999); All eligible new professors hired from 1998 to June 2002 have the NSF CAREER Award; Incoming women graduate students increased from 20% to 33%; eight female tenure track faculty as of this spring.

As I complete my fifth year as Chair of the EE Department, I'd like to take this opportunity to thank all of the faculty, staff and students who have made this job so rewarding—and who have so effectively contributed toward our mission of *Excellence in Education through Cutting Edge Research*.

— **HOWARD CHIZECK**
Professor and Chair
Department of Electrical Engineering

EDITORIAL CREDITS

PUBLISHER

Electrical Engineering Department of the University of Washington
Howard Chizeck, Chair
Mari Ostendorf, Associate Chair for Research
John Sahr, Associate Chair for Education

EDITORIAL STAFF:

Laura Allan, Howard Chizeck

DESIGN STAFF:

Sarah Conradt, Designer

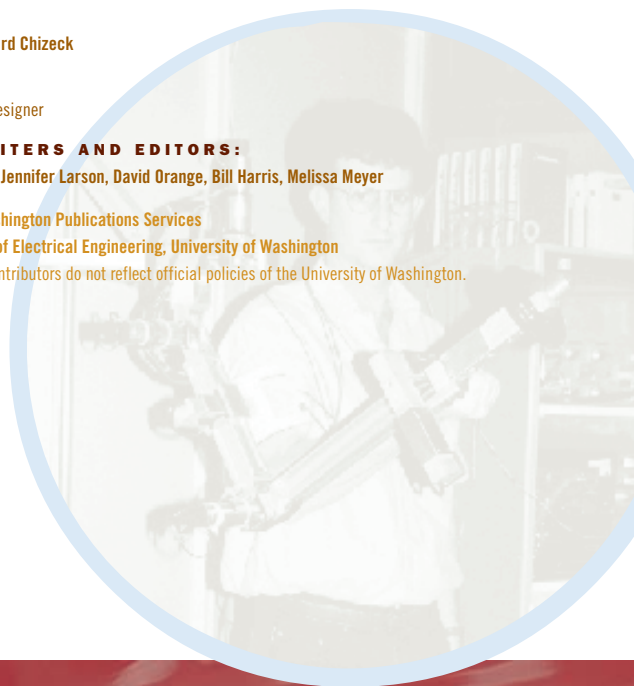
CONTRIBUTING WRITERS AND EDITORS:

Stephen Graham, Jennifer Larson, David Orange, Bill Harris, Melissa Meyer

Production by University of Washington Publications Services

©Copyright 2003, Department of Electrical Engineering, University of Washington

The opinions expressed by the contributors do not reflect official policies of the University of Washington.





SPRITES

over

BRAZIL

by **LAURA ALLAN**

Thought you saw something, blinked your eyes, and then it was gone? Imagine trying to measure sprite properties; an optical phenomenon that occurs like sparks in the sky above active thunderstorms, lasting about 5-300ms.

PICTURED

THE SPRITE BALLOON
EXPERIMENT TEST FLIGHT
FROM TILLAMOOK, OR.
MAY 15, 2002.

DURING November and December of 2002, researchers from UW's Electrical Engineering and Earth and Space Sciences departments collaborated with Instituto Nacional de Pesquisas Espaciais (INPE) in Brazil and Utah State University to study sprite events in Cachoeira Paulista, Brazil. The term "sprite" was first proposed by Dr. Davis Sentman from the University of Alaska for these high altitude flashes because of their unpredictable, erratic, and seemingly mystical behaviors.

The experiment was conducted in Brazil, home to some of the world's most magnificent thunderstorms. It involved launching balloon payloads over thunderstorms to measure electric fields, magnetic fields, and x-rays associated with sprites, while a plane flying over the storms recorded lightning activity using an image-intensified video at the same time.

Before heading to Brazil, EE Professor Tim Chinowsky was involved in building the payload for the balloon. He designed a high-speed

data acquisition and telemetry system that collects x-ray, magnetic field and electric field measurements and transmits them to a receiving station on the ground. "This payload is unique in its ability to measure both high and low electric fields. The high field measurements in particular have not been done before, and may help to increase our understanding of the physics behind sprite and other lightning events," said Chinowsky. "Another feature of this experiment is that both the payload and ground support equipment was built here at UW. So, we will be able to quickly and inexpensively repeat this experiment almost anywhere around the world."

In addition to Chinowsky, the project team includes ESS Professors Bob Holzworth and Michael McCarthy, Michael Taylor of Utah State University, Osmar Pinto Jr. from INPE, graduate student Jeremy Thomas, and undergraduate students Graylan Vincent, and Amit Mahtani. [EEK2003](#)

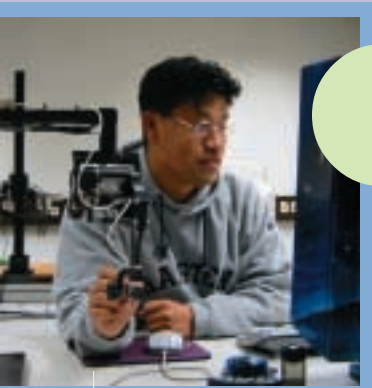
ROBOTIC HANDS IN SPACE

POSTDOC JEE-HWAN RYU from the Biorobotics Lab

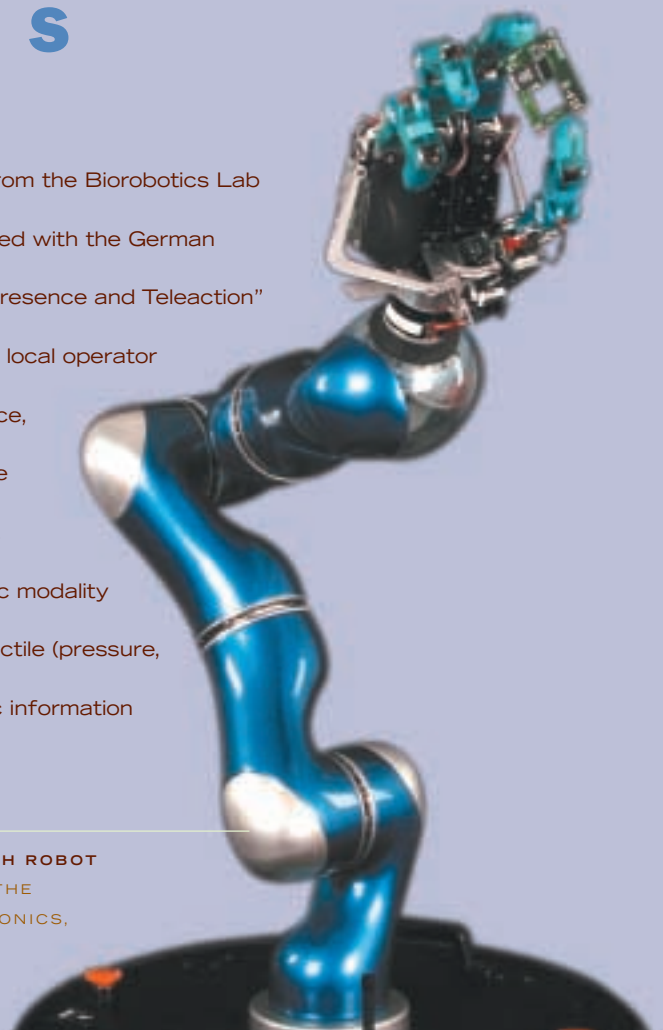
directed by Professor Blake Hannaford has collaborated with the German Space Agency DLR in Munich on a "High-Fidelity Telepresence and Teleaction" robot. It is designed to overcome barriers between the local operator and the remote environment, such as by spatial distance, inaccessible environments, and scaling tasks (which are present in minimal invasive surgery or micro assembly).

In addition to visual and auditory information, the haptic modality plays an important role. The haptic sense comprises tactile (pressure, temperature, roughness, and vibration), and kinesthetic information (proprioception, forces).

THE NEW DLR LIGHT-WEIGHT ROBOT WITH ROBOT ARM AND HAND. PHOTO COURTESY OF THE INSTITUTE OF ROBOTICS AND MECHATRONICS, GERMAN AEROSPACE CENTER (DLR).



DR. RYU MANEUVERING A SLAVE ROBOT AT THE REMOTE SITE WITH A PHANTOM HAPTIC DEVICE.





ANTARCTICA

1964-1965

IN THE 1960s, under the auspices of the NSF, a team of EE faculty, graduate students, and staff conducted experiments involving the propagation of electromagnetic waves between Antarctica and receivers throughout the world. In 1964-1965, three graduate students in Antarctica installed a 21-mile antenna that crossed a 10-mile antenna at right angles. Emeritus Professor Irene Peden and Professor Ward Helms (seated in photo above) were involved, along with former faculty Myron Swarm, Donald K. Reynolds, and retired staff member John Schulz. Dr. Peden was the first female faculty member of the department, joining in 1961.

PICTURED

KC4AAD WAS THE EE DEPARTMENT BYRD VLF SUBSTATION IN ANTARCTICA. THE EXPERIMENT SITE AND TRANSPORTATION IS SHOWN IN THE POSTCARD AT RIGHT.



2003

EE GRADUATE student Anthony Mactutis and UW's Earth and Space Science Professor Gonzalo Hernandez are installing precision optical sensors in Antarctica, which will be used to observe winds in the upper atmosphere. Mactutis has been building this instrument over the past year and will now get to find out just how well it works in the field.

Data from this instrument is useful for describing the circulation of high altitude air near the poles. These air circulation patterns are important for understanding long term global climate change, as well as more immediate effects such as the "ozone holes" which form in the high latitude winter hemisphere and are most pronounced over Antarctica. This continues a 50-year tradition of EE in Antarctica.

4

E

lectrical

E

ngineering

K

aleidoscope 2003

SIZE MATTERS: NEW MICRO TECHNIQUES

WITH ADVANCES in micro electronics and innovative materials, fabricating and manufacturing small systems becomes ever more possible, but manipulating and integrating devices at the micro scale is a major challenge because the forces that dominate at such small scales are vastly different than those at the macro scale. An interdisciplinary team led by EE Professor Karl Böhringer is developing techniques to manipulate micro objects by using surface forces with objects such as fabricated micro devices and protein or biological cells.

One project focuses on using surface tension to assemble micro devices on specific sites on a single substrate. This research aims to integrate different types of functional micro devices (electrical, mechanical, optical, chemical, biological) into a heterogeneous working system. The self-assembly techniques use a silicon substrate with hydrophobic alkanethiol-coated gold patterns as the binding sites. To assemble each batch of micro devices, an electrochemical method is used to selectively activate the desired binding sites. A hydrocarbon polymer wets the active binding sites in water and attracts, anchors, and bonds the devices to the substrate. By repeating the processes, multiple batches of micro components can

AN ILLUSTRATION OF
ARRAYS OF SELF-
ASSEMBLED SQUARE
SILICON PARTS.

be organized on to the substrate. This is a joint collaboration with Professor Schwartz from Chemical Engineering and is funded by the NSF.

A second project is developing proteomic and chemistry chips with programmable surfaces for protein and cell patterning. With a temperature sensitive polymer deposited on to arrays of micro-fabricated metallic heaters, modulation of the surface chemistry from non-fouling to fouling can be achieved by activating each individual heater in an aqueous environment. Two types of proteins and two types of cells were used to demonstrate localized immobilization of proteins and cells on such surfaces. This project is funded by NIH and NSF. It is a joint effort between the MEMS lab and Xuanhong Cheng and Buddy Ratner from Bioengineering.

MICRO Fallingwater (WITH APOLOGIES TO FRANK LLOYD WRIGHT)

A 1/1 MILLIONTH SCALE
VERSION OF FRANK LLOYD
WRIGHT'S FALLINGWATER,
INVISIBLE TO THE NAKED EYE.

KARL BÖHRINGER fabricated a model of Frank Lloyd Wright's Fallingwater using a silicon micromachining process in collaboration with Ken Goldberg from University of California at Berkeley. It is based upon the blueprints from Frank Lloyd Wright, automatically decomposed into a sequence of rectangles, which allowed the generation of patterns on lithography masks. The micro Fallingwater structure was fabricated on a silicon wafer in a sequence of lithography, deposition, and etching steps. This work, initiated several years ago, has recently been "discovered" by certain science magazines.

F.I.R.S.T. AGAIN



LAST SPRING, high school students from school districts in Washington, Oregon, Alaska, Hawaii, five other states, and even Brazil competed at the first Pacific Northwest Regional FIRST (For Inspiration and Recognition of Science and Technology) robotics competition, held at the University of Washington. After six weeks of intense design and construction, over 30 teams of high school students and their professional mentors demonstrated their skill for science, mathematics and technology in a competition for honors and recognition that rewards design excellence, competitive play, sportsmanship and high-impact partnerships between schools, businesses and communities. In a cross between NASCAR, basketball and TV robot shows, teams competed to a crowd of excited spectators accompanied by bands, cheerleaders, balloons, lots of excitement-and a collection of university faculty and administrators and regional technology industry leaders.

AFTER THE COMPETITION. BACK ROW, LEFT TO RIGHT: HOWARD CHIZECK, EE DEPARTMENT CHAIR; DANIEL PARK, STUDENT TEAM MARKETING VP; JEFF BEZOS, CEO OF AMAZON.COM. FRONT ROW: PROFESSOR ALEXANDER MAMISHEV, TEAM ADVISOR.



STUDENTS WORKING IN THE PIT.

Among the teams who competed last year was our own SWAT (Students Working Against Time) Robotics team (swatrobotics.org). The members of this team were students from Roosevelt High School, and the "technical advisors" were undergraduates from the University of Washington. Our team competed very well in the regional competition, and then in the national competition in Orlando. The UW effort, led by Professor Alexander Mamishev was featured in two stories aired on NPR's "All things Considered" (see episode six at: www.npr.org/news/specials/roosevelt/index.html).

This year, SWAT is again fielding a team combining the talents of Roosevelt High School and UW. You can follow their experiences in a series of articles appearing in the Seattle Post-Intelligencer (see first article at: seattlepi.nwsourc.com/local/104225_robots15.shtml). On April 3-5, 2003 the second annual Pacific Northwest FIRST Competition will be on campus at the Bank of America Arena.



DURING COMPETITION.

ROBOTS+KIDS= Fun and Learning

SMALL, mobile, self-directed, and still learning: this describes kids and autonomous robots. Bring them together and the results are a joyous mix of fun and learning.

The robots are the work of the Autonomous Robotic Control Systems (ARCS) Lab, run by EE Professor Linda Bushnell and Research Mentor Andy Crick of springdesign.com. The lab supports a variety of research on cooperation and communication between groups of robots, managing their batteries and power systems, and creating new abilities through ingenious digital electronics.

The kids come from a variety of local schools reached through the K-12 Outreach Program. Each year, the ARCS Lab host demonstrations at the Engineering Open House designed to intrigue a spread of interests and abilities. Other events have ranged from a visit to a 1st grade class at a Mercer Island elementary school to a series of workshops for teenaged girls at Shoreline Community College, all

quite successful. As a parent from Mercer Island wrote concerning her son: "I'm amazed that he picked up on so much and listened so well (not always the case)."

The ARCS lab is generously supported by The Boeing Company, Altera Corp., Clare Inc., Pitsco LEGO Dacta, Maxim, Coilcraft, E-Tech chips, and Ford Motor Company.

AN AUTONOMOUS MOBILE
ROBOT SHOWN TO MRS.
WILSON'S 1ST GRADE
CLASS AT LAKE RIDGE
ELEMENTARY SCHOOL
IN MERCER ISLAND, WA.
(PHOTO COURTESY OF
ANDY CRICK.)



ROBOT REALITYTV

JUSTIN WAHLBORG (ME Grad), Tho Nguyen (EE Senior) and Jon Gosting (EE Senior) are in the midst of a national robotics competition on the Do-It-Yourself network, a small cable station broadcasting from Knoxville, TN. The show is called *Robot Rivals*, and the idea is straightforward. Teams are given menagerie of parts, eight hours and a goal. The show provides a workspace, some equipment, and has a dedicated set for filming that resembles a minimalist, futuristic living room.

Assisted by Professor Linda Bushnell and EE mentor Andy Crick, the student team has prepared for battle against teams from MIT, Cornell, Georgia Tech, Virginia Tech, Harvard, and Berkeley. Once built, these mostly autonomous robots will be challenged to find and extinguish a fire, climb ropes, or any other concept the TV executives dream up.

In the first battle, UW's team will face off against Purdue in a Paul Bunyan style chopping and logging competition. Adding autonomous capabilities to the robots presents extra challenges. Since the robots have to fend for themselves, they'll need a combination of general abilities such as maneuvering, and other failsafe mechanisms complemented by task specific tools and intelligence. Because the show doesn't give the teams enough time to complete a fully autonomous robot, they have to combine elements of remote control to the robot intelligence. The DIY network will also show the audience how to build the robot that the engineers enter into the competition.

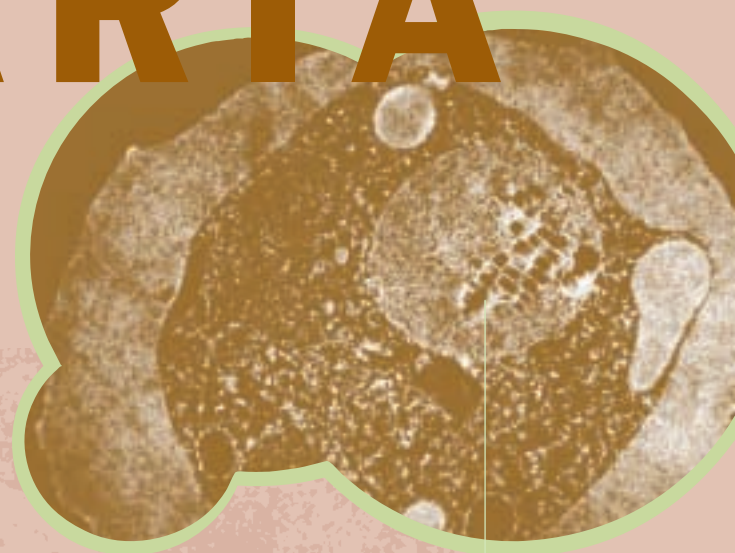
The station hopes that the competition exposes viewers to every aspect of robot construction, from soldering, to programming. While the network's usual fare covers home improvement, the show is bringing in robots because as the VP of programming explained, creating an autonomous robot "is like the ultimate how-to project."

MAGNETIC FIELDS to ZAP MALARIA

MAGNETIC FIELDS could prove to be a revolutionary tool for controlling malaria, a disease that the World Health Organization deems as one of the world's most complex and serious human health concerns.

The malaria parasite, Plasmodium, appears to lose vigor and can die when exposed to oscillating magnetic fields. These fields cause tiny iron-containing particles inside the parasite to move in ways that damage the organism. Further studies are being conducted by UW researchers to find the best field strength and exposure duration to destroy the parasite in the human body. In the past two decades, the emergence of drug-resistant malaria parasites has created enormous problems in controlling the disease. The magnetic field method could bypass those concerns because it is unlikely Plasmodium could develop a resistance to magnetic fields.

Work conducted by a collaboration of UW researchers appears to take advantage of how the parasites feed. Malaria parasites "eat" the hemoglobin in red blood cells of the host. The globin portion of the hemoglobin molecule is broken down, but the iron portion, or the heme, is left intact because the parasite lacks the enzyme needed to degrade it. This causes a problem for the parasite because free heme molecules can cause a chain reaction of oxidation of unsaturated fatty acids, leading to membrane damage in the parasite. The malaria organism renders the free heme molecules non-toxic by binding them into long stacks like "tiny bar magnets."



A MALARIA PARASITE WITHIN A HUMAN RED BLOOD CELL. THE LARGE CIRCLE IN THE PARASITE IS A FOOD VACUOLE. STACKED HEME ARE VISIBLE INSIDE THE VACUOLE.

The oscillating magnetic field may affect the parasites in two ways. First, in organisms still in the process of binding free heme molecules into stacks, the alternating field likely "shakes" the stacked heme molecules, preventing further stacking. This would allow harmful heme free reign within the parasite. Second, if the parasite is further along in its life cycle and has already bound the heme into stacks, the oscillating field could cause the stacks to spin, causing damage and death of the parasite.

If the method is proven effective and safe, researchers envision rooms equipped with magnetic coils to produce the oscillating fields to facilitate treatment. A portable handheld device could also be feasible, where treatment from village to village could be made easier.

Collaborating researchers include EE Research Scientist Ceon Ramon, as well as UW professors Henry Lai and Jean E. Feagin. The project is funded by a generous gift from the Akibene Foundation.



THE SCIENCE of SOUND:

by JENNIFER LARSON

Speech Recognition Projects Conducted in EE Labs

“IT’S NOT WHAT YOU SAY, it’s how you say it,” explains EE Professor Katrin Kirchhoff, referring to a project that creates and integrates a correction module into an automatic dialogue system. Kirchhoff, along with EE Professors Mari Ostendorf and Jeff Bilmes, work on projects that aim to solve existing problems with current speech recognition systems and create new theories in speech technology, language technology, and general signal interpretation.

Speech recognition systems are primarily based on a dictionary of set words, probability, and statistics. When a machine picks up a speech signal, it extracts certain features of the speech to make vectors, such as kuh-ah-t for cat. These vectors are then subjected to an acoustic model, which breaks the vectors into sounds. The system then matches the sound model to its speech dictionary, repeats the word recognition process previously stated, and then uses a series of statistics to determine what the user is saying. However, sometimes a user speaks an unrecognized word. In an angry attempt to correct the system, the user will enter into a correction sub dialog where he or she speaks louder and slower in an effort to be better understood. Deviating from a regular voice only causes the computer to misinterpret more information. Since the computer is installed with a vocabulary based on normal human

tone and speaking speed, the more the user attempts to correct the system, the less the system will understand. This scenario is one of the main problems that researchers in EE are trying to solve.

Right now, automated speech recognition systems for telephones and systems that convert speech to text involve only one information source; even if more than one person speaks, there is no way to differentiate between the two voices. Although there are many multi modal information systems available, the multi-party interaction paradigm that EE researchers are experimenting with is relatively new.

A newly funded project called Mapping Meetings attempts to summarize meeting recordings into a type of HTML file, where meeting information could be later accessed. The basic idea of this technology resembles that of automatic dictation systems. “When you speak, it [the dictation software] records what you say and automatically transcribes and loads it into Word or some other word-processing software,” explains Kirchhoff. The project will be similar to this technology only it will involve multiple speech sources.

The system must be able to recognize a number of different speakers and use statistical data to determine which information

CONTINUED...

needs summarizing and which information is extraneous. For instance, with current technology, a speech recognition system could not differentiate between a joke and actual meeting matters. Therefore, there is a need to implement a system that can differentiate between important information and “filler” conversation. The system must also be user adaptive because some users might find it beneficial to know who told the jokes and at which point during the meeting.

This project is headed by the International Computer Science Institute at the University of California at Berkeley, and Ostendorf and Kirchhoff are co-principal investigators along with Nelson Morgan at U.C. Berkeley.

Language technology that will evolve from the Mapping Meetings project will essentially be able to differentiate between all voices participating in meetings, and summarize the main point of the meeting. The research team is geared up to analyze over 100 hours of meetings.



Researchers are also working on a joint effort project with the Education at a Distance for Growth and Excellence (EDGE) program called Automatic Summarization of Recorded Lectures. This project is similar to the Mapping Meetings project, but differs in that it uses a single source of speech. UW's College of Engineering offers EDGE as a way to broadcast lectures over the web, but there is currently no sorting method in place. EE researches hope to use a speech identification program to transcribe the lectures into text. Automatic information summarization techniques would subsequently be employed to create a foundation for web-based engines that could then be used for searching and sorting lecture material.[EEK2003](#)

The MARS GRAVITY Biosatellite Project



AN ILLUSTRATION OF THE BIOSATELLITE ORBITING AROUND EARTH.

STUDENTS from EE and other departments at the University of Washington have been collaborating with Massachusetts Institute of Technology and the University of Queensland on the Mars Gravity Biosatellite Project. The mission is to send mice on a 56-day flight under simulated Martian gravity by using centrifugal force as the spacecraft circles in low Earth orbit. Some crew members will give birth and mature from newborns to adults while in orbit. Studying the gravity effects of Mars on mice may eventually aid in determining whether humans can live and develop normally on another planet.

MIT and Queensland are working on the re-entry module, while UW is designing and building the biosatellite's carrier module. Currently, EE students Kiarash Lashgari, Alexander Ellis, Konstantin Zak, and Neha Auluck are working on the communications subsystem, which will transfer visual data and atmospheric information to and from the satellite. They are also working on the power subsystem, which will be responsible for generating, distributing, and storing power.

THIS
PART NO.

Three flight-quality Viking Landers were built by the United States during the 1970's. Two of them are now on Mars, and the third has found a home in the UW EE building!

Viking 3

Lands at UWEE

NASA'S VIKING Mission to Mars was composed of two spacecraft, Viking 1 and Viking 2, each consisting of an orbiter and a lander. The primary mission objectives were to obtain high-resolution images of the Martian surface, characterize the structure and composition of the atmosphere and surface, and to search for evidence of life. On July 20, 1976 the Viking 1 Lander separated from the Orbiter and touched down at Chryse Planitia (22.48° N, 49.97° W at -1.5 km elevation). Viking Lander 2 followed, and touched down at Utopia Planitia (47.97° N, 225.74° W, -3 km) on September 3, 1976.

The Viking program included three complete Viking Flight Systems, A, B, and C, the latter being the "Flight Spare" system. Two other sets of Lander bodies were built, but these were not "Flight Quality" (one of these, the Lander in the Smithsonian National Air and Space Museum, Washington, D.C., is the "Science Test Bed Lander"). Management decided not to complete the "Flight Spare" to save \$20- \$40 million, leaving it in an intermediate stage of construction and checkout. This lander body can be identified as the "Flight" lander body #3 by the "FC3" designation on its tag, by ID numbers (see photo), and by notes on body such as "remove before sterilization" at various places.

This lander was acquired by Jim Tillman, Viking Meteorology Science Team Member and UW Atmospheric Sciences Professor (in response to his daughter Rachel's interest in saving it for educational purposes) when he found it was on a surplus list. Otherwise, it would have been sold as scrap metal. During the past year it has been carefully restored by a team of volunteers, headed by Chris Vancil, Professor Tillman and Dr. Eckart Schmitt. Retired EE staff member John Schulz has constructed the display area. Restoration occurred in space provided by the AA department, until the display area was ready and secured. The display is still under development, and includes a web cam and interpretive material. Later this year, there will be a formal dedication and celebration.

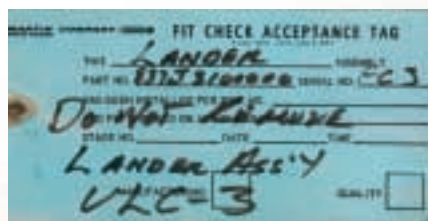


VIKING "C" SPACECRAFT
HERE IN THE EE DEPARTMENT.
PHOTO BY JAMES GRANT TILLMAN.

Prior to the launch of the first Viking Spacecraft, there was a problem with an attitude control jet. While this minor problem was being fixed, the Orbiter's batteries were discharged. This caused the removal of the complete Viking A spacecraft assembly including lander, orbiter and inter-planetary propulsion and its replacement by the B spacecraft for the first launch. Had the Viking "C" spacecraft been completed, this lander would be at the Viking Lander 1 site on Mars!

THIS IMAGE WAS ACQUIRED AT THE VIKING LANDER 2 SITE
WITH CAMERA NUMBER 2. THE ROUNDED ROCK IN THE
CENTER FOREGROUND IS ABOUT 20 CENTIMETERS WIDE.

PHOTO BY MARY A. DALE-BANISTER,
WASHINGTON UNIVERSITY IN ST. LOUIS.
INSET: SHIPPING TAG FOR THE VIKING 3.



NEXT Generation PHOTONICS:

New NSF Science and Technology Center at UW

NEW ORGANO-ELECTRO-OPTIC

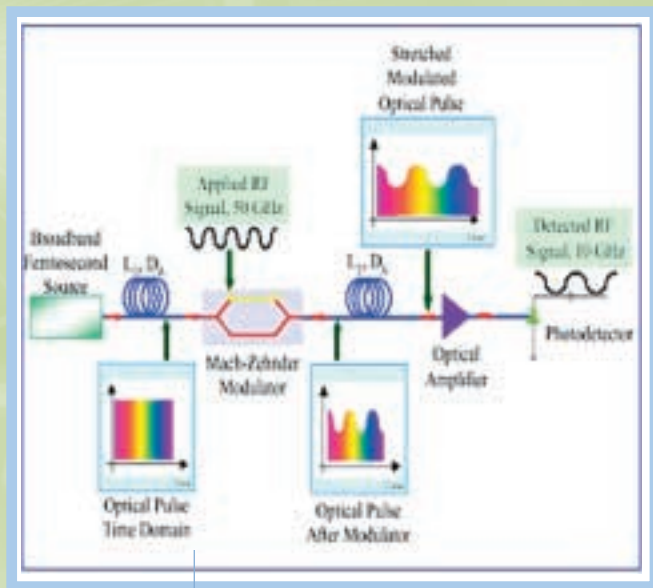
materials hold the promise of extraordinary bandwidth and speed, at extremely low costs. In August 2002, the National Science Foundation (NSF) announced an initial \$18.3 million grant for a new Center for Materials and Devices for Information Technology Research, one of six new science and technology centers funded by NSF this year. This center, directed by Chemistry Professor (and Electrical Engineering Adjunct Professor) Larry Dalton, instantly puts the UW at the international forefront in the research, development and implementation of photonics-related technology.

The Center, based at UW, involves a consortium of universities including Arizona (UA), California Institute of Technology, Southern California (USC), California-Berkeley (UCB) and California-Santa Barbara (UCSB), as well as designated minority institutions participating in the Alliance for Nonlinear Optics, and also historically black colleges.

Professor Dalton estimates the new NSF award, combined with grants from the private sector and federal agencies, such as the National Reconnaissance Office, the Ballistic Missile Defense Administration and DARPA (Defense Advanced Research Projects Agency), could ultimately reach \$100 million over the next decade.

The Center will focus on developing electro-optic and all-optical technologies, including optical amplification, light-emitting diodes, photovoltaic and passive photonic waveguide technologies—and their integration with both traditional semiconductor devices and new organic electronics. We anticipate strong collaborations between the center and the department's mixed signals, "systems on a chip," and MEMS activity, as well as with the UW nanotechnology program.

This fall, the first EE graduate students began research projects associated with the center. The EE Department is committed to hiring three faculty in photonics (beginning with one late this spring), in part through support of a State of Washington Advanced Technology Initiative (ATI) in photonics. The Chemistry and Materials Science and Engineering Departments are also participants in this ATI.

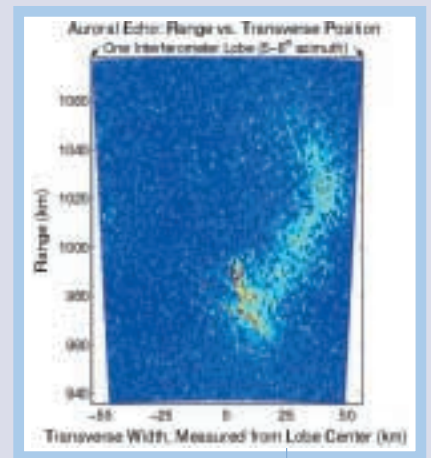


A 100 GBIT/SEC A TO D CONVERTER.

World's First Passive RADAR INTERFEROMETER

PROFESSOR JOHN SAHR'S Radar Remote Sensing Lab has added the capability to do interferometric direction finding to passive radar. This may be the first implementation of such a technique with passive radar, and the lab is energetically providing the ionospheric science community with a type and quality of data that was previously unavailable.

Interferometry is a correlation technique that utilizes the signals arriving at two or more antennas to determine the angle from which the signal arrived. Currently, the interferometer is most useful for resolving the structure of targets in the transverse, or azimuthal, direction. Combined with the normal radar information about absolute range (or distance from the transmitter), the interferometer allows targets in the sky to be represented in a two-dimensional image.



AN IMAGE OF AN AURORAL ECHO OBSERVED ON FEBRUARY 2, 2002. THE FINE RESOLUTION REVEALS A STRUCTURE IN THE ECHO THAT IS SUGGESTIVE OF PHYSICAL PHENOMENA SUCH AS ELECTRIC FIELDS AND CURRENTS IN THE IONOSPHERE WHEN COMBINED WITH FREQUENCY INFORMATION (ALSO A READILY AVAILABLE BYPRODUCT OF THE RADAR SIGNAL PROCESSING). THE NEW DATA PROVIDES AN OPPORTUNITY TO LEARN MORE ABOUT THESE PHYSICAL PHENOMENA.

Researchers at UW ACCELERATE IMAGE COMPRESSION by 450 Times

AN IMAGE is worth a 1000 words. Unfortunately, it also consumes a tremendous amount of today's computing resources: network bandwidth to transmit them, disk space to maintain them, and computer time to compress and decompress them. For example, a single satellite of NASA's can produce an equivalent of up to a disk drive's worth of data every hour or two.

EE Professors Scott Hauck and Eve Riskin, and Computer Science and Engineering Professor Richard Ladner have significantly reduced the size of these image files via hardware systems fast enough to keep up with the data-rate. Using the Set Partitioning In Hierarchical Trees (SPIHT) algorithm developed by Said and Pearlman at Rensselaer Polytechnic Institute, Riskin's and Ladner's research groups can shrink files down 1/8th to 1/80th their original size, yet still retain most image quality. Using Field-Programmable Gate Arrays (FPGAs), Hauck's group can transform this software algorithm into reprogrammable chips that can be configured to implement almost any computation. These hardware systems can process images more than 450 times faster than comparable computer systems, allowing them to keep pace with the torrent of satellite data. Researchers hope to put their system on the satellites to reprocess the information at the source and radically reduce the amount of data that is sent back to Earth. This work is funded by NASA and NSF.

Currently, the group is working on ways to squeeze the data down even further. NASA satellites take Hyperspectral images, which are essentially multiple pictures of the same location, but at different wavelengths of light. They believe that by using similarities between these multiple images, file sizes could be cut in half or more.

AN EXAMPLE OF A NASA SATELLITE IMAGE OF WASHINGTON. THE RED BLOTCHES ARE FOREST FIRES DETECTED IN THE IMAGE. PHOTO COURTESY OF NASA.



Approaching **BORG—** MELTING Human & MACHINES



NO LONGER just an element of science fiction, integrating human and robot entities into a single system offers remarkable opportunities for creating assistive technology. Humans possess naturally developed algorithms for control of movement, but are limited by muscle strength. Robotic manipulators can perform tasks requiring large forces, but artificial control algorithms do not provide the flexibility to perform under various conditions as well as humans. Combining these two entities into one integrated system under human control can benefit from the advantages of each subsystem.

Supported through an NSF grant, research conducted by EE professors Jacob Rosen and Blake Hannaford, Stephen Burns from UW's department of Rehabilitation Medicine, and graduate student Joel Perry, aims to design, build, and study the integration of a powered exoskeleton controlled by myosignals for the human arm. The exoskeleton robot worn by the human functions as a human-amplifier; its joints and links correspond to those of the human body. One of the primary innovative ideas of their research is to set the Human Machine Interface at the neuromuscular level and use the body's own neural command signals as one of the main command signals of the exoskeleton. These signals will be detected by surface electrodes placed on the operator's skin in the form of processed surface electromyography signals. This takes advantage of the musculoskeletal system's time delays, between when the neural system activates the muscular system and when the muscles generate moments around the joints. The myoprocessor is a model of the human muscle running in real-time and in parallel to the physiological muscle. During the time delay, the system will gather data on the neural activation level of the physiological muscle based on processed signals, the joint position, and angular velocity and predict the force generated by the muscle before physiological contraction occurs using the myoprocessor. By the time the muscle contracts, the exoskeleton will move the human in a synergistic fashion, allowing natural control of the exoskeleton as an extension of the operator's body.

The researchers anticipate that their findings will advance current knowledge in the field of modeling human muscles and their mathematical formulation, which can in turn be used to create novel devices in a long-term goal to develop assistive technology for individuals with various neurological disabilities.

PICTURED

POWERED EXOSKELETON SYSTEMS CONTROLLED BY MYOSIGNALS (ELECTROMYOGRAPHY—EMG) DEVELOPED BY DR. JACOB ROSEN. **TOP LEFT:** DR. ROSEN WEARING A ONE DEGREE OF FREEDOM SYSTEM (ELBOW JOINT). **TOP RIGHT:** GRADUATE STUDENT MOSHE BRAND FROM TEL-AVIV UNIVERSITY WEARING A THREE DEGREES OF FREEDOM SYSTEM (ELBOW AND SHOULDER JOINTS).

ALGEBRAIC Systems THEORY and DNA Structure

IS THERE an underlying mathematics that can be used to develop predictive models of genomic and proteomic phenomena? This is the question that Professor Howard Chizeck and graduate student Stephen Hawley are exploring. They are applying elements of algebraic systems theory to the modeling of DNA molecule structure and function.

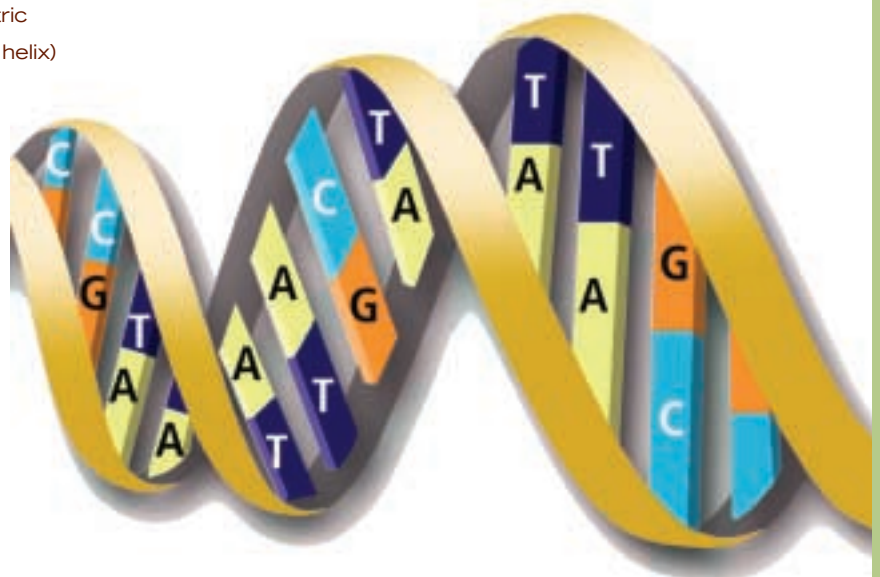
The base pair sequence of DNA contains one-dimensional information used to produce proteins. The DNA molecule also carries information in its three-dimensional structure, which codes for the binding of specific proteins to gene control regions along the helix. These DNA-binding proteins control the rate and amount of protein production by turning on and off the gene; that is, they activate or inactivate gene expression. The affinity of DNA-binding proteins for a particular gene control region may be affected by local structural variations of the DNA helix.

The relationship between the base pairs of DNA and structural variations can be represented as a type of algebraic dynamic system. The base pair sequence, as one goes from one end of the helix to the other, can be considered as the input sequence to the system. It takes values in the four letter set {A,C,T,G}. Geometric features of the DNA molecule (at different locations along the helix) are the output.

The inverse system for a given algebraic system model lets you mathematically determine the base pair sequence which gives a specified sequence of structural variations. Thus the inverse system has potential use as a tool in designing sequences of DNA with desired geometrical structures (which influence specific biochemical and genetic activity). Calculation of both the inverse and forward systems for a sequence of length N is linear in N , rather than depending on $4N$.

This project is an extension of work done sixteen years earlier by Chizeck and his graduate student Mary Karpen, at Case Western Reserve University. Unlike 1987, it is now possible to determine DNA sequence structure in liquid as well as solid phases, and there exists the ability to construct specified DNA sequences. Moreover, because of the Human Genome project and other advances in the field, DNA and protein structure questions have new practical implications.

This work is supported by a seed grant of the Microscale Life Sciences Center (National Human Genome Research Institute Center of Excellence in Genomic Science at UW).



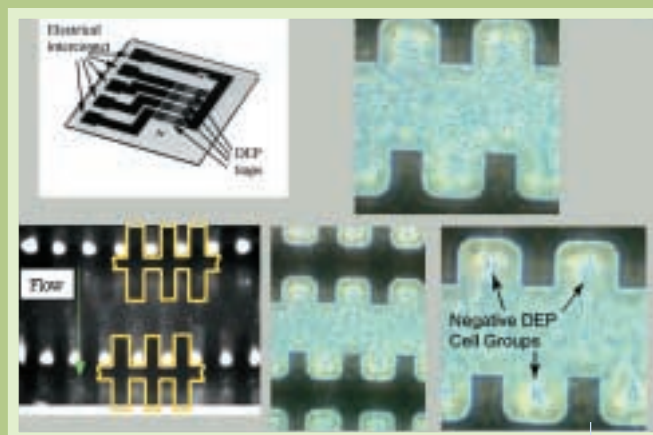
THE FOUR BASES OF DNA ARE ARRANGED ALONG THE SUGAR-PHOSPHATE BACKBONE IN A PARTICULAR ORDER (THE DNA SEQUENCE), ENCODING ALL GENETIC INSTRUCTIONS FOR AN ORGANISM. ADENINE (A) PAIRS WITH THYMINE (T), WHILE CYTOSINE (C) PAIRS WITH GUANINE (G). THE TWO DNA STRANDS ARE HELD TOGETHER BY WEAK BONDS BETWEEN THE BASES.

A GENE IS A SEGMENT OF A DNA MOLECULE (RANGING FROM FEWER THAN 1 THOUSAND BASES TO SEVERAL MILLION), LOCATED IN A PARTICULAR POSITION ON A SPECIFIC CHROMOSOME, WHOSE BASE SEQUENCE CONTAINS THE INFORMATION NECESSARY FOR PROTEIN SYNTHESIS.

GRAPHIC COURTESY OF THE U.S. DEPARTMENT OF ENERGY HUMAN GENOME PROGRAM AT:
[HTTP://WWW.ORNL.GOV/HGMIS](http://www.ornl.gov/hgmis).

LIFE on a Chip CONTINUES...

THE MICROSCALE Life Sciences Center (MLSC) continues to make progress in its second year of research. The Center of Excellence in Genomic Science is funded for \$15 million over five years by the NIH National Human Genome Research Institute to develop microsystems that analyze single cells in real time. These cells help researchers study biological applications such as HIV infection of T-cells, salmonella infection of macrophages, proteomics, metabolic networks, DNA from biopsies of diseased tissue samples, and genetic-related aging effects. EE Professor Deirdre Meldrum (PI) co-directs the MLSC with Professor Mary Lidstrom of Chemical Engineering and Microbiology.



THIS FIGURE SHOWS POTENTIAL METHODS OF PARTICLE CAPTURE AND CONTROLLED MOVEMENT OF DNA AND CELLS USING DIELECTROPHORETIC (DEP) MANIPULATION (SHANE CRIPPEN, MARK HOLL, AND DEIRDRE MELDRUM OF EE). FLUORESCENT LABELED DNA WAS OBSERVED USING AN EPI-FLUORESCENT MICROSCOPE UNDER APPLICATION OF APPLIED FIELDS AT DISCRETE FREQUENCIES OF 30 HZ, 100 HZ, 1 KHZ, 10 KHZ, 100 KHZ, AND 1 MHZ AND AT APPLIED VOLTAGES BETWEEN 0.5 VP-P AND 20 VP-P. SHOWN ARE: (UPPER LEFT) AN INTERDIGITATED MICROELECTRODE ARRAY WITH INDEPENDENTLY ADDRESSABLE REGIONS, (LOWER LEFT) CASTELLATED ELECTRODE GEOMETRY AND TRAPPING OF DNA AT 30 HZ, AND (LOWER RIGHT) NEGATIVE DEP OF CELLS.

TALKING Trees



EE GRADUATE STUDENT, Sean Hoyt, has brought “talking” trees to the UW campus. The Brockman Memorial Tree Tour was originally constructed on paper to assist campus visitors in identifying and understanding the multitude of tree species planted on the UW Seattle campus. The revision of the tree tour uses implanted radio frequency identification tags to identify each tree on the tour.

Vandalism, weather, and other external damage to tree identification was a common problem with the plaques used to identify trees in the original tree tour, but they are no longer an issue with the RFID-based tree tour since the tags are implanted in each tree. The tour participant uses an antenna, a reader system, and a personal digital assistant to approach the tree. The tree then “talks” to the participant through the PDA and provides the species type and other salient information.

The revised tree tour encourages exposure to the RFID-based technologies and provides more robust, easily updated information about each tree to the tour participant. Participant surveys show substantially increased satisfaction with the RFID-based tree tour as compared to the original paper tour.

EE Alumnus Awarded University's Highest Honor

INVENTIONS SCHEDULED FOR PERMANENT DISPLAY AT SMITHSONIAN

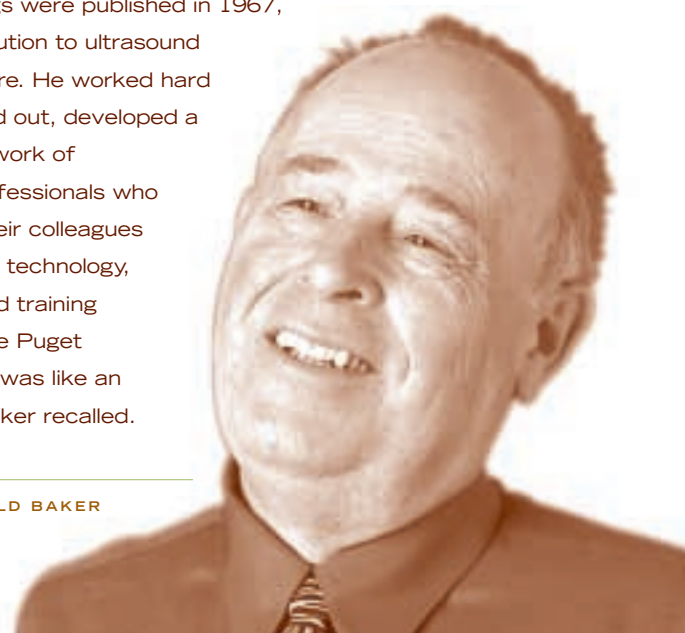
When your doctor sends you for an ultrasound, you can thank University of Washington alum Donald Baker for making the non-invasive procedure an option.

BAKER, a 1960 graduate of the UW Department of Electrical Engineering, came up with a way in the '60s to turn ultrasound's formerly fuzzy images into sharp, detailed representations of what's inside a person's body, making the now ubiquitous technology useful as a diagnostic tool. For that, and for his subsequent work in popularizing the new technology, Baker is the 2002 recipient of the UW's highest alumni honor: the Alumnus Summa Laude Dignatus Award. Later this year, Baker's inventions will go on display in the Smithsonian Institution's National Museum of American History to mark the 40th anniversary of medical ultrasound.

Baker made his discovery while working in the lab of Robert Rushmer, the late founder of the UW Bioengineering Department. The ultrasound machine there used continuous sound waves to produce images that were fuzzy and, for medical purposes, unusable. Baker figured out that pulsed, rather than continuous, sound waves could create the sharp images physicians needed.

Baker's findings were published in 1967, but his contribution to ultrasound didn't stop there. He worked hard to get the word out, developed a worldwide network of healthcare professionals who could teach their colleagues how to use the technology, and established training programs in the Puget Sound area. "I was like an evangelist," Baker recalled.

DONALD BAKER



Sinclair and Genevieve YEE

Honored For Community Service Work

LAST SEPTEMBER, EE Professor Sinclair Yee and his wife, Genevieve, were honored for their dedication and involvement at the Chinese Information and Service Center's (CISC) 30th Anniversary celebration.

According to the Seattle Times, the Yee's began teaching Chinese immigrants in the evenings and on weekends because they didn't like seeing "Chinese immigrants being held back by their struggles with language." CISC is a long-standing, non-profit organization, which provides a variety of support and services to Seattle's Asian community, particularly for at-risk youth, recent immigrants, and the elderly.

Volunteers and staff from CISC offer services in areas such as education, health, welfare, as well as linking people to job opportunities and government services.

Over the years, CISC has grown tremendously. The agency now has over 100 volunteers, 25 full-time professionals, and assists about 3,500 clients per year. Mrs. Yee is currently serving as one of the board members for the organization. CISC's 30th Anniversary celebration raised over \$100,000 to support its cause.

SINCLAIR AND GENEVIEVE YEE.



EE Students TAKE **1st Place** IN PHASE 1 of **SRC SiGe IC** DESIGN CHALLENGE

OUT OF OVER 30 TEAMS that participated in Phase 1 of the Semiconductor Research Corporation (SRC) silicon germanium (SiGe) IC Design Challenge, UW's very own EE team took home 1st place. The team led by Professor David Allstot attended the IEEE International Solid-State Circuits Conference (ISSCC) held in San Francisco, where they were presented with a \$7,000 check on February 10th.

Each team's objective was to design innovative circuits that exploited the high performance SiGe technology in the areas of digital circuits, mixed-signal implementation, or wireless/radio frequency circuits. Allstot's team, as well as 15 others, will continue to Phase 2 of the challenge. The IC designs will be fabricated in the IBM 6HP SiGe technology and teams will be judged on their creativity, efficiency, test procedures, completeness, and overall impact of the design on future applications. Winners of Phase 2 will be announced in August 2003, at the SRC TECHCON 2003 in Dallas, TX. The SRC SiGe Design Challenge was sponsored by the SRC, Cadence Design Systems, Inc., IBM, MOSIS, National Semiconductor Corporation, and NurLogic Design, Inc.

FROM LEFT TO RIGHT: JEYANANDH PARAMESH, PROFESSOR ALLSTOT, HOSSEIN ZAREI, DICLE OZIS, AND XIAOYONG LI FROM UW, AURANGZEB KHAN FROM CADENCE DESIGN SYSTEMS, AND DALE EDWARDS FROM THE SRC.



Riding the WAVE

THE TECHNOLOGIES of Electrical Engineering are getting ever faster, smaller, smarter and cheaper. The most famous example of this is the four decades reality of “Moore’s Law”; the 18 month doubling of computer power that has sparked a technological and cultural revolution. The number of transistors per chip has grown by 300 million since Intel’s first microprocessor 35 years ago, while the cost per transistor has dropped from \$1 in 1968, to \$1 per 50 million transistors in 2003.

What is remarkable is how this law, has become a self-fulfilling prophecy, as codified in the periodic “technology roadmaps” generated by academic and industrial leaders. As each technology reaches its limiting physical constraints, a new one is devised so that Moore’s Law can continue.

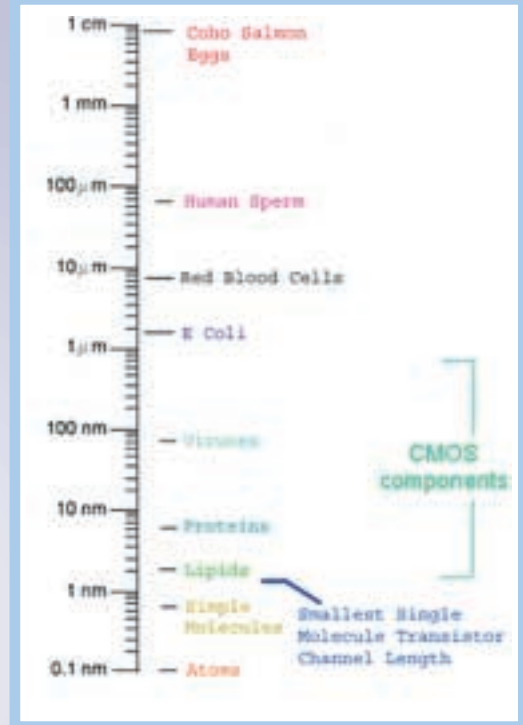
For the past 30,000 years or so, humans have produced art, writing, diagrams, and later microprocessor chips using a lithographic approach—whether with paint on a cave wall, a quill pen, carbon film ink, light of ever higher frequencies, or electron beams. We have now begun to build on a nanometer scale where this traditional “top down” fabrication approach is not possible so instead, new methods using self-assembling components are under development on the exciting boundary between electrical engineering, physics, chemistry, materials science and biology. Similarly, as the bandwidths of our devices grow too fast for electrons in conductors, new technologies are arising to allow computation and communication using photons instead. And advanced manipulation of quantum phenomena is no longer a topic of purely abstract discussion, but rather a technology that is attracting substantial industrial investment. All of this presents an extraordinary challenge to EE and ECE departments.

Hiring a new faculty colleague may involve a 35 year commitment. How do we choose individuals with the backgrounds and abilities to ride this technological wave? At UW EE, we have had the opportunity to hire a large number of faculty in a very few years. We have reinforced traditional areas of strength and have built our efforts in mixed signals, systems-on-a-chip and VLSI because of the critical

near-term importance of these technologies. We have enhanced our efforts in human/machine interfaces (speech and haptics), sensors, communications and MEMS — because these are topics of increasing relevance. In cooperation with many other UW departments, we are making investments on the interface of genomics and EE, in nanotechnology, and in next-generation photonics. Within a decade, these fields will fundamentally influence Electrical Engineering. It is crucial that we select new faculty who are not only of the highest quality, but who are also highly adaptable to change.

And what do we teach our students, when the technological half life of the components and tools that they use in our laboratories is sometimes counted in months, rather than years or decades? We must provide both depth in the fundamentals, and breadth in the current and developing technologies that they will encounter. We must also train our students to continue to learn after they leave us.

In the current climate of war and threats of war, as well as budgetary restrictions, it is natural to focus on the immediate. But as researchers in the every-expanding field of Electrical Engineering, it is our duty and privilege to work to build the future. May it be a good and peaceful one for us all.



EE Faculty

AFROMOWITZ, MARTIN

Professor

Microtechnology/Sensors

Ph.D., 1969 Columbia University

NIH Career Development Award

ALLSTOT, DAVID

Professor

VLSI and Digital Systems

Ph.D., 1979 University of California

IEEE Fellow, IEEE Circuits & Systems

Society Darlington Award, IEEE W.R.G

Baker Award

ATLAS, LES

Professor

Signal and Image Processing

Ph.D., 1984 Stanford University

NSF Presidential Young Investigator

BILMES, JEFF

Assistant Professor

Signal and Image Processing

Ph.D., 1999 UC-Berkeley

NSF CAREER Award

BÖHRINGER, KARL

Assistant Professor

Microelectromechanical Systems (MEMS)

Ph.D., 1997 Cornell University

NSF CAREER Award

BUSHNELL, LINDA

Research Assistant Professor

Controls & Robotics

Ph.D., 1994 UC-Berkeley

NSF ADVANCE Fellow

CHEN, TAI-CHANG

Research Assistant Professor

MEMS and Microfabrication

Ph.D., 1997 University of Washington

CHINOWSKY, TIM

Research Assistant Professor

Sensors, Instrumentation, Analog

Electronics

Ph.D., 2000 University of Washington

CHIZECK, HOWARD

Professor/Chair of EE

Controls & Robotics

Sc.D., 1982 MIT

IEEE Fellow

CHRISTIE, RICH

Associate Professor

Energy Systems

Ph.D., 1989 Carnegie Mellon University

NSF Presidential Young Investigator

CRUM, LAWRENCE

Research Professor

Medical Ultrasound

Ph.D., 1967 Ohio University

DAILEY, DAN

Research Associate Professor

Intelligent Transportation Systems

Ph.D., 1988 University of Washington

DAMBORG, MARK

Professor

Energy Systems

Ph.D., 1969 University of Michigan

DARLING, R. BRUCE

Professor

Devices, Circuits and Sensors

Ph.D., 1985 Georgia Institute of

Technology

DENTON, DENICE

Professor/Dean

Microelectromechanical Systems (MEMS)

Ph.D., 1987 MIT

NSF Presidential Young Investigator,

AAAS Fellow, Harriet B. Rigas Award

DUNHAM, SCOTT

Professor

Materials and Devices

Ph.D., 1985 Stanford University

EL-SHARKAWI, MOHAMED

Professor

Intelligent Systems and Energy

Ph.D., 1980 University of British

Columbia

IEEE Fellow

HANNAFORD, BLAKE

Professor

Biorobotics

Ph.D., 1985 UC-Berkeley

NSF Presidential Young Investigator,

IEEE/EMBS Early Career Achievement

Award

HAUCK, SCOTT

Associate Professor

VLSI and Digital Systems

Ph.D., 1995 University of Washington

NSF CAREER Award, Sloan Research

Fellowship

HELMS, WARD

Associate Professor

Circuits and Sensors

Ph.D., 1968 University of Washington

HOLL, MARK

Research Assistant Professor

MEMS, Micro-total analytical systems

Ph.D., 1995 University of Washington

HWANG, JENQ-NENG

Professor

Signal and Image Processing

Ph.D., 1988 University of Southern

California

IEEE Fellow

JANDHYALA, VIKRAM

Assistant Professor

Electromagnetics, Fast Algorithms,

Devices

Ph.D., 1998 University of Illinois

NSF CAREER Award

JAVIDI, TARA

Assistant Professor

Communication, Wireless Networks,

Control

Ph.D., 2002 University of Michigan, Ann

Arbor

KIM, YONGMIN

Professor/Chair of Bioengineering

Digital Systems, Image Processing and

Medical Imaging

Ph.D., 1982 University of Wisconsin -

Madison

IEEE Fellow, IEEE/EMBS Early Career

Achievement Award

KIRCHHOFF, KATRIN

Research Assistant Professor

Multilingual Speech Processing, Machine

Learning

Ph.D., 1999 University of Bielefeld

KUGA, YASUO

Professor

Electromagnetics

Ph.D., 1983 University of Washington

NSF Presidential Young Investigator

LI, QIN

Research Assistant Professor

Electromagnetics

Ph.D., 2000 University of Washington

LIN, LIH

Associate Professor

Photonics, MEMS

Ph.D., 1996 UC-Los Angeles

LIU, CHEN-CHING

Professor & Associate Dean

Power Systems

Ph.D., 1983 UC-Berkeley

NSF Presidential Young Investigator,

IEEE Fellow

LIU, HUI

Associate Professor

Communications and Signal Processing

Ph.D., 1985 University of Texas, Austin

NSF CAREER Award, ONR Young

Investigator

MAMISHEV, ALEXANDER

Assistant Professor

Electric Power Systems, MEMS, Sensors

Ph.D., 1999 MIT

NSF CAREER Award

MARKS, ROBERT

Professor

Signal and Image Processing

Ph.D., 1977 Texas Technical University

IEEE Fellow, OSA Fellow

MCMURCHIE, LARRY

Research Assistant Professor

VLSI and Digital Systems

Ph.D., 1977 University of Washington

**MELDRUM, DEIRDRE**

Professor
Genome Automation
Ph.D., 1993 Stanford University
Presidential Early Career Award
(PECASE), NIH SERCA Award

NELSON, BRIAN

Research Associate Professor
Plasma Physics
Ph.D., 1987 University of Wisconsin -
Madison

OSTENDORF, MARI

Professor & Associate Chair for
Research
Signal and Image Processing
Ph.D., 1985 Stanford University

PECKOL, JAMES S.

Lecturer
Digital Systems
Ph.D., 1985 University of Washington

POOVENDRAN, RADHA

Assistant Professor
Communications Networks and Security
Ph.D., 1999 University of Maryland
NSA Rising Star Award, NSF CAREER
Award, ARO YIP Award

RAMON, CEON

Research Scientist, Lecturer
Electromagnetics & Remote Sensing
Ph.D., 1973 University of Utah

RISKIN, EVE

Professor
Signal and Image Processing
Ph.D., 1990 Stanford University
NSF Presidential Young Investigator,
Sloan Research Fellowship

RITCEY, JAMES

Professor
Communications and Signal Processing
Ph.D., 1985 UC-San Diego

ROSEN, JACOB

Research Assistant Professor
Biorobotics, Human-Machine Interfaces
Ph.D., 1997 Tel-Aviv University

ROY, SUMIT

Professor
Communications and Networking
Ph.D., 1988 UC-Santa Barbara

SAHR, JOHN

Associate Professor & Associate
Chair for Education
Electromagnetics and Remote Sensing
Ph.D., 1990 Cornell University
NSF Presidential Young Investigator,
URSI Booker Fellow, URSI Young
Scientist Award

SECHEN, CARL

Professor
VLSI and Digital Systems
Ph.D., 1986 UC-Berkeley
IEEE Fellow

SHAPIRO, LINDA

Professor
Signal and Image Processing
Ph.D., 1974 University of Iowa
IEEE Fellow, IAPR Fellow

SHI, C.J. RICHARD

Associate Professor
VLSI and Digital Systems
Ph.D., 1994 University of Waterloo
NSF CAREER Award

SOMA, MANI

Professor
Mixed Analog-Digital System Testing
Ph.D., 1980 Stanford University
IEEE Fellow

SPINDEL, ROBERT

Professor
Signal Processing/Ocean Acoustics
Ph.D., 1971 Yale University
IEEE Fellow, ASA Fellow, MTS Fellow,
A.B. Wood Medal, IEEE Oceanic
Engineering Society Technical Achieve-
ment Award

STRUNZ, KAI

Assistant Professor
Electric Power Systems and Power
Electronics
Ph.D., 2001 Saarland University
NSF CAREER Award

SUN, MING-TING

Professor
Signal and Image Processing
Ph.D., 1985 UC-Los Angeles
IEEE Fellow

TROLL, MARK

Research Associate Professor
Biophysical/Electronic Devices, Optics
Ph.D., 1983 UC-San Diego

TSANG, LEUNG

Professor
Electromagnetics and Remote Sensing
Ph.D., 1976 MIT
IEEE Fellow, OSA Fellow

WILSON, DENISE

Associate Professor
Circuits and Sensors
Ph.D., 1995 Georgia Institute of
Technology
NSF CAREER Award

WINEBRENNER, DALE

Research Associate Professor
Electromagnetics and Remote Sensing
Ph.D., 1985 University of Washington

YEE, SINCLAIR

Professor
Photonics
Ph.D., 1965 UC-Berkeley
IEEE Fellow

ZICK, GREG

Professor
VLSI and Digital Systems
Ph.D., 1974 University of Michigan

EMERITI**ALBRECHT, ROBERT**

Controls & Robotics
Ph.D., 1961 University of Michigan

ALEXANDRO, FRANK

Controls & Robotics
Ph.D., 1961 University of Michigan

ANDERSEN, JONNY

Circuits and Sensors
Ph.D., 1965 MIT

BJORKSTAM, JOHN L.

Controls & Robotics
Ph.D., 1958 University of Washington

CLARK, ROBERT N.

Ph.D., 1969 Stanford University
IEEE Fellow

DOW, DANIEL G.

Ph.D., 1958 Stanford University

GUILFORD, EDWARD C.

Ph.D., 1960 UC-Berkeley

HARALICK, ROBERT

Signal & Image Processing
Ph.D., 1969 University of Kansas
IEEE Fellow

HSU, CHIH-CHI

Ph.D., 1957 Ohio State University

ISHIMARU, AKIRA

Electromagnetics and Waves in Random
Media
Ph.D., 1958 University of Washington
IEEE Fellow, OSA Fellow, IOP Fellow,
IEEE Heinrich Hertz Medal, URSI John
Dillinger Medal and Member, National
Academy of Engineering

JACKSON, DARRELL

Ph.D., 1977 California Institute of
Technology

JOHNSON, DAVID L.

Ph.D., 1955 Purdue University

LAURITZEN, PETER O.

Ph.D., 1961 Stanford University

LEWIS, LAUREL

Ph.D., 1947 Stanford University

LYTLE, DEAN W.

Ph.D., 1957 Stanford University

MEDITCH, JAMES S.

Ph.D., 1956 Purdue University
IEEE Fellow

MORITZ, WILLIAM E.

Ph.D., 1969 Stanford University

NOGES, ENDRIK

Ph.D., 1959 Northwestern University

PEDEN, IRENE

Ph.D., 1962 Stanford University
NSF "Engineer of the Year", Member,
National Academy of Engineering, IEEE
Fellow, IEEE Harden Pratt Award, U.S.
Army Outstanding Civilian Service Medal

PORTER, ROBERT B.

Ph.D., 1970 Northeastern University
ASA Fellow, OSA Fellow

POTTER, WILLIAM

MSEE, 1959 US Naval Postgraduate
School

REDEKER, CHARLES C.

Ph.D., 1964 University of Washington

SIGELMANN, RUBENS A.

Ph.D., 1963 University of Washington

CONGRATULATIONS TO EVE
RISKIN AND SUMIT ROY WHO
WERE BOTH RECENTLY
PROMOTED TO FULL PROFESSOR.

WE APOLOGIZE FOR ANY ERRORS,
OMISSIONS OR MISSPELLINGS IN
2003 EEK. WE WOULD LIKE TO
EXTEND SPECIAL APPRECIATION
TO THE FACULTY AND STAFF
WHO ASSISTED IN PRODUCING
THIS PUBLICATION AND TO THE
SPONSORS WHOSE GENEROSITY
MADE IT POSSIBLE.

Milestones...

Discover Magazine Highlights

Karl Böhringer's Research

IN THE JANUARY 2003 ISSUE OF *DISCOVER* MAGAZINE, EE PROFESSOR KARL BÖHRINGER'S RESEARCH IS FEATURED AS ONE OF THE TOP 100 SCIENTIFIC STORIES OF 2002. THE STORY IN *DISCOVER* MAGAZINE APTLY TITLED, "FINGERS WITH FORCE" DESCRIBES BÖHRINGER'S WORK TO DEVELOP PATCHES OF MINIATURE SILICON AND POLYMER BASED FINGERS CAPABLE OF PUSHING OBJECTS AROUND.

THESE BEDS OF TINY FINGERS WERE DEVELOPED WITH THE IDEA THAT THEY COULD BE USED AS A MECHANISM FOR MOVING MINIATURE SATELLITES AT DOCKING STATIONS IN SPACE. THE FINGERS ARE HELD TOGETHER WITH TUNGSTEN WIRES AND WHEN AN ELECTRICAL CHARGE RUNS THROUGH THE WIRES, THE CURRENT CAUSES THE FINGERS TO STAND UP. BY TIMING WHEN CERTAIN FINGERS ARE STRAIGHTENED WHILE OTHERS ARE BENT, THE PULSATING ACTION CAN MOVE OBJECTS ALONG IN DIFFERENT DIRECTIONS.

BÖHRINGER'S PROJECT WAS FUNDED BY THE UNIVERSITIES SPACE RESEARCH ASSOCIATION AND BY THE AIR FORCE.

Ph.D. Graduates (Autumn 2001 - Autumn 2002)

MARK BILLINGHURST, IVAN BULYKO, KYOUNG HO CHOI, CHRIS YOOCHANG CHUNG, JOHN TODD ELSON, PAVEL FASTENKO, BRADFORD GILLESPIE, JIANJUN GUO, SANPACHAI HUVANANDANA, JU-HWAN JUNG, SEUNG-WOO LEE, CHENGYANG LI, AGNIESZKA MIGUEL, DESIKACHARI NADADUR, ANTHONY NGUYEN, NIKOLAOS PAGOULATOS, JI HO PARK, DANIEL GATICA PEREZ, SUREE PUMRIN, MINGZHOU SONG, JACK STOKES, YALIN WANG, JUN XIN, HONGBO YAN, MING YE

NSF Career Award Recipient

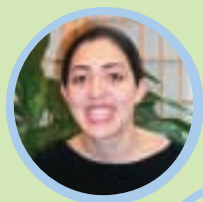
EE PROFESSOR KAI STRUNZ HAS BECOME OUR DEPARTMENT'S 11TH NSF CAREER AWARD RECIPIENT. HIS PROJECT, TITLED "REAL TIME DIGITAL SIMULATION METHODOLOGY FOR NEXT-GENERATION DISTRIBUTED ENERGY SYSTEMS", RECEIVED A GRANT THAT RUNS FROM FEBRUARY 1, 2003 TO JANUARY 31, 2008.

First EE Undergraduate Research Project Proposals Funded

THE DEPARTMENT HAS BEGUN A QUARTERLY COMPETITIVE PROPOSAL PROCESS TO PROVIDE FUNDS FOR INNOVATIVE UNDERGRADUATE RESEARCH. A PANEL OF SEVERAL FACULTY AND A GRADUATE STUDENT EVALUATE ALL PROPOSALS AND PROVIDE FEEDBACK TO THE APPLICANTS. THE FIRST THREE SUCCESSFUL PROPOSALS (FOR WINTER 2003) ARE:

- INVESTIGATION OF CORONA PROPULSION TECHNOLOGY FOR COOLING MICROELECTRONICS
TEAM LEADER: NELS JEWELL-LARSEN; ADVISOR: ALEX MAMISHEV
- COMPUTER MODELING OF THE ELECTRICAL ACTIVITY OF THE HUMAN BRAIN
TEAM LEADER: SEEMA R. GHOSH; ADVISOR: CEON RAMON
- MICRO-ACTUATOR MIRROR DISPLAY (MMD)
RESEARCHER: KHYE SUIAN WEI; ADVISOR: KARL BÖHRINGER

New Faculty



DR. TARA JAVIDI JOINED THE EE DEPARTMENT IN SEPTEMBER 2002, AS AN ASSISTANT PROFESSOR. SHE RECEIVED AN MS DEGREE IN ELECTRICAL ENGINEERING: SYSTEMS, IN 1998 AND AN MS IN APPLIED MATHEMATICS IN 1999 FROM THE UNIVERSITY OF MICHIGAN. HER PHD IS FROM THE ELECTRICAL ENGINEERING AND COMPUTER SCIENCE DEPARTMENT AT THE UNIVERSITY OF MICHIGAN. TARA'S RESEARCH INTERESTS ARE IN COMMUNICATION NETWORKS, STOCHASTIC RESOURCE ALLOCATION, AND WIRELESS COMMUNICATION.

WE ARE PLEASED TO ANNOUNCE THAT DR. LIN Y. LIN HAS AGREED TO JOIN THE EE DEPARTMENT IN JUNE 2003 AS AN ASSOCIATE PROFESSOR WITH TENURE. SHE RECEIVED HER PH.D. DEGREE IN ELECTRICAL ENGINEERING FROM UCLA IN 1996. SHE THEN JOINED AT&T LABS-RESEARCH AS A SENIOR TECHNICAL STAFF MEMBER, WHERE SHE CONDUCTED RESEARCH ON MICROMACHINED TECHNOLOGIES FOR OPTICAL SWITCHING AND LIGHTWAVE SYSTEMS, AS WELL AS WDM NETWORK ARCHITECTURES. IN MARCH 2000, SHE JOINED TELLUM, INC. AS DIRECTOR OF OPTICAL TECHNOLOGIES, WHERE SHE LED THE MEMS TEAM FOR THE ALL-OPTICAL SWITCHING PROGRAM. SHE HAS OVER 110 PUBLICATIONS IN THE AREAS OF OPTICAL MEMS, HIGH-SPEED PHOTODETECTORS, AND NETWORK ARCHITECTURES. SHE HOLDS 13 US PATENTS, AND HAS 10 PATENTS PENDING. DR. LIN JOINS US AS PART OF AN "ADVANCED TECHNOLOGY INITIATIVE" (ATI) IN PHOTONICS.



Departmental Awards

For 2002

LAST MAY, EE FACULTY, STAFF, AND STUDENTS GATHERED TO RECOGNIZE THE DEPARTMENTAL AWARD WINNERS AT THE THIRD ANNUAL AWARDS AND RECOGNITION EVENT. HERE ARE THE WINNERS:

- **Outstanding Teaching Award**

RADHA POOVENDRAN

- **Outstanding Teaching Assistant Award**

MINGYAN LI AND EDDIE CHAN

- **Outstanding Research Advisor Award**

RADHA POOVENDRAN AND CARL SECHEN

- **Outstanding Graduate Research Assistant Award**

DIDEM TURELI AND MARK CHANG WERE THE WINNERS OF THE OUTSTANDING GRADUATE RESEARCH ASSISTANT AWARD. TURELI WAS RECOGNIZED FOR DEVELOPING AN MAC (MEDIA ACCESS CONTROL) PROTOCOL THAT PUSHES THE ENVELOPE WITH REGARD TO SYSTEM ADAPTABILITY, CAPACITY, AND AFFORDABILITY. CHANG'S RESEARCH FOCUSES ON DEVELOPING A HYBRID DESIGNER AID TO HANDLE VARIABLE PRECISION ANALYSIS. HIS TOOL CALLED "PRECIS" TAKES IN APPLICATIONS IN MATLAB AND ALLOWS THE DESIGNER TO EASILY MODEL THE EFFECT OF FIXED-POINT ARITHMETIC ON THEIR MATLAB CODE.

- **Yang Research Award**

CONGRATULATIONS TO ALICIA MANTHE WHO RECEIVED THE YANG RESEARCH AWARD FOR HER ORIGINAL WORK ON DEVELOPING ALGORITHMS TO MINIMIZE THE SIZE OF THE DETERMINANT DECISION DIAGRAMS (DDDS) USED FOR ANALYZING VLSI CIRCUITS. MANTHE'S RESEARCH ALSO INVOLVED EXTENDING THE IDEA OF DDDS TO SOLVING A NEW MATHEMATICAL PROGRAM CALLED LINEAR COMPLEMENTARITY PROBLEM.

- **Outstanding Undergraduate Research Assistant Award**

DUSTIN HILLARD RECEIVED THE OUTSTANDING UNDERGRADUATE RESEARCH ASSISTANT AWARD FOR HIS WORK WITH PROFESSOR MARI OSTENDORF ON THE PROBLEM OF AUTOMATICALLY RECOGNIZING AGREEMENT AND DISAGREEMENT IN MEETING TRANSCRIPTS. HILLARD ALSO DEVELOPED NEW LABS FOR EE235 AND EE341 COURSES THAT HAD REAL-TIME SIGNAL PROCESSING DEMONSTRATIONS FOR BOTH AUDIO AND IMAGE SIGNALS.

- **Faculty Service Award**

RICH CHRISTIE

- **Outstanding Staff Award**

GLORIA HEATON

- **Spirit of Community Award**

THE SPIRIT OF COMMUNITY AWARD APPROPRIATELY WENT TO THE GRADUATE STUDENT ASSOCIATION (GSA) BECAUSE THE CONTRIBUTION MADE TO THE EE DEPARTMENT TRULY WAS A TEAM EFFORT. SOME OF GSA'S CONTRIBUTIONS WERE: SUPPORT FOR THE PROSPECTIVE STUDENT VISIT DAYS WHICH RESULTED IN AN UNPRECEDENTED 69% ACCEPTANCE RATE OF THE STUDENTS WHO VISITED, AN ONLINE PHOTO BOARD OF CURRENT GRADUATE STUDENTS, AND MANAGEMENT OF DEPARTMENT'S FRIDAY SOCIALS. MITCH LUM AND JASON WAN WERE THE EE UNDERGRADUATES WHO RECEIVED THE SPIRIT OF COMMUNITY AWARD.

- **Chair's Award**

CONGRATULATIONS TO THE OFFICERS OF HKN, WHO RECEIVED THE CHAIR'S AWARD. OVER THE PAST COUPLE OF YEARS, THEIR HARD WORK AND DEDICATION BROUGHT THE ORGANIZATION BACK TO LIFE. THEIR ACCOMPLISHMENTS INCLUDED INSTITUTING METHODS OF OPERATION, MARKETING PLANS, AND COMMUNITY-BUILDING. THE PEOPLE WHO HELPED MAKE THIS POSSIBLE ARE: AMY FELDMAN-BAWARSHI, DANIEL DAOURA, DANIEL LEE, CHUNG-I LIN, ASHLI KELLER, HOLLI PHEIL, BENJAMIN HEDIN, BRAD EMERSON, JESSICA YAN, AND IRENE CHIN.

AN AERIAL PHOTO SHOT
OF THE EE/CSE BUILDING
ON OCTOBER 27TH 2002.



CONSTRUCTION Progress

CONSTRUCTION on the Paul G. Allen Center for Computer Science & Engineering continues on schedule. The finished building will connect to the existing EE building. It will provide 75,000 square feet for the CSE department and an additional 10,000 square feet for EE. The EE and CSE departments will have headquarters next to each other on the 1st floor, looking out into a beautiful atrium. Occupancy is scheduled for September of 2003.



BEGINNING OF
DEMOLITION OF THE
OLD EE BUILDING.



DEMOLITION NEARING COMPLETION
ON JUNE 25TH, 2001.

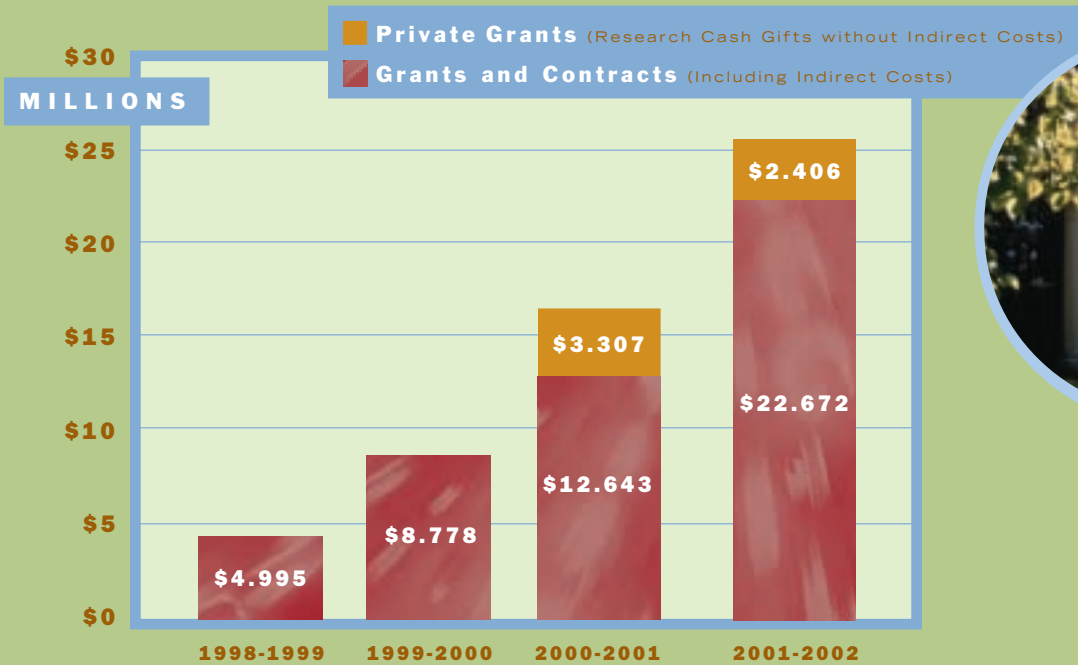


A VIEW OF THE NEW
ATRIUM. THE EE
BUILDING IS ON THE
RIGHT, AND BEHIND.

University of Washington

Electrical Engineering Department

EXTERNAL GRANTS & CONTRACT AWARDS



DEGREES GRANTED (SUMMER 2001 - SPRING 2002)

221	BACHELOR OF SCIENCE
52	MASTER OF SCIENCE
24	DOCTORATE

EDUCATION

THE DEPARTMENT OF ELECTRICAL ENGINEERING AT THE UNIVERSITY OF WASHINGTON IS COMMITTED TO EXCELLENCE IN EDUCATION. WE OFFER THE BACHELOR OF SCIENCE, MASTERS OF SCIENCE, AND PH.D. DEGREES WITH CONCENTRATIONS IN:

- ELECTROMAGNETICS
- DEVICES AND MEMS
- ENERGY
- CONTROL AND ROBOTICS
- VLSI AND DIGITAL SYSTEMS
- COMMUNICATIONS AND WIRELESS
- SIGNAL AND IMAGE PROCESSING

STUDENTS USUALLY JOIN THE UNDERGRADUATE MAJOR AS JUNIORS, ALTHOUGH WE DO ADMIT A SMALL NUMBER OF OUT-STANDING APPLICANTS TO THE MAJOR IN THE FRESHMAN YEAR. ADMISSION TO THE DEPARTMENT IS COMPETITIVE; THIS YEAR THE AVERAGE FRESHMAN/SOPHMORE GPA OF OUR NEW MAJORS IS OVER 3.6. THE CURRICULUM IS ABET-ACCREDITED AND COMBINES STRENGTH IN ELECTRICAL ENGINEERING FUNDAMENTALS WITH EXTENSIVE LABORATORY EXPERIENCE AND AN ENVIRONMENT THAT STRESSES LEADERSHIP, TEAMWORK AND CREATIVITY. THE DEPARTMENT HAS AN UNDERGRADUATE TUTORIAL CENTER TO PROVIDE SENIOR PEERS HELP FOR ALL UNDERGRADUATE COURSES.

RESEARCH STRENGTHS

OUR OUTSTANDING TENURE TRACK FACULTY, STAFF, OVER 300 GRADUATE STUDENTS AND MANY UNDERGRADUATES ARE ENGAGED IN RESEARCH OF INFLUENCE IN THESE TOPICS.

- ADVANCED POWER TECHNOLOGIES
- BIOROBOTICS, HAPTIC INTERFACES AND ROBOTIC SURGERY
- INTELLIGENT TRANSPORTATION SYSTEMS
- AUTOMATED TOOLS FOR GENOMICS AND PROTEOMICS
- COMPUTATIONAL INTELLIGENCE (FUZZY LOGIC, NEURAL NETS)
- WIRELESS NETWORKS AND COMMUNICATIONS
- NETWORK SECURITY AND CRYPTOGRAPHY
- ELECTROMAGNETICS AND EM INTERFACE
- RADAR AND REMOTE SENSING
- SYSTEMS-ON-A-CHIP DESIGN AND TESTING
- HIGH-SPEED, LOW-POWER DESIGN
- RECONFIGURABLE COMPUTING
- MICROELECTRONIC PROCESS, DEVICE AND CIRCUIT MODELING
- MICROELECTROMECHANICAL SYSTEMS (MEMS)
- DISTRIBUTED, PORTABLE AND 'SMART' SENSOR
- PHOTONICS, OPTICAL SENSORS AND OPTICAL COMMUNICATIONS
- NANOTECHNOLOGY
- STREAMING AND BROADCAST MULTIMEDIA
- IMAGE AND VIDEO PROCESSING AND ANALYSIS
- SIGNAL PROCESSING AND COMPRESSION
- COMPUTATIONAL SPEECH AND LANGUAGE MODELING



DEPARTMENT OF ELECTRICAL ENGINEERING

University of Washington
253 EE Building
Campus Box 352500
Seattle, Washington 98195-2500