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DECEMBER 2009

Digital signal-processing techniques are extracting information from DNA to detect cancer very early on. P. 6



Celebrating 125 Years  
of Engineering the Future

## STRIDES IN CANCER DETECTION

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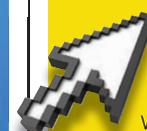
A Life Fellow travels the world taking photos, and an IEEE member and his dog find missing people. P. 18



## ONLINE

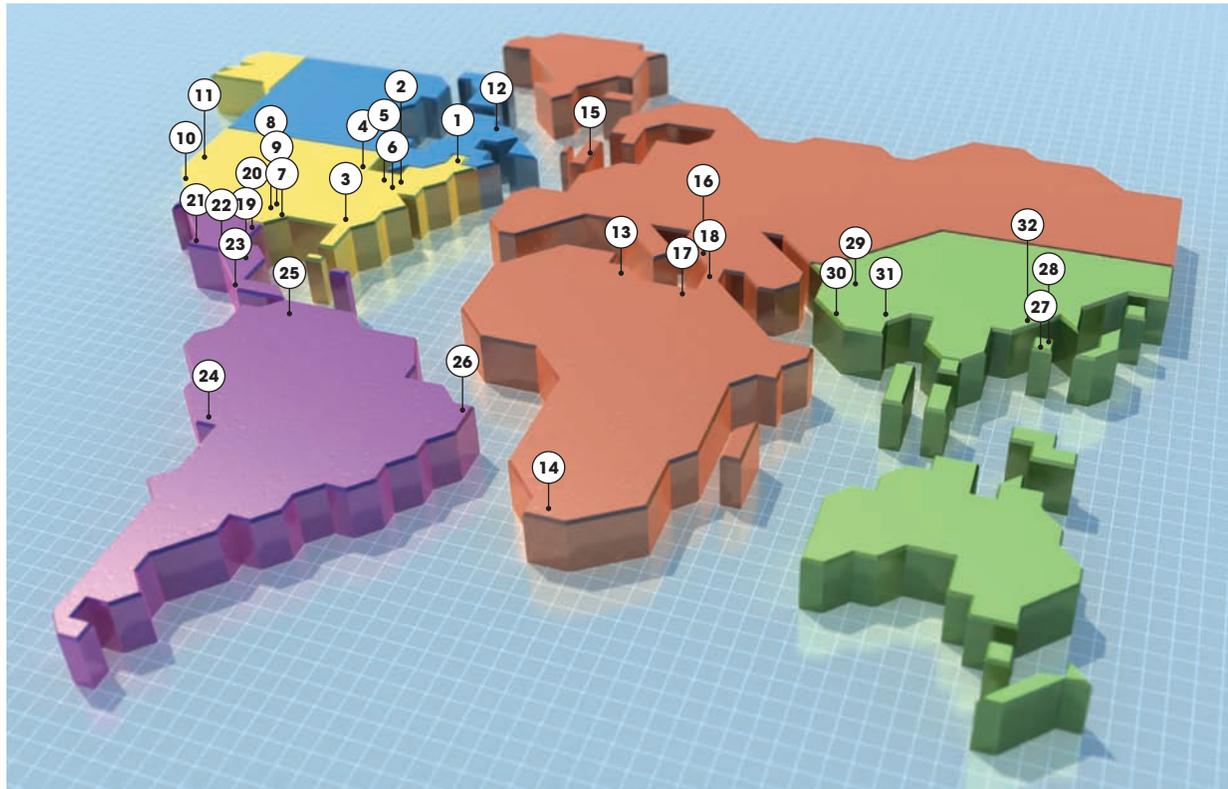
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[WWW.IEEE.ORG/THEINSTITUTE](http://WWW.IEEE.ORG/THEINSTITUTE)

**ELECTION RESULTS** Find out whom members chose to be 2010 IEEE President-Elect.



**STUDENTS' CORNER**  
Read about the top prizewinners of the Presidents' Change the World competition.

## IEEE AROUND THE WORLD



### REGION 1: Northeastern U.S.

1. Maine Section establishes Women in Engineering (WIE) affinity group.

### REGION 2: Eastern U.S.

2. Susquehanna (Pa.) Section establishes IEEE Consumer Electronics Society chapter.

### REGION 3: Southeastern U.S.

3. Student branch formed at Westwood College, Atlanta.

### REGION 4: Central U.S.

4. Iowa-Illinois Section establishes IEEE Computer Society chapter.
5. Calumet (Mich.) Section forms joint chapter of IEEE Electron Devices and Photonics societies.
6. Central Indiana Section establishes IEEE Communications Society chapter.

### REGION 5: Southwestern U.S.

7. Houston Section establishes IEEE Nanotechnology Council chapter.
8. Student branch at the University of Texas, Dallas, forms IEEE Computer Society chapter.
9. Student branch formed at Texas State University, San Marcos.

### REGION 6: Western U.S.

10. Metropolitan Los Angeles Section establishes IEEE Geoscience and Remote Sensing Society chapter.
11. Student branch established at Sonoma State University, Rohnert Park, Calif.

### REGION 7: Canada

12. Canadian Atlantic Section establishes Life Members affinity group.

### REGION 8: Europe, Middle East, and Africa

13. Tunisia Section establishes WIE affinity group and joint chapter of IEEE Aerospace and Electronic Systems, Engineering in Medicine and Biology, Education, and Microwave Theory and Techniques societies.
14. South Africa Section establishes IEEE Nanotechnology Council chapter.
15. City University London forms student branch and chapter of IEEE Systems, Man, and Cybernetics Society.
16. Student branch at Bilkent University, Ankara, Turkey, forms IEEE Computer Society chapter.
17. Student branch at the University of Tanta, Egypt, forms IEEE Robotics and Automation Society chapter.

18. Student branch formed at An-Najah National University, Nablus, Palestine.

### REGION 9: Latin America

19. Honduras Section establishes IEEE Industry Applications Society chapter.
20. Centro Occidente (Mexico) Section establishes IEEE Communications Society chapter.
21. Student branch at the University of Colima, Sede Manzanillo, Mexico, forms joint chapter of IEEE Controls Systems, Power & Energy, Robotics and Automation, and Communications societies.
22. Student branch at the Technological Institute of Morelia, Mexico, forms IEEE Communications Society chapter.
23. Student branch at the Techno-

logical University of Panama, in Chiriquí, establishes IEEE Industry Applications Society chapter.

24. Student branches formed in Peru at San Luis Gonzaga National University, Ica, and Catholic University of Santa María, Arequipa.
25. Student branch formed at the University Santo Tomás, Bogotá, Colombia.
26. Student branch formed at the Federal Institute of Education, Science, and Technology of Paraíba, João Pessoa, Brazil.

### REGION 10: Asia and Pacific

27. Tainan (Taiwan) Section establishes IEEE Vehicular Technology Society chapter.
28. Taipei (Taiwan) Section establishes IEEE Instrumentation and Measurement Society chapter.
29. WIE student branch affinity groups formed in Pakistan at the University of Engineering and Technology, Lahore, and Balochistan University of Information Technology, Engineering, and Management Science.
30. WIE student branch affinity groups formed in India at Father Conceicao Rodrigues College of Engineering, Mumbai, and Velammal Engineering College and the Sri Venkateswara College of Engineering, both in Chennai.
31. Student branches formed in India at the KMCT College of Engineering, Kozhikode; the G.L. Bajaj Institute of Technology and Management, Greater Noida; the Park College of Engineering and Technology, Coimbatore; the Vardhaman College of Engineering, Shamshabad; the Kshatriya College of Engineering, Armour; the RRS College of Engineering, Patancheru; and the Anil Neerukonda Institute of Technology and Sciences, Visakhapatnam.
32. Student branch formed at Zhejiang University, Hangzhou, China.

Send your region or section news to [institute@ieee.org](mailto:institute@ieee.org).

## IEEE to Introduce Five New Journals in 2010

THE SMART GRID, sustainable energy, and biometrics are three of the topics to be covered by five new IEEE publications launching next year. Sponsored by IEEE societies and councils,

the new publications include three online-only journals.

*IEEE Transactions on Smart Grid* will publish research papers that relate to energy generation, transmission, dis-

tribution, and delivery. The quarterly covers theory, technology, policy, and implementation of the smart grid, as well as surveys of ongoing work and papers evaluating power systems affected by the grid. The IEEE Power & Energy Society is sponsoring the journal.

The quarterly *IEEE Transactions on Sustainable Energy* will publish research on the theory and development of sustainable energy technologies and systems. The IEEE Power & Energy Society, IEEE Power Electronics Society, IEEE Industry Applications Society, and

IEEE Industrial Electronics Society are sponsoring the journal.

The *Biometrics Compendium*, a quarterly online publication, addresses the theory, design, and application of biometric characterization of human beings based on physiological or behavioral

features and traits, specifically for identification, identity verification, authentication, and medical diagnosis. Topics include biometric feature extraction and analysis, multimodal analysis, biometrics systems engineering, and biometric databases. The jour-

nal, sponsored by the IEEE Biometrics Council, is expected to include papers previously published in the transactions and conference proceedings of the 17 societies that make up the council.

The online *IEEE Transactions on Affective Computing and Intelligent Interaction* will publish papers on the design of systems that can recognize, interpret, and simulate human emotions and related affective phenomena. The quarterly covers how affective sensing and simulation

techniques can influence the understanding of human affective processes, psychology, and behavior as they relate to affective computing, behavior generation, and user interaction. The IEEE Computer Society, IEEE Computational Intelligence Society, and IEEE Systems, Man, and Cybernetics Society are the sponsors.

Another online-only publication, *IEEE Magnetics Letters*, will cover the physics and engineering of magnetism, magnetic materials, applied magnetics,

the design and application of magnetic devices, biomagnetics, magnetolectronics, and spin electronics. The IEEE Magnetics Society is sponsoring the annual journal.

All five publications will be available through the IEEE Xplore digital library, from various IEEE online collections, and by individual subscription.

For more information on each journal, visit the parent society or council home page via <http://www.ieee.org/web/societies/home>.

## Herz Award Goes to Burgmeyer

ANN BURGMEYER, who retired in 2007 as manager of IEEE Conference & Custom Publishing, received this year's Eric Herz Outstanding Staff Member Award. Burgmeyer was cited for "pioneering work in electronic publishing and data archiving contributing to IEEE's leadership in publishing, and for support of volunteers and staff for over 35 years."

She oversaw her department's transition from an operation relying completely on paper to a modern electronic publishing system employing cutting-edge technology. She set up an electronic conference peer review process and the IEEE PDF eXpress online tool, which helps conference organizers and authors comply with IEEE's requirements for submitting PDF files.

Burgmeyer began her career with IEEE in 1968 as an editorial assistant and spent 39 years with the organization. She worked in the Transactions/Journals department for 25 years and oversaw the publication of IEEE's first electronically produced article in 1985. The manuscript was submitted by e-mail, edited by Burgmeyer's group electronically, then e-mailed to the typesetter. It was then electroni-



cally converted into type and published in print. She went on to establish the Conference Publishing department, where she helped develop IEEE's first publication on CD-ROM.

She is to receive the Herz Award certificate and honorarium at a presentation on 20 November during the IEEE Meeting Series in New Brunswick, N.J.

The IEEE Board of Directors created the award in 2005 to honor Herz, a longtime volunteer who became IEEE general manager and executive director before retiring in 1992. The award recognizes a present or past staff member whose actions have had a substantial impact on the goals and objectives of IEEE, contributed to the success of a number of IEEE initiatives, and led several staff activities.

The nomination deadline for the 2010 Herz Award is 31 January. For more information, visit <http://www.ieee.org/portal/pages/about/awards/sums/ericherzsum.html>.

### Correction

The image of the Apollo crew shown on the calendar for 24 November [September, p. 4] was of the Apollo 7 mission, not Apollo 12.



An IEEE Foundation Grant brings electricity through solar energy and technology training to the Rugerero Survivors' village, a home to families surviving the Rwanda genocide.

## Imagine a community hopeful for the future

Every innovative, life-changing idea comes from someone's imagination—rainwater can be made pure for drinking, solar power can help people in need, and training programs can empower a community to take control of its future.

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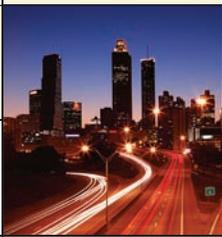
Donate today at [www.ieeefoundation.org](http://www.ieeefoundation.org)

 **IEEE FOUNDATION**

# CALENDAR

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1	2		4 ◀ 1812: Peter Gaillard of Lancaster, Pa., receives a patent for a <b>horse-drawn grass mower</b> .	5
6 ▲ 1923: U.S. President Calvin Coolidge broadcasts the <b>first presidential address on radio</b> .	7 1972: <b>Apollo 17</b> , the program's final moon mission, launches from Kennedy Space Center, Fla. ▶		9		11	12
13	14 1988: The first transatlantic optical-fiber cable system, <b>TAT-8</b> , begins operating between Europe and North America.		16	17 1903: Wilbur and Orville Wright complete the first successful <b>motor-powered and piloted airplane flight</b> at Kill Devil Hills, N.C. ▼	18 <b>18-20 December: Year's final IEEE 125th anniversary celebration, in Ahmedabad, India.</b>	19
20	21 	22 1968: The first live telecast from a U.S. manned craft in outer space is transmitted from <b>Apollo 8</b> .	23		26	
27		29 ◀ 1891: Thomas A. Edison receives a patent for <b>telegraphy without wires</b> , involving wireless communication using an induction circuit.	30	<h1>December</h1>		

<h1>January</h1>						
					1	2
	4	5	6 1838: <b>Samuel Morse and Alfred Vail</b> conduct the first successful public demonstration of their telegraph system. ▲		8	9
17 ▲ 1706: Birth date of <b>Benjamin Franklin</b> .	18 	19		14	15	16
24			27	21	22-24 January: <b>Region 4 meeting</b> in Dearborn, Mich. ▶	
	31			28	29	

	1	2	3	4	5 1952: New York City installs the first electric <b>Walk/Don't Walk</b> sign in Manhattan. ▶	
7 2003: IBM's chess computer <b>Deep Junior</b> and grandmaster <b>Garry Kasparov</b> end their two-week match in a draw. ▶	8 	9 <b>9-14 February: IEEE Meeting Series</b> in Atlanta. ▶		11 1847: Birth date of <b>Thomas A. Edison</b> .	12	13
14		16		18	19	20 1962: <b>John Glenn</b> becomes the first American to orbit Earth, aboard the Friendship 7 spaceship on the Mercury-Atlas 6 mission.
21 		23 1927: U.S. President Calvin Coolidge signs into law the <b>Radio Act of 1927</b> , which creates the Federal Radio Commission.	24	25 		27 ◀ 1891: Birth date of <b>David Sarnoff</b> , radio and television pioneer.
28 <b>27-28 February: Region 10 meeting</b> in Lapu-Lapu City, Philippines.		<h1>February</h1>				

Historical events provided by the IEEE History Center

IEEE events indicated in RED

# We're still looking for the final frontier.

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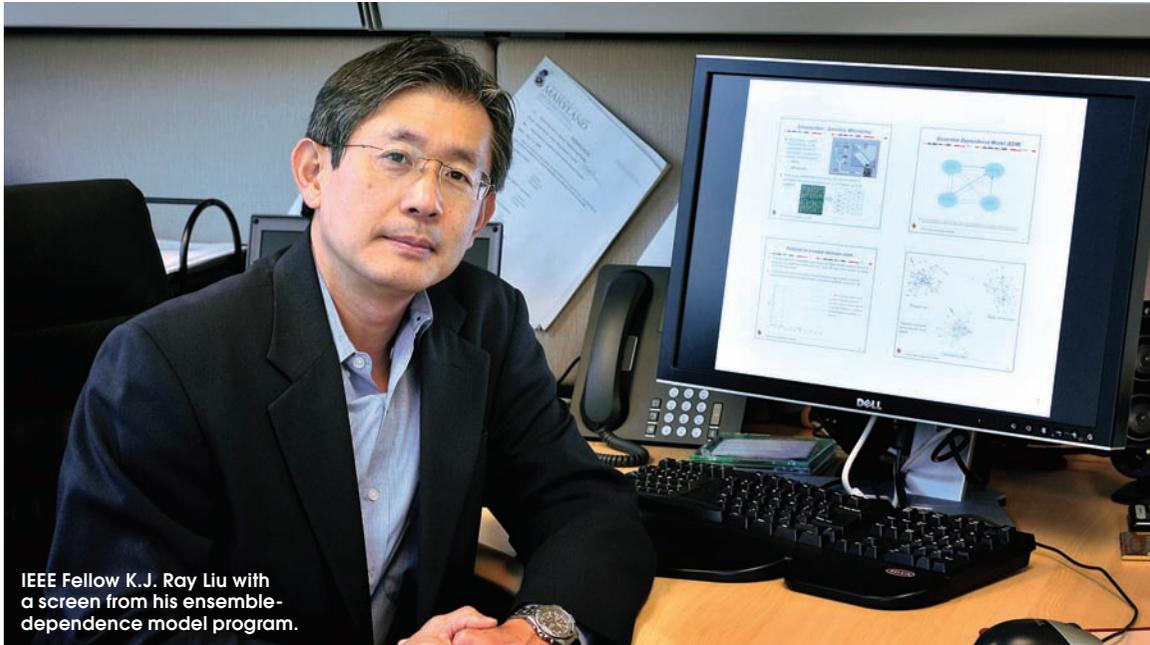
In fact, IEEE members have been part of nearly every major technical development of the last 125 years. So when you need to draw on the most advanced technical knowledge on Earth, or anywhere else, you'll see that IEEE members aren't just waiting for the future, they're engineering it—one trek at a time.

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## TECHNOLOGY



IEEE Fellow K.J. Ray Liu with a screen from his ensemble-dependence model program.

## A Digital Breakthrough for Cancer Diagnosis

BY KATHY KOWALENKO

**M**EDICAL CHECKUPS often involve screening blood to measure the levels of such components as glucose, cholesterol, and triglycerides. One day an ordinary screening test may also include checking your DNA to tell whether you might be developing cancer.

That's the vision of IEEE Fellow K.J. Ray Liu and his team at the University of Maryland, in College Park. They are using digital signal-processing techniques to extract information from DNA to identify changes that occur as cancer develops, which they hope will ultimately lead to the ability to predict whether cells will become cancerous.

"Nowadays a doctor can tell you, for example, what your cholesterol level is and express it by a number," Liu says. "Hopefully, through our work, one day a doctor will be able to give you a number related to cancer—whether the number is within a normal range, whether the num-

ber shows cells are transitioning to the cancerous stage and preventative treatment is needed, or whether the number is high and you need to watch for cancer developing in, say, your liver or breast."

Liu has written or cowritten 10 books and more than 500 research papers. He coedited the *Handbook on Array Processing and Sensor Networks* (Wiley-IEEE Press, 2009).

"There is a paradigm shift in cancer diagnosis under way, from a completely biological process to engineering a digital world," Liu said in March when he described his work at an IEEE media event in New York City. "We are seeing the dawn of a digital revolution in cancer diagnosis at the gene and protein level by using digital signal processing."

### SIMPLIFYING SIGNALS

Cancer is a leading cause of death worldwide and the number of cases is increasing, according to the World Health Organization. WHO reports that the number of cancer deaths

around the world is projected to jump from about 7.9 million annually to almost 12 million by 2030. New cases of cancer are expected to rise from 11.3 million per year to 15.5 million in 2030.

As the disease develops, cancerous cells release unique proteins and other molecules that can serve as early indicators. Such biomarkers display alterations of patterns at the cellular, molecular, or genetic level. Correctly identifying protein biomarkers for cancer holds enormous potential for early detection, diagnosis, and treatment—which is particularly important for cancers of the skin, breast, cervix, mouth, larynx, colon, and rectum.

Thanks to the sequencing of the complete human genome, there have been many advances during the past decade to help identify biomarkers. One technique involves the application of microarrays that can measure and translate the expression level of thousands of genes simultaneously. Those expressions

can be processed into digital signals, Liu points out.

Liu's microarray technology translates seemingly random biological information in DNA into an expression of data that can be read by a computer. His "ensemble-dependence model" looks at the microarray DNA data or proteins via a mass spectrograph by classifying them into different clusters; analyzes the dependence between genes and proteins; and assesses their behavior and interaction. Each cluster contains specific genes that have a well-defined relationship to one another.

That dependence is used in Liu's model to classify normal and cancerous samples. The system is then applied to identify cancer biomarkers using several real cancer data sets, including prostate and gastric cancers. Liu's group used its model-driven approach to uncover the relationship between the global gene expression profile and a subject's health. That could lead to the ability to predict cancer development in the lungs, stomach, colon, prostate, and ovaries with an accuracy rate as high as 98 percent, he says.

"We are trying to use very simple equations in very simple models to explain the very complex phenomena of cancer development," Liu says. "We're developing different models to try to classify whether there is cancer, and if so, at what stage."

### YEARS AWAY

Unlike the two-year time frame it typically takes to conduct R&D for a new high-tech product like an iPod, a much longer and more expensive process is required for medical research, Liu notes. He estimates it will take 10 to 20 years to see the application of his early-prediction technique, which he began developing in 2002.

He says he hopes that in the next 5 to 10 years "digital testing for cancer can supplement the traditional biological testing to offer a reliable second opinion, improve cancer detection accuracy rates, and reduce false alarms." ■

**FOR MORE INFORMATION** You can watch Liu's talk at the media briefing at <http://www.ieee.org/web/membership/IEEEtv/about.htm>.

# A Year of Progress

BY GAILANNE BARTH

**B**UILDING AWARENESS and positioning IEEE as a thought leader on important technological and engineering issues around the globe were key achievements of IEEE's Public Visibility Initiative in 2009. The initiative is a multiyear communications program that seeks to raise IEEE's global visibility and increase public understanding of how engineering, computing, and technology benefit humanity. This year's efforts were centered on launching and implementing three programs:

- A communications program consisting of key messages about the organization.
- A public relations campaign that targets all IEEE regions.
- Innovation roundtables and forums featuring thought leaders who are IEEE members.

"Our focus is to position IEEE as the world's trusted source and forum—the voice of the profession," says Howard E. Michel, 2009 chair of the Public Visibility Ad Hoc Committee, which is charged with overseeing the initiative. "This goes hand in hand with one of the major goals of IEEE's Envisioned Future: to get the public to increasingly value the role of IEEE and technical professionals in enhancing the quality of life and the environment."

## KEY MESSAGES

The Public Visibility team worked on developing three components of IEEE's communications program: a positioning statement (a short description of what the organization does and what makes it different [see sidebar]), an elevator pitch (a message about IEEE that can be delivered in a matter of seconds, or as long as it takes to ride with someone in an elevator), and a tagline (a memorable phrase that summarizes IEEE's essence and reinforces the audience's identity with the brand). "Advancing Technology for Humanity" was the tagline approved by the IEEE Board of Directors in September.

## GLOBAL CAMPAIGN

Central to the initiative is a far-reaching global public relations effort aimed at IEEE's four target audiences (individuals at the

preuniversity and university levels, IEEE members, and professionals) across the Global-10 countries: Brazil, Canada, China, Finland, Germany, India, Japan, Mexico, the United Kingdom, and the United States. To date there have been more than 975 media placements, which



IEEE Spectrum editor in chief Susan Hassler with inventor Ray Kurzweil at Fortune's Brainstorm Tech (top). Three publications in which IEEE was featured (bottom).

is estimated to be the equivalent of about US \$44 million worth of free advertising, based on circulation and TV audience. News outlets in which IEEE technical experts were quoted include BBC TV (UK), *CTO* (China), *EE Times* (India), and *The Wall Street Journal* and *Investor's Business Daily* (United States).

## EXPERT FORUMS

IEEE members recognized as thought leaders in their fields discussed pressing technical issues at a series of forums and roundtables with members of the media. Such events serve as showcases for IEEE experts to discuss, for example, innovations that could lead to new industries, technological advances

to meet the world's challenges, and, ultimately, new jobs for engineers.

One such event, *Fortune* magazine's annual Brainstorm Tech held in July, brought together leading icons of the digital world to consider the future of business and technological innovation. As *Fortune*'s program partner, IEEE helped develop the meeting's content. In addition, several IEEE members had prominent roles, including 2007 IEEE President Leah Jamieson, Fellow John McDonald, and Fellow Saifur Rahman, who served on the "Smart Grid: Making It a Reality"

biomedical engineering, sustainable energy, and security issues. These meetings with media groups around the world are aimed at positioning IEEE as a trusted "voice" for engineering, computing, and technology information, Michel notes.

Two roundtables took place in September at the annual conference of the IEEE Engineering in Medicine and Biology Society (EMBS) in Minneapolis. At one roundtable, six IEEE technical experts in neuro-engineering, including IEEE Member Andrew Schwartz, professor of neurobiology at the University of Pittsburgh, discussed ways to identify key locations in the brain where electrodes can be placed to control external devices such as robotic arms and prosthetic devices.

Senior Member Paolo Bonato, director of the Motion Analysis Laboratory at Spaulding Rehabilitation Hospital, in Boston, talked about combining wearable sensors and Web-based applications to monitor patients with Parkinson's disease. Fellow Bin He, 2009 president of IEEE EMBS and professor and director of the Center for Neuroengineering at the University of Minnesota, in Minneapolis, covered noninvasive brain-computer interfaces for thought-driven devices aimed at restoring motor functions in disabled patients.

The second media roundtable featured four technical experts discussing the latest advances in rehabilitating patients who have nervous system injuries. You can watch both sessions on IEEE.tv at <http://www.ieeetv.org>.

## ENGAGING SOCIETIES

A number of IEEE societies worked with the Public Visibility team to give their technical experts greater exposure. So far, more than 60 have been interviewed, quoted, or profiled in the media.

Check IEEE's online newsroom (<http://www.ieee.org/go/newsroom>) to see examples of media coverage and read feature stories. ■

## IEEE POSITIONING STATEMENT

IEEE is the world's largest professional association advancing innovation and technological excellence for the benefit of humanity. IEEE and its members inspire a global community to innovate for a better tomorrow through its highly cited publications, conferences, technology standards, and professional and educational activities. IEEE is the trusted "voice" for engineering, computing, and technology information around the globe.



# A Recipe for Innovation

BY KATHY KOWALENKO

**B**ANKING ON INNOVATION as the key to their future prosperity and even as a way out of the recession, countries are pouring loads of money into research to ensure their long-term economic growth. But being successful at encouraging innovation does not come overnight. And it takes more than research alone. It requires investments in math and science education, understanding what innovation is, and cultivating a culture conducive to creativity, according to three IEEE members who know a thing or two about the topic. IEEE Life Fellow Gerard H. “Gus” Gaynor, Fellow Gordon W. Day, and Senior Member Mauro Togneri

recently shared their views on innovation with *The Institute*.

Gaynor is president of the IEEE Technology Management Council, which focuses on good practices for members involved with overseeing the management of engineering, technology, innovation, and strategy. He is former director of engineering for 3M Co., in St. Paul, Minn., where he worked for 25 years. He has authored books and articles about innovation, as well as a series of e-books for IEEE-USA on the topic.

Day, president of IEEE-USA, conducted and managed research at the National Institute of Standards and Technology for 33 years.

Togneri began working as an engineer in industrial instrumentation and control in 1961. He also managed and owned several technology-based companies in North America, Europe, and Asia before retiring in 2003. Now a management consultant, he is a member of the IEEE-USA Innovation Institute Steering Committee and cochair of the Entrepreneurs Activities Committee.

“Countries have two reasons for becoming more innovative. One is national, the other global,” Togneri says. “Nationally, a country wants to raise its citizens’ standard of living, create well-paying jobs, and develop products to offer to the world market. From a global view, innovation in one country helps all countries, because it reduces poverty, creates more efficient ways of doing things, and opens up world markets for technology products.”

Gaynor finds innovation essential to leading countries out of a recession but points out that “it can’t be done at the national level.

“It’s got to be done down at the individual level,” he says. “Innovation starts at the bottom, not at the top.”

Every country has local, cultural, and governmental differences when it comes to innovation, according to Day. “But,” he says, “they will use many of the same tools to stimulate innovation: building a solid infrastructure, creating good communication systems, putting into place financial structures that encourage entrepreneurship and innovation, and funding education to create a high-tech workforce.”

## THE “STEM” FIELDS

In the United States, IEEE-USA works at the national level on legislation that encourages the government to, among other things, stimulate innovation. One way is to invest in STEM (science, technology, engineering, and mathematics).

“The most important raw material for innovation is brainpower, and assuring there is an abundance of that is perhaps the most important thing IEEE can do,” Day says. “Engineers create jobs because they come up with ideas, invent new products, and build up the companies they work for as well as start new ones. That’s how an economy grows.”

IEEE-USA scored a recent success on the education front. The America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act, better known as the America

Competes Act, was signed into law in August 2007 and began receiving funding 10 months ago. The act authorizes an increase in the nation’s investment in science and engineering research as well as in STEM education from kindergarten to graduate school. According to Day, the act was the culmination of four to five years of hard work by the business community, the high-tech industry, and—especially—universities, IEEE, and other professional societies.

The world is aware of education’s importance. Brazil, China, and other countries are allocating money from their economic stimulus packages to improve their school systems.

## CAREFUL NURTURING

Innovation needs to be cultivated, the experts say.

“Innovation requires an environment that fosters it, people who are willing to take risks, and companies that can be patient and tolerate failure,” Togneri says. “When you are creating or inventing something, you need to take chances, because you don’t know whether it will work.

“To be innovative, a company needs a longer horizon, where it isn’t just worrying about tomorrow’s financial results but looking at its long-term future,” he continues.

The purpose of innovation is to provide something of economic value, Gaynor adds. It begins with an idea that is developed into a workable concept, and then, hopefully, into a product. “Innovation equals invention plus commercialization or implementation,” he says. “The process is not simple. Until someone takes research results and commercializes them, it’s not really innovation.

“In today’s world, people are expecting innovations to be churned out every 12 months, and that’s not going to happen.”

He points out that innovation also includes activities that refine or simplify an organization’s processes, such as doing something more efficiently or reducing waste.

You can learn more about innovation from Gaynor’s four e-books: *Doing Innovation: Creating Economic Value*; *Developing a Workable Innovation Process*; *Fostering an Innovation Culture*; and *What It Takes to Be an Innovator*. The e-books are available to IEEE members for US \$9.95 each and can be found under the IEEE-USA e-books section of the IEEE Career site at <http://www.ieee.org/web/careers/home>. ■

# Honoring the Trailblazing Transistor

BY ANNA BOGDANOWICZ

IT'S HARD TO IMAGINE what life would be like without the transistor, which was invented a little more than six decades ago. Considered by researchers and historians to be the most important invention of the 20th century, the transistor has led to groundbreaking advances in computing, communications, transportation, medicine, and virtually every technically related field. Without it, such developments as the personal computer, the cellphone, the GPS, and the pacemaker would not exist. IEEE is honoring the breakthrough this month with an IEEE Milestone in Electrical Engineering and Computing.

The transistor was invented by researchers John Bardeen and Walter Brattain, under physicist William Shockley's leadership, in December 1947 at Bell Telephone Laboratories in Murray Hill, N.J.

## TUBES TO TRANSISTORS

Transistors are solid-state devices used to amplify or switch electronic signals. They're made of layers of semiconductor materials and three terminals that connect to an external circuit.

Before transistors, computers and other electronics relied on vacuum tubes, which consist of electrodes in an evacuated bulb through which an electric current can be passed and manipulated, allowing the tubes to function as amplifiers and switches. John Fleming invented a two-element vacuum tube, or diode, in 1904. Fleming's invention, which was used as a rectifier in early radio work, was honored with an IEEE Milestone in 2004. In 1906 Lee De Forest—who in 1930 became president of the Institute of Radio Engineers, one of IEEE's predecessor societies— invented the three-element tube, or triode. The device became the model for most later vacuum tubes. It was one of the most important breakthroughs in electronics history, making possible amplification, modulation, and switching and thereby laying the groundwork for commercial radio and television, high-fidelity audio, and the development of the first, primitive computers.

Vacuum tubes, also known as valves, were far from ideal, however. They were large, and the heated metal that emitted electrons would eventually burn out. Their glass envelope made them relatively fragile. The tubes also required a lot of power, so they ran hot. The few computers built with tubes were huge and slow.

For years, researchers had sought to replace tubes with solid-state devices. In 1926, physicist Julius Lilienfeld patented the concept of a field-effect transistor, a type that relies on changes to an electric field to control the shape and conductivity

of a channel in a semiconductor material. It is the principle behind today's field-effect transistor, the most common type of transistor. But it's not clear whether Lilienfeld ever produced such a device or indeed whether it would even be possible to build one from his patent description. Another development came in 1934, when physicist Oskar Heil patented another type of field-effect transistor.

Two years later, Mervin Kelly, research director at Bell Labs, established a department there to research solid-state physics in the hope of



A replica of Bell Labs' first point-contact transistor.

producing a replacement for the vacuum tube from semiconducting materials. But when World War II broke out, the group disbanded, putting the research on hold. Wartime research, meanwhile, led to a much better understanding of semiconductors such as silicon and germanium.

## THE BREAKTHROUGH

After the war, Kelly was determined to continue work on solid-state devices, and he restarted the group in 1945. Led by Shockley and chemist Stanley Morgan, the team included Brattain, Bardeen, and researchers Robert Gibney, Bert Moore, and John Pearson. Shockley focused the group's efforts on silicon and germanium, instead of semiconductors such as selenium and copper oxide, which had drawn much attention before the war.

Two years later, Bardeen made a historic discovery: He realized that electrons form a barrier at the surface of crystals. He and Brattain also began

investigating ways to reduce the effects of surface states so as to make a viable solid-state device. They decided to make one based on the point-contact principle, rather than the field effect. In a point-contact device, the electrical capacitance, heretofore a problem, can be reduced by making the junction area of connection as small as possible.

By late November 1947, Bardeen and Brattain had created the first functioning transistor, a crude little unit made of a plastic triangle with strips of gold foil pushed down into contact with a chunk of germanium [see photo]. They spent the next few weeks improving their device and by 16 December had succeeded in producing the first solid-state transistor.

The two connected the transistor to a simple circuit with a battery and a meter and showed that the transistor amplified current. They also put their invention in a circuit containing a microphone and a speaker so they could hear how the transistor amplified the electrical signal from a microphone.

On 23 December, they showed it to Bell Labs executives, who immediately realized the potential of the new technology. Envious of his subordinates' success, Shockley went on to invent another type of transistor—the junction transistor—which was built on thin slices of different types of semiconductor materials pressed together. The junction transistor could be manufactured more easily, and it was more rugged and reliable than the point-contact transistor.

The transistor is acknowledged today as one of the greatest inventions in history. It established the vast new field of solid-state electronics and thereby set the stage for today's US \$250 billion global semiconductor industry. Bardeen, Brattain, and Shockley received the 1956 Nobel Prize in physics for their research on semiconductors and their discovery of the transistor effect.

A ceremony recognizing the milestone is scheduled for 8 December at Bell Labs in Murray Hill. A plaque is to be mounted in the labs' Hall of Innovations, near the room where the researchers worked. The hall houses various awards, including Nobel Prizes, and replicas of devices that trace the history of inventions developed at Bell Labs.

The Milestone plaque reads:

*"At this site, in Building 1, Room 1E455, from Nov 17th to Dec 23rd, 1947, under the direction of William B. Shockley, Walter H. Brattain and John A. Bardeen discovered the transistor effect and developed and demonstrated to their colleagues a point-contact germanium transistor. This led directly to subsequent developments in solid-state devices that revolutionized the electronics industry and changed the way people around the world lived, learned, worked, and played."* ■

**FOR MORE INFORMATION** about the IEEE Milestones program or to submit a nomination for a Milestone, visit [http://www.ieeeahn.org/wiki/index.php/Milestones:IEEE\\_Milestones\\_Program](http://www.ieeeahn.org/wiki/index.php/Milestones:IEEE_Milestones_Program).



**THIS MONTH'S QUESTION:**

## The Exclusivity Dilemma

The U.S. Federal Communications Commission is investigating whether exclusive contracts between cellphone makers and carriers are helpful or harmful to innovation. One such example is the arrangement for AT&T to be the exclusive carrier for Apple's iPhone in the United States. Many iPhone users complain about AT&T's service but love the iPhone and can't switch to another carrier. In France and other countries, however, the iPhone can be used with a number of carriers. Critics of exclusive contracts argue that they inhibit innovation and are unfair to consumers. But some wireless carriers say such deals promote innovation by inspiring cellphone makers to develop imaginative products.

**Do you think exclusive cellphone contracts inhibit or promote innovation? Are they fair to consumers?**

Respond to this question by e-mail or regular mail. Space may not permit publication of all responses, but we'll try to draw a representative sample. Responses will appear in the March issue of The Institute and may be edited for space. Suggestions for questions are welcome.

**MAIL:** The Institute, IEEE Operations Center, 445 Hoes Lane, Piscataway, NJ 08854-4141 USA **FAX:** +1 732 562 1746 **E-MAIL:** institute@ieee.org

**RESPONSES TO SEPTEMBER'S QUESTION**

### A Patent "Strike" for Engineers?

A recent editorial on EE Times's UK Web site called for engineers to band together and stage a patent "strike" to gain control of their inventions. Engineers should refuse to sign contracts giving their employers sole rights to their inventions, the edi-

torial said, adding that engineers should refuse to file patent applications "for every idea," a practice that companies have used to spawn "a business of litigation and licensing that charges for portfolios by the pound." Although engineers shouldn't stop working during a recession, the editorial added, it's about time engineers stood up for themselves.

Do you agree? Would you take part in such a patent strike?

### No Choice

Few engineers are in a position to refuse to sign away their rights to their inventions, because most need a job. Even if they could find a way to retain ownership rights, it's doubtful that many would have the economic resources to take advantage of their patents. Besides, the concept of one person working alone to come up with a novel, patentable idea is by and large a thing of the past. And the idea that a patent is a pot of gold is—with rare exception—an illusion.

**MICHAEL ERNSTOFF**  
Los Angeles

### Litigation Lowdown

As a patent lawyer, I have much exposure to the business and legal sides of engineering. I realize that without patents many engineers would be jobless. Very little would get invented without employment contracts that assign inventions to companies. The business of licensing and litigation—like it or not—is part of the modern electronics industry.

Given the lack of balanced media coverage, one may think it's time to resist patents. Indeed, there are faults with the system when companies do such things as troll for infringements. Companies often go too far with their contracting and licensing practices, but overall we need the patent system.

Perhaps it will give engineers some comfort to know there are people in the legal and corporate worlds who see both sides of the issue and will stand up against bad patent practices.

**TOM GREK**  
Hong Kong

### Park Your Rights

Companies pay their employees to advance the organization. When an employee receives a patent, it usually is a result of a creative idea related to the company's future. That employee does not deserve an ownership interest. He or she learned what the company needed on company time and likely tested the development on company time while using company tools. Anyone who refuses to sign over patent rights to a company when offered a position should find another job, including becoming self-employed.

**DONALD G. WILSON**  
Carlsbad, Calif.

### Keep Ideas to Yourself

Companies use patents to keep competitors' inventions off the market. If a company engineer invents something that would improve a product only slightly, there is rarely a net financial gain for the company after retooling costs. But a competitor could incorporate the improvement at virtually no cost and come up with a new product. The originator doesn't want that to happen, so it tries to protect itself with a patent. Keep your inventions to yourself. Save them for a new-product start-up, either in your current company or at a new one.

**JAMES A. KUZDRALL**  
Nashua, N.H.

### Show Me the Money!

I fully support a strike. Engineers have been taken advantage of for far too long. They should receive no less than 2 percent of the gross revenue from the patents they're responsible for. The payment must be based upon the gross revenue—not the net. Everyone should stick together and insist on an addendum to any existing employment agreements, and the same provision should be included in all future agreements.

**RAY V. MILLER**  
Burnsville, N.C.

### Patent Pandemonium

Patents are totally useless for the inventor; they serve only to enrich patent attorneys. By suing everybody in the industry for patent infringement, attorneys frequently settle for a small, extortionate fee and earn a nice living, but the inventor usually gets nothing substantial in return.

Sadly, too many people are distracted by the illusion that they can become rich if only they could patent their ideas. This leads to too many useless patents issued for ideas that do nothing to improve our lives.

What matters is who can bring an idea to market. If you have an idea and patent it but do nothing with the patent, you're just getting in the way of progress. If you have an idea and put together a team that builds the product and sells it, then you have done something worthwhile that deserves economic reward.

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Lee's Summit, Mo.

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# We Must Tell the World

**H**OW MANY OF US know how to explain to a non-technically trained person what professionals such as engineers and scientists have contributed to humanity? One way is to describe what the world would be like if all their contributions were to disappear. We would have no electricity, electric lights, telephones, radio, television, GPS, washing machines, refrigerators, microwave ovens, thermostats, modern transportation systems, computers, the Internet, or e-mail—and that's just for starters.

Why should everyone be aware of the contributions of these professionals? It would create a more receptive environment for communicating with audiences such as government leaders and preuniversity students—two groups essential to future technological development.

We need to raise the technological awareness of government leaders and others who support and fund research and development. It might be a difficult task because, in the United States and some other countries, there is a lack of technical competence in government. Government leaders must understand how critically important R&D is to the future of humanity and to our quality of life. Without the resources to discover and develop new technologies, we will not see the continuation of the great technological advances that have occurred since the advent of IEEE 125 years ago.

IEEE's technical communities, including its authors, conference participants, and standards developers, have been at the forefront of the advances. Our 144 journals and magazines and more than 900 conferences each year continue to help accelerate the pace of change by enabling the sharing of technical information.

Encouraging young people to consider careers in science, engineering, and mathematics is essential to progress. IEEE's efforts include the volunteer-led Teacher In-Service Program, in which professional development workshops help teachers bring hands-on engineering lessons into their classrooms. Another effort is TryEngineering.org. This is a Web site for preuniversity students, parents, teachers, school counselors, and the general public that lets visitors explore how

to prepare for an engineering career, ask experts engineering-related questions, play interactive games, and more.

We also need to show the next generation how an engineering and science education can benefit humanity. To this end, I initiated the first IEEE Presidents' Change the World Competition last year as one of IEEE's 125th anniversary events. The competition recognizes students who identify a real-world problem and apply engineering, science,

They focus on emerging technologies and on the contributions that engineers and scientists are making toward a better world.

Another effort completed this year is a video entitled *IEEE: One Voice*. It is designed to make members proud to be part of IEEE and to encourage those not affiliated with IEEE to have a positive view of the contributions of technology to society. You can download the video at [http://www.ieee.org/go/brand\\_videos](http://www.ieee.org/go/brand_videos).



**Government leaders must understand how critically important R&D is to the future of humanity and to our quality of life.**

computing, and leadership skills to solve it.

Two hundred entries were submitted by students around the world. Their solutions addressed a wide range of humanitarian challenges. Among the winning entries were a handheld device to analyze proteins for medical diagnoses in areas remote from health facilities; games, devices, and toys that create excitement, interest, and learning opportunities for physically and mentally handicapped children; a bicycle-operated mill for rural areas where converting grain to flour is difficult because of the lack of electricity; and a solar energy-powered module to light homes and run radios and other low-power devices.

But the competition and its subsequent publicity are only a small part of what we must do to impress key audiences with the IEEE story. That's why in 2008 IEEE began a long-term public visibility program to reach audiences around the globe [see p. 7]. Among the program's goals is encouraging news media to publish the great stories about IEEE, its members, and the professionals who work in IEEE's fields of interest. Such stories are now appearing in news media worldwide.

I asked earlier how we would explain what scientists and engineers have done for humanity. Now I ask, "What will our future be—especially in addressing humanitarian challenges—if we don't have enough engineers and scientists and if we don't vigorously support research and development?" For example, many countries are providing massive funding to build a smart grid, but some countries face a shortage of technical professionals with the expertise to work on this evolving technology.

We need to tell the world about the accomplishments of engineers and scientists and, thereby, engender support for engineering and scientific education and research. And we must encourage the best and brightest to join us in our quest to engineer the future and apply technology to meet the humanitarian challenges of the next 125 years and beyond.

**John R. Vig**  
 IEEE President and CEO

## PRODUCTS & SERVICES



## Webinars Offer Career and Tech Tips

BY KATHY KOWALENKO

LOOKING FOR TIPS on how to win in today's job market? Need help learning to network? Want to get up to speed on today's hot new tech fields? IEEE has a variety of free webinars for members that offer career advice and technical overviews. Here's a sample of what's available.

### CAREER HELP

**FINDING WORK** Part 1 of "How to Win in a Competitive Job Market" covers strategies for an effective job search and exposes misconceptions that could hold you back from landing a position. Part 2 deals with how you can take charge of your search, modify your approach to meet market conditions, and rebuild your confidence after

you've been out of a job for a while. Career counselor Sherri Edwards presents both sessions.

**GETTING HIRED** The process of finding a new job can be frustrating and confusing. The webinar "Why Aren't I Hired Yet?" tries to answer that question by examining market data and the latest hiring trends. Elizabeth Lions offers tips to help you get noticed in today's competitive job market. Lions is an author and career coach, specializing in working with engineers.

**CONSULTING BASICS** If you're looking for ways to earn extra income, consider becoming a consultant. The "Consulting 101" webinar explains how to get into the game—part-time or full-time. If you're already a consultant, it can show you ways

to increase your assignments and expand your client base. The webinar explores why becoming a consultant can be a good idea and offers suggestions for running a business. The presenter is IEEE Senior Member Gary Black, a consultant in electrical and electronic engineering, including power, energy, and control systems.

**SUCCESSFUL NETWORKING** Whether you're searching for a job, considering a career change, or simply trying to climb the job ladder, networking could be your key to success. Speaker Michelle Tullier examines the factors that make networking productive in "Networking Solutions for Career Success."

The author of eight books, Tullier is vice president of career transition consulting for Right Management. She explains how to overcome the most common networking obstacles, such as feeling like you're "just not the networking type" or getting through to hard-to-reach people. She also shares tips for expanding networks and building stronger relationships.

*These webinars are available at <http://www.ieee.org/web/careers/home>.*

### TECH OVERVIEWS

**ROBOTICS** The first in a four-part series, "Robotics 101" shows how cutting-edge technologies are used to design, test, and deploy sophisticated robot architectures. The speaker is Anu Saha, product marketing manager at National Instruments Corp. Other seminars cover unmanned robot systems, research being conducted at universities, and future applications.

**DATA CAPTURE** Learn how bar-code scanning and imaging can streamline business operations, cut costs, and improve customer service. In "Powerful Data-Capture Solutions," three experts from Motorola demonstrate how to set up data-capture systems with the company's OEM technology, differentiating between products. The speakers are Anthony Gangemi, senior product manager, and Jonathan Chin, product manager, both with the OEM Advanced Data Capture Division, and Richard Woodburn, senior director for the Enterprise Wireless LAN Division.

**MULTIPHYSICS** "Multiphysics Modeling and Simulation" introduces a variety of modeling and simulation techniques for solving challenging design problems. Presenter David Kan, branch manager for the COMSOL Group, a software company, also gives a tutorial that demonstrates the work flow in the design of microelectromechanical systems, including the coupling of electromagnetic and heat-transfer phenomena and structural mechanics in the same simulation.

*These are from the Tech Insiders webinar series, found at <http://www.spectrum.ieee.org/webinar>. ■*



## IEEE International Solid-State Circuits Conference

San Francisco; 7-11 February

The theme of this year's conference is "Sensing the Future." An important trend in the semiconductor industry is the migration toward highly integrated systems. ISSCC 2010's technical program focuses on integrated system-on-chip technology and innovative component design, with an emphasis on energy efficiency. Nine tutorials provide introductory overviews on topics including battery management for portable devices, designing energy-efficient on-chip networks, and multicore processing for mobile phones.

**SPONSOR:** IEEE Solid-State Circuits Society

**VISIT:** <http://www.isscc.org>

## ACM/IEEE International Conference on Human-Robot Interaction

Nara, Japan  
2-5 March

The conference covers social psychology, cognitive science, human factors, artificial intelligence, and organizational behavior. Topics include multimodal interaction, task allocation and coordination, autonomy and trust, and robot-team learning.

**SPONSORS:** IEEE Robotics and Automation Society, American Association for Artificial Intelligence, Association for Computing Machinery Special Interest Group on Computer-Human Interaction, Human Factors and Ergonomics Society  
**VISIT:** <http://hri2010.org>

## IEEE Symposium on New Frontiers in Dynamic Spectrum Access Networks

Singapore  
6-10 April

As networks and devices increasingly gain intelligence and cognitive capabilities, and as

regulators around the world seek to enhance spectrum utilization, dynamic decentralized access is becoming one of the most important topics in wireless communications. The goal of the conference is to expand the understanding of complex next-generation wireless systems that are focused on using the RF spectrum more efficiently and dynamically.

**SPONSOR:** IEEE Communications Society

**VISIT:** <http://www.ieee-dyspan.org>

## IEEE International Symposium on Biomedical Imaging

Rotterdam, Netherlands  
14-17 April

Subjects include image formation and reconstruction; computational and statistical image processing and analysis; dynamic imaging; image quality assessment; and physical, biological, and statistical modeling.

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**VISIT:** <http://www.biomedicalimaging.org>

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## STANDARDS

# Spotlight on Products

### IEEE Std. 802.11n-2009, released September 2009

The IEEE Wireless Local Area Networks (WLAN) Enhancements for Higher Throughput standard is an amendment to the IEEE 802.11 wireless base standard and defines mechanisms that provide significantly improved data rates and ranges. WLANs will now be able to deliver data rates that are 10 times faster than before while remaining compatible with existing systems. This amendment is aimed at addressing the escalating demands placed on WLANs because of higher-bandwidth file transfers and next-generation multimedia applications.

### IEEE Std. 1654-2009, released July 2009

The IEEE Guide for RF Protection of Personnel Working in the Vicinity of Wireless Communications Antennas Attached to Electric Power Line Structures explains how to establish a safety program that complies with regulations

for radio-frequency protection for electrical workers near antennas adjacent to power lines. The guide also describes the power-frequency electric and magnetic field immunity of personal monitors and protective clothing.

### IEEE Std. 1636-2009, released July 2009

The IEEE Trial-Use Standard for Software Interface for Maintenance Information Collection and Analysis provides specifications for software interfaces for information systems containing data for diagnosing and maintaining complex systems.

The standard covers how to create open software architectures for mature diagnostics systems and stresses the importance of assessing the effectiveness of diagnostics throughout a product's life cycle.

**FOR MORE INFORMATION** on these and other standards, visit the IEEE Standards Association Web site: <http://www.standards.ieee.org>.



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The screenshot shows the myIEEE web portal interface. At the top, there's a navigation bar with tabs for myIEEE, Volunteer, Knowledge, Community, and Profession. Below this is a search bar and a "Welcome, James!" message. The main content area is divided into several sections: "My Memberships" (no additional memberships), "Service Advisor" (My Technical Interest Profile (TIP) with a list of interests like Integrated Avionics, Cryptography, etc.), "IEEE News" (Planned Service Disruptions, IEEE Life Fellow Leslie Gaddes, etc.), "IEEE memberNet" (connect to IEEE members, my Opt-In Preferences, Launch Network), "Who's new?" (Mem Testing, Membertnet, Jushchenko, Andrew, Vacation, June), "IEEE Spectrum RSS" (Open Arms, Will Washington Kick-start the U.S. Battery Biz?, Slideshow: Zeus's Thunderbolt Factory), "The Institute" (Anderson Selected as Next President-Elect), and "IEEE.tv" (New Programs, Most Viewed, MyTV, The Benefits of Membership, Electric Ship Technologies Symposium).

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## PROFILE



Paul Cram at home  
in his workshop,  
in Mansfield, Ga.

## Paul Cram Engineering a Long Life

A 100-year-old life member helps usher in digital TV and looks back at how things have changed

BY SUSAN KARLIN

**A**S TV STATIONS in the United States switched off their analog signals and went digital in June, WAGA-TV, in Atlanta, interviewed the engineer who had switched on its signal 60 years before.

That man is Paul Cram, the station's first broadcast engineer. As IEEE celebrated its 125th anniversary this year, Cram also celebrated a milestone: He turned 100 last month. Cram spoke to reporter Tom Haynes in the station's transmitter room about what it felt like to return there after so many decades and how the station has changed. With WAGA's cameras rolling, he then pressed the button that cut off the analog signal.

### AT THE START

It has been a remarkable personal and professional journey for Cram, an IEEE life member who spent most of his career at the forefront of radio, radar, and television engineering. Cram lives with a grandson in Mansfield, Ga., where he occasionally fields questions about his longevity and shows his relatives how to build small electronic devices.

"People ask, 'What's your secret?'" he says. "I don't have any secrets. I've taken good care of myself. I'm not a smoker or drinker, and I drink a lot of milk."

Growing up in Birmingham, Ala., Cram began considering a career in engineering after meeting the local radio station engineer. "It looked like a pretty good way to make a living," he says. In 1927, after a year at Birmingham-Southern College, Cram headed to Chicago to work in a Grigsby-Grunow factory that was building the first AC-powered radios. "Radios were all battery-powered until 1928," Cram notes.

Then came the stock market crash of 1929. "Some people lost all their money and committed suicide," he says. "But I wasn't affected. As a kid, I didn't have any money invested. The factory closed, and although it was hard to get a job, I always managed to find one. My friends said it was because I was the type of person companies wanted."

Cram returned to Birmingham and attended night classes at the University of Alabama while helping to design substations for Alabama Power.

In 1932 he joined the local radio station, WKBC (later WSGN and now WAGG), and went on to become chief engineer. WKBC gave Cram on-the-job training with directional antennas—cutting-edge technology at the time. In those days, radio operated with only AM frequencies, and those antennas directed broadcasts away from each other to avoid interference. "I ended up specializing in directional antennas and have made my living working on them," he says. "I'm one of the few people left who still knows how to build one."

In the mid-1930s, Cram earned a bachelor's degree in electricity from the University of Alabama. "The university's records don't go back that far, so I'm no longer sure of the exact year," Cram says.

He joined one of IEEE's predecessor societies, the Institute of Radio Engineers, in 1935. Except for a few years from the end of the 1930s to the beginning of the 1940s, he has been a member ever since. "The IRE was primarily U.S.-based," he says. "So whenever an engineer took a job in another country, he'd be responsible for developing an engineering community there."

Cram says his most interesting work came in 1942, when he moved to Waltham, Mass., to work for Raytheon. "Radar had just been invented, and it was a very interesting time in electronics," he recalls. "There were no experts, no people with experience. I was working with people who had Ph.D.s and scientists doing classified work, and even they were having trouble developing radar. I would interview the scientists and turn their notes into a real system. It was absolutely my favorite job."

### ENTER WAGA

In 1947, Cram moved to Atlanta to head the engineering department at WAGA-TV, the first TV station in the southern United States. "The owner asked me what I knew about television, and I said, 'Absolutely nothing.' He pointed a finger at me and said, 'Well, you're about to learn.' In those days, all you had to do to succeed was be determined to learn. That's been my attitude all my life." When the station went on the air in 1949, it was Cram who switched on the signal.

From 1954 to 1975, Cram worked out of Orlando, Fla., as director of engineering at Rounsaville Enterprises, a now-defunct broadcasting firm. He then ran his own consultancy, Broadcast Technical Services, out of his Orlando home. He moved to Georgia in 2000 and retired last year.

In his long life, Cram has had many good times but has also dealt with difficult losses. "Almost everyone I've known in my life has died," he says. "The last time I called a friend I'd started out working with in Birmingham, the phone had been disconnected. It gives you a feeling of helplessness, but you can't do anything but accept it. An associate once said the reason I've lived so long is because I don't worry about anything. Hmm, maybe *that* is my secret." ■

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## Derek Koonce

### Training Canine Heroes

**W**HEN SOMEONE GOES missing in California and county sheriffs need help, they just might call in Derek Koonce and his partner, Belle. She is a highly trained search-and-rescue dog.

Over the years, Koonce and Belle [see photo], or his previous dog, Tasha, have taken part in more than two dozen missing person missions, with several happy endings.

The IEEE member became curious about search-and-rescue dogs in 1985 while on a skiing trip. "I saw a ski patrolter with a search dog coming down the slopes and thought it looked interesting," recalls Koonce, who is an electrical engineer at Aerometals, an aircraft parts manufacturer in El Dorado Hills, Calif.

Koonce decided to get involved, so he joined the National Ski Patrol and took some classes. Eager to work with rescue dogs, Koonce began asking around and was pointed to the California Rescue Dogs Association (CARDA), a volunteer organization that trains, certifies, and dispatches search-dog teams. That's when he decided it was time to take the next step and get a dog.

His wife picked out their first dog, Tasha, a Labrador/German shepherd mix. Koonce and Tasha attended CARDA's search-and-rescue

training several times a week for the next two years. Koonce learned how to work with Tasha in a search-and-rescue situation. For example, he'd have her sniff a personal item of the missing person or command her verbally to find a human scent if nothing personal was available, and then Tasha would trail the scent. She also learned to communicate with Koonce by barking or pulling him toward whatever she had found. Once Tasha received her certification, Koonce began receiving calls from CARDA for help.

His most memorable mission, he says, was the first time he and Tasha found a missing person. In July 1998, Koonce and Tasha were called to Blackstone Canyon, just north of San Francisco, to search for an 80-year-old woman who had disappeared during a walk. After hours of searching, Tasha caught a scent and worked her way up a nearby canyon, where she found a figure lying on the ground. It was the woman, unconscious.

"It was an incredible feeling," Koonce recalls. "All the training and hours of hard work paid off that day." The woman later recovered.

Koonce lost his beloved partner to old age in 2006, after 20 missions. It was difficult to move on, but he began training Belle, a black Labrador/golden retriever who got her certification in May and has already been on several missions.

"Working with Tasha and Belle has made me realize how unbelievably intelligent dogs are," Koonce says. —Anna Bogdanowicz

**PASSION**  
Search and rescue

**PROFESSION**  
Electronic design engineer

**HOMETOWN**  
Roseville, Calif.

## Eli Brookner

### Globe-Trotting Photographer

**A** STRING OF COINCIDENCES more than four decades ago led IEEE Life Fellow Eli Brookner to photography, his longtime hobby. When Brookner had a layover in Hawaii on his way to the 1964 IEEE Information Theory Conference in Tokyo, he ran into a local who had just returned from Japan. The man gave Brookner a shopping tip: Buy a Nikon F camera in Tokyo because it was half the U.S. price.

It sounded like a good deal, so when he landed, Brookner did just that. He didn't know how to best use the camera, however. But while doing some sightseeing on a bus going from Osaka to Kyoto before the conference, Brookner struck up a conversation with another passenger who happened to be a professional photographer.

"He was on assignment for a *National Geographic* article on U.S. troop exercises in Guam and was spending the weekend sightseeing in Japan," says Brookner, who works for Raytheon, in Sudbury, Mass. When the engineer explained that he had just bought a new camera, the photographer invited Brookner to join him.

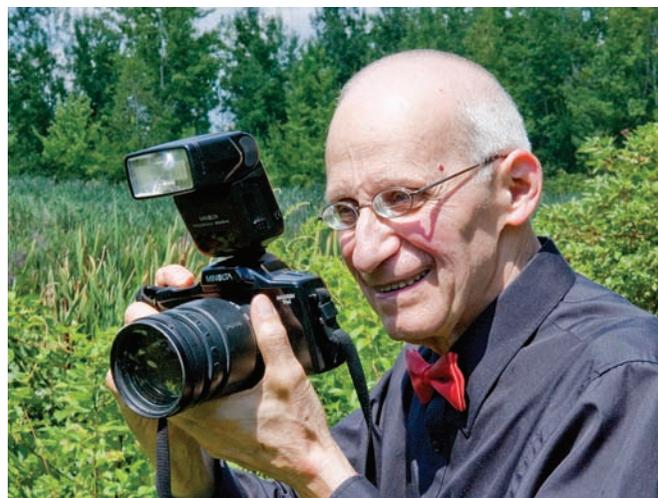
"It was quite an experience to see how a professional photographer operates," he says, adding that the lessons he learned have stuck with him.

"He was continually taking pictures, so I learned that if you want to end up with a few good photos, you need to take lots of them."

The photographer gave him tips on which lenses to use for different types of shots. Brookner bought several, including a telephoto lens for shooting close-up portraits of people from a distance—which wound up being his favorite type of photography. His work has been exhibited at several of Raytheon's U.S. offices and at galleries throughout Massachusetts. His photos of radars have appeared on the covers of books, conference proceedings, and technical magazines including *Scientific American*.

The Kyoto trip also made Brookner realize he had another passion: travel. He enjoys teaching courses around the world on radar and phased arrays, based on his four books, which include *Radar Technology* (Artech House, 1977).

Brookner has taken photographs in more than 35 countries. Among his favorite locations are Papua, New Guinea, where he photographed indigenous people; Singapore, where he shot a body-piercing event, part of the annual



**PASSION**  
Photo portraits

**PROFESSION**  
Radar engineer

**HOMETOWN**  
Sudbury, Mass.

Thaipusam festival; Shemya, Alaska, where he photographed World War II artifacts and a Raytheon Cobra Dane radar; and Bali, Indonesia, where he photographed a cremation, which he describes as "a happy event representing the passing of the deceased into the afterlife."

"When I took a close-up of the burning bier, one of the relatives urged me to take more photos to make sure I got a good shot," Brookner says, recalling that tip he received so many years ago. —A.B.

*If you have an interesting hobby you'd like to share, e-mail the editors: institute@ieee.org.*

## DEADLINES & REMINDERS

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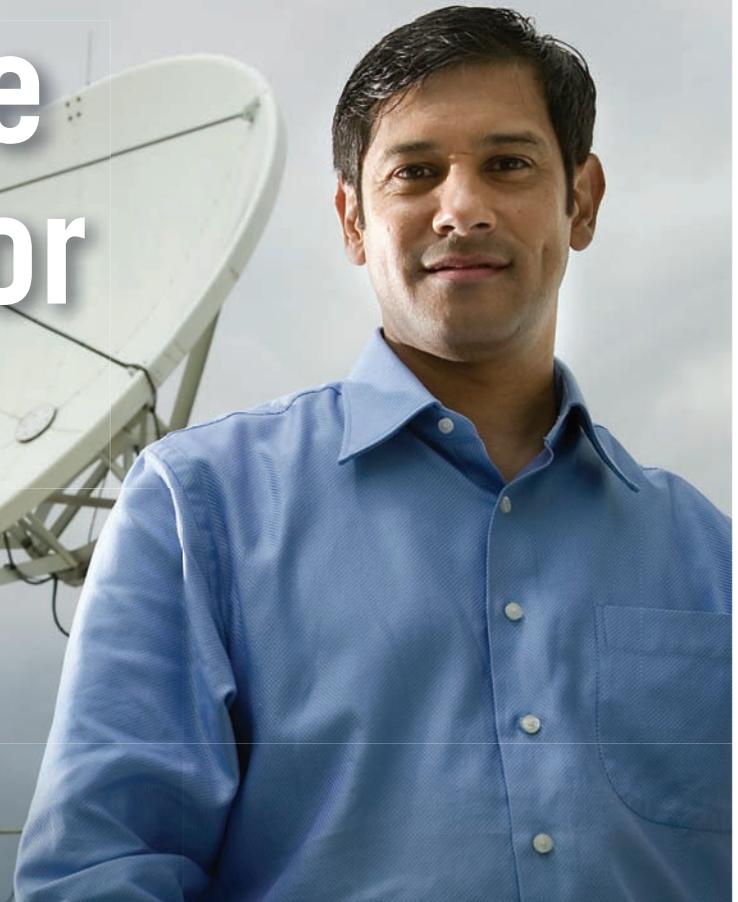
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