the institute

SEPTEMBER 2013 • THEINSTITUTE.IEEE.ORG

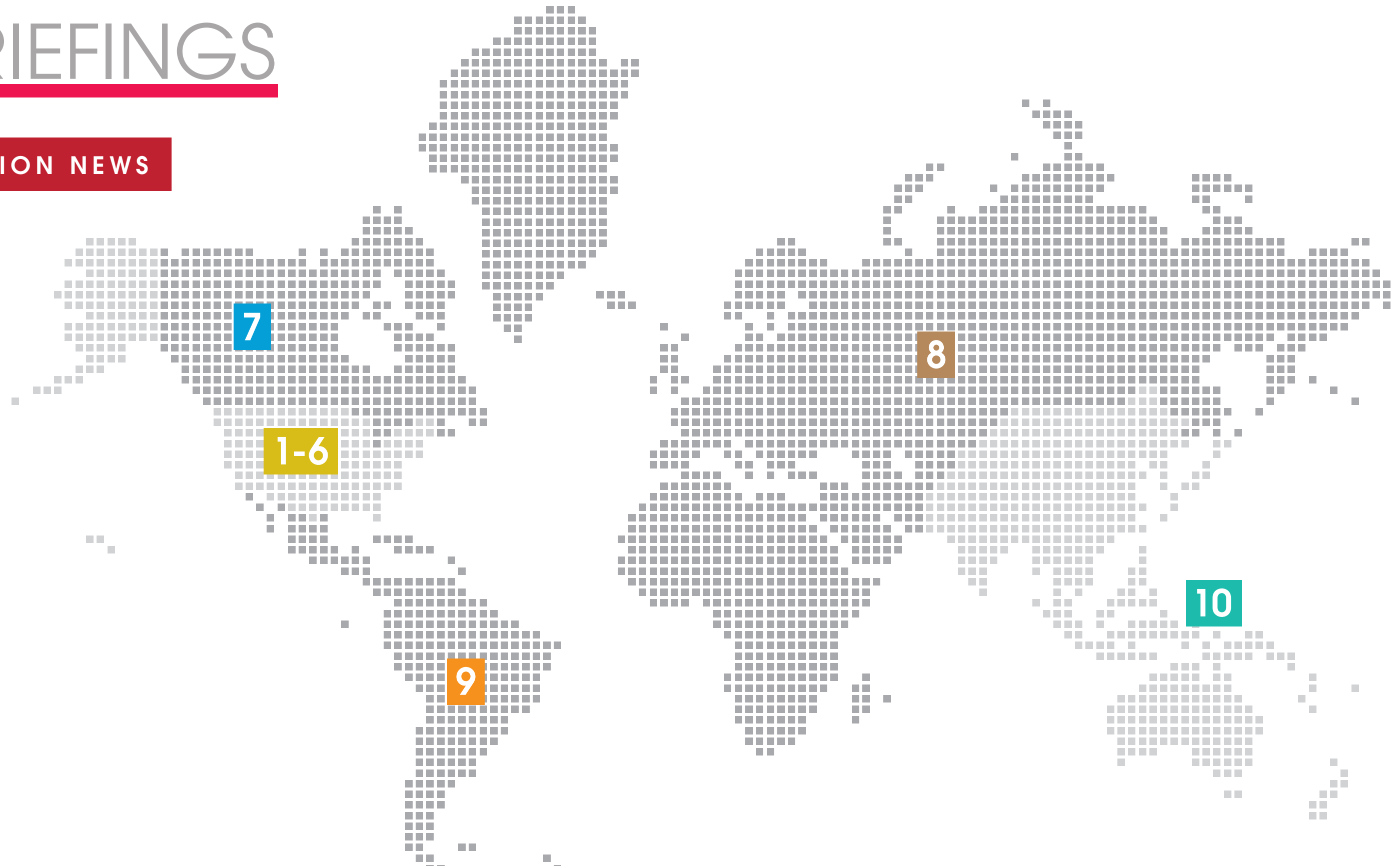
SENSING DISASTERS

Images from above can help lessen the impact of earthquakes, sinkholes, and other catastrophes

IEEE

BRIEFINGS

REGION NEWS



REGION 1 NORTHEASTERN UNITED STATES

■ Student branch at **Hofstra University, Long Island, N.Y.,** forms IEEE Computer Society chapter.

■ **Long Island Section** forms IEEE Power Electronics Society chapter.

■ Student branch at **University of Massachusetts, Lowell,** forms IEEE Power & Energy Society chapter.

REGION 3 SOUTHEASTERN UNITED STATES

■ **Huntsville (Ala.)** and **Memphis (Tenn.)** sections form Graduates of the Last Decade affinity groups.

■ **Alabama Section** forms Life Member affinity group.

■ Student branch at **Alabama Agricultural and Mechanical University, Huntsville,** forms Women in Engineering affinity group.

■ Student branch at **Florida Institute of Technology, Melbourne,** forms IEEE Robotics and Automation Society chapter.

REGION 4 CENTRAL UNITED STATES

■ Student branch formed at **Waukesha County Technical Institute, Pewaukee, Wis.**

REGION 5 SOUTHWESTERN UNITED STATES

■ Student branch formed at **John Brown University, Siloam Springs, Ark.**

■ Student branch at **Tulane University, New Orleans,** forms IEEE Engineering in Medicine and Biology Society chapter.

■ **High Plains (Texas) Section** forms IEEE Power & Energy Society chapter.

■ Student branch at **Texas State University, San Marcos,** forms IEEE Computer Society chapter.

REGION 6 WESTERN UNITED STATES

■ **Metropolitan Los Angeles Section** forms IEEE Computer Society chapter.

■ Student branch at **California State University-Dominguez Hills, Carson,** forms IEEE Computer Society chapter.

■ **Boise (Idaho) Section** forms IEEE Solid-State Circuits Society chapter.

■ Student branch formed at **University of Washington, Tacoma.**

REGION 7 CANADA

■ Student branch at **British Columbia Institute of Technology, Burnaby,** forms IEEE Power & Energy Society chapter.

■ **Southern Alberta Section** forms joint chapter of IEEE Computer and IEEE Instrumentation and Measurement societies.

REGION 8 EUROPE, MIDDLE EAST, AND AFRICA

■ Student branch at **University of Rijeka, Croatia,** forms IEEE Computer Society chapter.

■ Student branches formed in England at **University of Bath** and **University of Kent.**

■ Student branch at **Université de Technologie de Belfort-Montbéliard, France,** forms IEEE Industry Applications Society chapter.

■ Student branch formed at **Universidade de Aveiro, Portugal.**

■ Student branch at **University of Pretoria, South Africa,** forms IEEE Microwave Theory and Techniques Society chapter.

■ Student branch at **Royal Institute of Technology, Stockholm,** forms IEEE Power & Energy Society chapter.

REGION 9 LATIN AMERICA

■ Student branch at **Universidade de Brasília, Brazil,** forms IEEE Robotics and Automation Society chapter.

■ Student branches formed in Brazil at **Centro Universitário da FEI, São Bernardo do Campo,** and **Universidade Federal do Vale do São Francisco.**

■ Student branch at **Universidad Industrial de Santander, Bucaramanga, Colombia,** forms IEEE Computer Society chapter.

■ Student branches formed in Mexico at **Centro Universitario UAEM Ecatepec, Instituto de Ingenieros de Morelos, Instituto Tecnológico de San Luis Potosí,** and **Universidad Politécnica de Pachuca.**

■ Student branch at **Universidad Tecnológica del Perú, Lima,** forms IEEE Robotics and Automation Society chapter.

REGION 10 ASIA AND PACIFIC

■ Student branch at **University of Wollongong, Australia,** forms IEEE Power & Energy Society chapter.

■ **Macau (China) Section** forms joint chapter of IEEE Power & Energy and Power Electronics societies.

■ Student branch at **University of the Chinese Academy of Sciences, Shanghai,** forms IEEE Electron Devices Society chapter.

■ Student branches in India at **Amrita Vishwa Vidyapeetham, B K Birla Institute of Engineering and Technology, Jeppiaar Engineering College,** and **Saveetha School of Engineering** form IEEE Power & Energy Society chapters.

■ **Nagoya (Japan) Section** forms IEEE Intelligent Transportation Systems Society chapter.

■ Student branches formed in Malaysia at **Universiti Selangor, Bestari Jaya,** and **University of Nottingham, Seminyih.**

■ Student branch at **Mehran University of Engineering and Technology, Karachi, Pakistan,** forms IEEE Communications Society chapter.

■ Student branch at **NED University, Karachi,** forms IEEE Power & Energy Society chapter.

■ **Thailand Section** forms IEEE Education Society chapter.

SEND US YOUR NEWS The Institute *publishes announcements of new groups once they've been approved by IEEE Member and Geographic Activities. To send us local news, like student branch events, preuniversity outreach efforts, or other IEEE group activities, use our form on the Region News page at http://theinstitute.ieee.org/region-news.*

COVER: GUANG NIU/GETTY IMAGES; THIS PAGE: ISTOCKPHOTO

NEWS

Proposed Changes to IEEE Code of Ethics

The IEEE Board of Directors at its meeting of 1 July 2013 approved the following resolutions:

"Resolved that the following resolutions shall be, and are hereby, approved:

Resolved that, in accordance with Section 7.8 of the IEEE Policies, the publisher of *THE INSTITUTE* is instructed to include, both in its August 2013 online version and September 2013 print version, copies of the proposed changes in the IEEE Code of Ethics presented to this meeting with a request for comment thereon; and further

Resolved, that all IEEE Major Boards shall have the opportunity to discuss proposed changes prior to final action by the IEEE Board of Directors; and further

Resolved, that this Board shall engage in final consideration of such changes to the IEEE Code of Ethics at its November 2013 meeting."

The following is the IEEE Code of Ethics, marked to show the proposed changes and published for comment in accordance with Section 7.8 of the IEEE Policies:

"We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

- to accept responsibility in making decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;
- to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
- to be honest and realistic in stating claims or estimates based on available data;
- to reject bribery in all its forms;
- to improve the understanding of technology, its appropriate application, and potential consequences;
- to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
- to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
- to treat fairly all persons **and to not engage in acts of discrimination based on** ~~regardless of such factors as~~ race, religion, gender, disability, age, ~~or~~ national origin, **or sexual orientation**;
- to avoid injuring others, their property, reputation, or employment by false or malicious action;
- to assist colleagues and coworkers in their professional development and to support them in following this code of ethics."

Comments on the foregoing changes should be directed to IEEE Director Parviz Famouri at pfamouri@ieee.org or IEEE Director Karen S. Pedersen at kspedersen@ieee.org on or before 7 November.

Online

Available 9 September at theinstitute.ieee.org

IEEE HERZ AWARD
The Eric Herz Outstanding Staff Member Award will go to Cecelia Jankowski.

BOOKS OF INTEREST
Free e-books cover topics relating to remote sensing of natural disasters.

ISTOCKPHOTO

Sections Congress Is One Year Away

NEXT YEAR'S IEEE Sections Congress is scheduled for 22 to 24 August at the Amsterdam RAI convention center. The IEEE Member and Geographic Activities Board is partnering with Region 8 (Europe, Africa, and the Middle East) to host the event.

Held every three years, the congress provides IEEE volunteers and leaders of IEEE regions, sections, subsections, chapters, geographic councils, and affinity groups with the opportunity to network and discuss ways to promote and increase members' participation in IEEE activities. The congress also develops recommendations that it submits to the IEEE Board of Directors to help guide the direction of IEEE.

Registration begins in February. To register online or learn more about the event, visit http://www.ieee.org/societies_communities/geo_activities/sections_congress/2014/index.html. —*Amanda Davis*

Four Priorities for IEEE

THE IEEE BOARD of Directors set four priorities at its February Meeting Series, in Austin, Texas:

- Ensure that IEEE is prepared for social and technological disruptions that may affect its operations.
- Provide an open forum for discussion, development, and implementation of emerging technologies.
- Leverage IEEE's technology-related insight to provide governments, nongovernmental organizations, and other groups with innovative, practical recommendations to address public policy issues.
- Expand IEEE communities, in which individuals from around the world can share, collaborate, network, debate, and engage with colleagues. —*A.D.*

September

4 1995: Computer programmer Pierre Omidyar [above] launches AuctionWeb, an online auction and shopping website that was renamed **eBay** two years later.

15 1888: Birth date of **Alfred N. Goldsmith** [above], 1928 IRE president and first editor of *Proceedings of the IRE*.

16 1877: Birth date of **Jacob Schick**, inventor of the electric shaver.

21 1976: William Millard establishes **ComputerLand** in Hayward, Calif. Its more than 800 stores by 1986 made it the largest computer retailer in the world.

24 1869: Birth date of **John S. Stone**, 1915 IRE president and a pioneer in the study of high-frequency currents.

October

6 1846: Birth date of **George Westinghouse**, founder of Westinghouse Air Brake Co., in Pittsburgh, and Westinghouse Electric Co., in Cranberry Township, Pa.

18–20 Region 7 meeting in Toronto.

27 1904: The first **New York City subway** line goes into operation.

28 1971: England's **Prospero** satellite is launched.

31 1961: Australia's **Parkes Observatory**, which has a 64-meter-tall radio telescope [below], is completed.

November

5 1863: Birth date of **James Packard**, founder of Packard Motor Car Co., in Detroit, a maker of parts and luxury automobiles.

9 1965: Parts of Canada and the northeastern United States, including New York City [above], are hit by the most **massive power blackout** up to that time.

14 1922: The **British Broadcasting Co.**, in London, makes its first radio broadcast [below].

21 1969: The first link in **ARPANET**, a precursor of the Internet, is established, between Stanford University and the University of California, Los Angeles.

20–26 IEEE Meeting Series in New Brunswick, N.J.

Historical events provided by the IEEE History Center. IEEE events indicated in red.

CLOCKWISE FROM LEFT: ISTOCKPHOTO; JB REED/BLOOMBERG/GETTY IMAGES; ORVILLE ANDREWS/HULTON ARCHIVE/GETTY IMAGES; AP PHOTO; CSIRO; IEEE

TECH TOPIC

SENSING DISASTERS

Minimizing the Damage From Natural Disasters

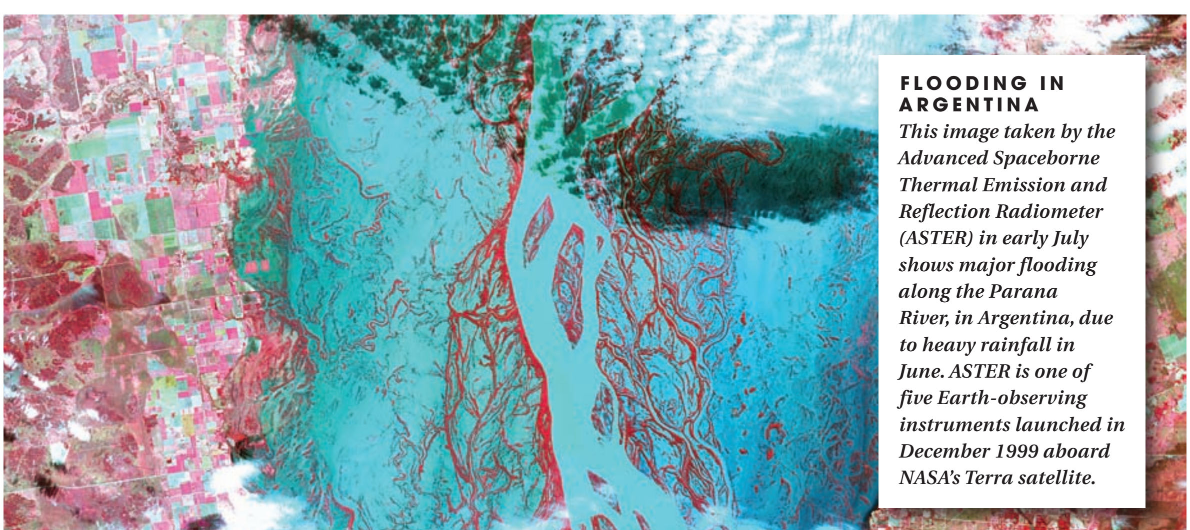
Researchers use satellites to monitor Earth's conditions BY **KATHY PRETZ**

WHETHER THEY'RE floods, earthquakes, or sinkholes, natural disasters wreak havoc. Since 2010, more than 700 have been registered worldwide, affecting more than 450 million people, according to a study released last year by the International Monetary Fund. The IMF reports that since the 1990s, annual damages have risen from an average of US $20 billion to about $100 billion. And that upward trend is expected to continue.

Natural disasters can't be prevented, but much can be done with technology to lessen their financial impact and reduce the loss of life. In this special issue, *The Institute* examines three such projects: the global-mapping ASTER instrument on board a NASA satellite that shares with relief organizations the images it gathers from catastrophes; a method of applying a satellite system to monitor temperature changes on the ground that might lead to forecasting earthquakes [p. 7]; and software for detecting sinkholes [p. 8].

You might think technologies that warn of impending natural disasters have been developed only recently, but inventions that were meant to do so existed more than 170 years ago, as an article from the IEEE History Center describes [p. 9].

Also featured in this issue is the work of IEEE Fellow James A. Smith, who helped pioneer the remote sensing of Earth's biosphere [p. 17].



FLOODING IN ARGENTINA
This image taken by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) in early July shows major flooding along the Parana River, in Argentina, due to heavy rainfall in June. ASTER is one of five Earth-observing instruments launched in December 1999 aboard NASA's Terra satellite.

FROM HIGH ABOVE

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on board NASA's Terra spacecraft is a multispectral instrument launched in 1999. ASTER is part of the agency's Earth Observing System, a series of satellites that monitor Earth to better understand its nature.

The instrument provides high-resolution images of Earth in 14 different bands of the electromagnetic spectrum. The images in turn are used to identify changes in the land, atmosphere, climate, and oceans. For example, ASTER monitors glaciers and volcanic activity, heat in urban areas, and changes in land use. It can also track floods [see image below], hurricanes, and earthquakes. Since its launch, ASTER has taken more than 2 million images of Earth's surface, adding about 500 to its archives daily.

ASTER is a joint project of Japan's Ministry of Economy, Trade, and Industry (METI) and NASA. METI monitors the instrument, notifies NASA staff when the position of the instrument's antenna or the satellite's orbit needs adjustment, and handles the preliminary data processing of the images. ASTER has three instrument subsystems divided by wavelength: visible and near-infrared, shortwave infrared, and thermal infrared. Each subsystem has a different ground resolution, with several bands spanning each range of wavelengths.

"This agreement with Japan is quite typical of the kind of bilateral arrangements NASA has with other space-enabled countries such as Canada, France, and Germany," says Michael Abrams, leader of the U.S. ASTER science team at NASA's Jet Propulsion Laboratory, in Pasadena, Calif.

Abrams is coauthor of the paper "ASTER Satellite Observations for International Disaster Management," along with Kenneth A. Duda, a senior scientist with the Earth Observing System, which is part of the Earth Resources Observation and Science Center, in Sioux Falls, S.D. The two are part of the team at NASA that executes the commands and controls the Terra satellite on which ASTER sits.

Their paper appeared in *Proceedings of the IEEE* in October 2012, a special issue dedicated to the remote sensing of natural disasters. It is available in the IEEE Xplore Digital Library.

GLOBAL COOPERATION

ASTER's most prominent mission is to acquire and deliver emergency observations about natural disasters, one of the things it was specifically designed to do more than 14 years ago. NASA participates in the effort through the International Charter on Space and Major Disasters, which is composed of private, national, and international space agencies. The 20 signatories to the charter, which went into effect in 2000, agree to share data from their satellites with relief organizations. The satellite images can help officials prepare for troubling events, provide warnings, reveal the extent of damage, and assist with recovery efforts.

The charter provides a way for authorized groups that urgently need imagery of a disaster to make a request for multiple images through a single call, according to Duda. "Annual charter activations have been generally trending upward since inception as the value of the service has repeatedly been demonstrated," he says.

According to Abrams, the cooperation ensures that only data from the most appropriate sensors are used, which minimizes the redundancy of data collection by the agencies and makes information available faster.

"The agreements, based on friendship and cooperation, are meant to share knowledge and experience," he says. "ASTER is one of many such instruments operated by different countries that cooperate to provide data whenever satellite imagery for any kind of big disaster is needed."

PREDICTION HURDLES

While they do a fairly good job of warning of impending events such as floods because of the information they gather about rainfall and snow packs, ASTER and other such instruments can't make exact predictions because of the random nature of disasters, Abrams explains. "At least with warnings, you can evacuate people and prevent loss of life," he says.

The Terra mission and ASTER project will continue to be funded by NASA through September 2014.

ICON PHOTO: EVEGENY TERENTEV/GETTY IMAGES; NASA/GSFC/METI/ERSDAC/JAROS/U.S.-JAPAN ASTER SCIENCE TEAM

CHINAFOTOPRESS/GETTY IMAGES

TECH TOPIC

Subtle Signals Could Help Forecast Earthquakes

Satellite system analyzes thermal anomalies

BY **KATHY PRETZ**

EARTHQUAKES strike suddenly, almost without warning. There were 80 quakes in the first six months of this year with a magnitude of 6 or greater, according to the European Mediterranean Seismological Centre. Countries where they struck include Colombia, Greece, Indonesia, and the United States. Earthquakes can cause loss of life and structural damage in populated areas. Poorly designed buildings are destroyed, walls tumble, and furniture is smashed.

Because earthquakes strike seemingly at random, they are among the most difficult disasters to forecast, but that hasn't stopped scientists from trying to decipher the clues that may foretell an occurrence.

One area of research relies on images from satellites to analyze thermal anomalies caused by the stress in fault lines and the energy buildup that occurs before an earthquake. The anomalies alter several electromagnetic radiation signals, including outgoing longwave radiation, which is thermal infrared energy leaving Earth; microwave radiation; and surface latent heat flux, or the heat that moves from Earth's surface to the atmosphere—all of which can be tracked by remote-sensing systems.

A number of observation systems are taking images of the anomalies, some with higher resolution than others, and scientists are using different methods of analysis. So far, inconsistent results have prompted questions about how useful the anomalies are as forecasters.

But confident that the anomalies are, in fact, valid indicators, IEEE Members Li-Xin Wu and Shan-Jun Liu and Graduate Student Member Kai Qin have developed a method to study them using data from GEOSS, the Global Earth Observation System of Systems. The network brings together data gathered by thousands of sensors aboard buoys, weather stations, and satellites, measuring conditions across the land, water, and atmosphere. GEOSS is supported by dozens of nations and scientific organizations, including IEEE through its Committee on Earth Observation.

Wu is chief professor with the Academy of Disaster Reduction and Emergency Management at Beijing Normal University and with the School of Environment Science and Spatial Informatics at the China University of Mining and Technology, in Xuzhou. He is the IEEE Geoscience and Remote Sensing Society's liaison with the Group on Earth Observation's User Interface Committee.

Liu is a professor and vice head of the Institute of Geoinformatics and Digital Mine Research at Northeastern University, in Shenyang, China.

Qin received his Ph.D. in March in photogrammetry and remote sensing at the College of Geosciences and Surveying Engineering at China University of Mining and Technology, in Beijing, and Wu was his thesis advisor. Now Qin is a lecturer at the School of Environment Science and Spatial Informatics at the university's Xuzhou campus.

Their paper, "GEOSS-Based Thermal Parameters Analysis for Earthquake Anomaly Recognition," was published in the October 2012 *Proceedings of the IEEE* special edition on remote sensing of natural disasters.

"We can use the multiple thermal parameters from this integrated Earth observation system for seismicity analysis and earthquake anomaly recognition," Wu says.

THE METHOD

The group's project—a deviation-time-space thermal (DTS-T) earthquake anomaly recognition method—is what they call a spatiotemporal statistical analysis, based on notable deviation, quasi-synchronism, and geo-adjacency. It mines data from GEOSS, looking for multiple thermal parameters and observations in the important interface between the lithosphere—the solid outer covering of Earth itself—and the atmosphere.

The theoretical basis behind the project, Wu says, is the coupling effect between the lithosphere, the coversphere (which includes soil, bodies of water, and vegetation), and the atmosphere that occurs before an earthquake. Precursor anomalies include changes in ground stress, temperature, moisture, groundwater, and electromagnetic radiation.

The researchers also look at the energy balance and the thermal radiation from Earth's surface and analyze surface latent heat flux, thermal infrared radiation, outgoing longwave radiation, diurnal temperature range (DTR), atmospheric temperature, and radiometric surface temperature.

"The advantage of the DTS-T method," Wu says, "is its synergistic analysis of multiple thermal parameters from GEOSS." It takes into account "the inherent correlations among different thermal parameters so as to avoid bias and misjudgments if we took a single parameter and particular anomaly."

PRECURSORS

To test their theory, the researchers examined data from GEOSS in the days preceding seven medium-to-large earthquakes. Those included the Wenchuan earthquake, with a magnitude (M) of 8.0 that struck China on 12 May 2008 [see photo] and the M7.1 quake that hit Christchurch, New Zealand, on 3 September 2010.

Their analysis of the Wenchuan quake showed that on 6 May there were abnormal changes near the epicenter in the DTR, outgoing longwave radiation, atmospheric temperature, and surface temperature.

In studying the 2010 Christchurch earthquake, they found changes to the surface latent heat flux, atmospheric temperature, surface temperature, and DTR during July and August. Strong anomalies occurred near the epicenter.

The group will soon develop a software system built around parallel computing techniques, as well as analysis tools and a reliability index, which they will make available free to Group on Earth Observation (GEO) members, Wu says. GEO is a partnership among 90 countries and 67 international organizations that helped build GEOSS.

"With the DTS-T method and the software system," Wu says, "it will be possible to provide a practical way to make earthquake pre-warning and short-term forecasts, at least to some extent, for specific active seismic regions."

AFP/GETTY IMAGES

STUDENTS

Predicting Sinkholes in the Road

A new algorithm can identify trouble spots BY IVAN BERGER

MANY OF us take for granted the solidity of the ground we walk on. But on occasion the ground can open wide enough to swallow a person, a house, or a street full of cars.

Sinkholes are alarming to witness and can be catastrophic when they appear suddenly on a road or under a home. A new computer algorithm could provide warning signs, to save lives and avoid expensive repairs.

Current detection methods might provide us with clues to where a sinkhole will appear, but these methods require observing minute changes in ground level over time. For example, a roadway subsidence requiring immediate attention might amount to only a half-centimeter shift in a month over an area 3 to 5 meters in diameter. Physically checking roads and highways for such relatively minor warning signs is impractical.

To address the problem, two graduate students at the University of Virginia, in Charlottesville, created an algorithm that analyzes data from existing Earth-sensing satellites, then calculates which changes in ground level probably indicate incipient sinkholes. Andrea Vaccari, an IEEE graduate student member, and research assistant Michael Stuecheli developed the algorithm with the guidance of Scott Acton, an IEEE Fellow and professor of electrical and computer engineering at the university's School of Engineering and Applied Science.

The project was financed with a US $870 000 grant from the U.S. Department of Transportation's Research and Innovative Technology Administration. The funds cover the study of a 40- by 40-kilometer area of the Interstate-81 corridor in Virginia. The Virginia Center for Transportation Innovation and Research, the research branch of the Virginia Department of Transportation (VDOT), chose that area because of its diverse geological conditions, including "karst" terrain, whose soluble subsurface rocks have been found to cause sinkholes.

Karst terrain underlies about 20 percent of the United States. Other common causes of sinkholes include changes in groundwater levels and disturbances in the subsurface structure caused by mining or nearby construction. The problem is widespread. In May alone, sinkholes were reported in more than 20 states.

The algorithm Vaccari and Stuecheli developed uses data from the synthetic aperture radar on board the Italian Space Agency's COSMO-SkyMed earth-observation satellites. The radar data were originally collected for analysis of seismic hazards, environmental disaster monitoring, and agricultural mapping.

The raw satellite data were then processed by Tele-Rilevamento Europa (TRE) Canada, in Vancouver, into high-resolution measurements of ground displacements of about 1 centimeter. TRE is a global company specializing in satellite data to measure geophysical changes in the ground.

"Our algorithm maps those measurements and analyzes them to identify regions not just of subsidence but also of subsidence that is behaving according to a sinkhole model we developed," Vaccari says. "Rather than simply looking at displacement beyond a certain threshold, the goal is to distinguish between places where subsidence continues to increase and those places that, after a single ground settlement, are now stable. It is then up to highway or transportation authorities to decide which areas are considered risky.

"It's too early to make any sweeping claims about the algorithm's predictive ability and accuracy," he continues. "But in tests, the results of our algorithm have correlated pretty well with signs of actual cases of subsidence evaluated by VDOT geologists on the ground."

When VDOT engineering geologists inspected 32 areas pegged by the algorithm as possible trouble spots, they observed strong signs of subsidence in 25 of them.

"We have predicted locations where subsidence is occurring according to a specific sinkhole model," Vaccari says, "and VDOT geologists verified subsidence activity. That's quite encouraging!"

Acton says that it is the first time sinkhole collapses have been predicted. "If we can use remotely sensed data to detect and monitor the subsidence that precedes sinkholes and other major problems," he says, "we can potentially save millions of dollars in highway repairs, reduce highway closures, and enhance public safety."

For now, getting the most from the algorithm requires that the user be familiar with MATLAB software, though there are software routines that can export the results to graphic information systems (GISs) such as Google Earth, says Vaccari. There is a graphical user interface for users without MATLAB experience, but it's a rather basic one, he says.

Adam Campbell, an electrical engineering undergraduate researcher at the University of Virginia, has written a program to let Android devices access the team's project servers and display the 20 subsidences closest to a user's current location, using Google Maps. "We wanted to show that in an actual implementation, our results could be disseminated via smart devices to ground crews," Vaccari says.

The project will soon reach the end of its two-year funding. The team has submitted a new proposal to the U.S. DOT to continue the development and implement it on a larger transportation network. The team's goal is to work first with VDOT and potentially with other state DOTs "to provide hooks to integrate our remote-sensing approach with their GIS, a system that captures and analyzes geographical data, allowing them to use the information within the existing decision support system," Vaccari says.

The team also hopes to extend its algorithm's analyses. "We started with sinkholes because of the challenge of finding them," Vaccari says. "But we plan to extend the approach to monitor natural and man-made features whose locations are known, such as bridges [for settlement] and slopes [for monitoring motion that can be a precursor to a landslide].

"We might possibly also be able to analyze road surface conditions from the satellite data and provide a simple good/bad condition index," he continues. "Should this be proven effective, it would allow the DOTs to target their road inspection and further reduce their costs."

TECH HISTORY

Sound the Alarm: A History of Disaster Detection and Warning Technologies

The telegraph and radar were among the first to be applied BY ROBERT COLBURN

ELECTRICAL AND computing technologies have greatly enhanced the ability to warn of impending natural disasters. Before electrical communications, a severe storm simply traveled faster than observers could warn of its formation.

The invention of the telegraph stimulated the formation of networks of weather observers. In 1848, James Pollard Espy of the Franklin Institute, in Philadelphia, helped establish a network of observation stations to report weather conditions. The following year, the Smithsonian Institution, in Washington, D.C., supplied weather instruments to telegraph companies so they could transmit information over an extensive observation network. In 1868, Cleveland Abbe, director of the Cincinnati Astronomical Observatory, suggested that warnings should be issued three days in advance for storm systems and six hours for hurricanes.

TORNADO WATCH

In 1883, astronomer Edward Holden, director of the Washburn Observatory at the University of Wisconsin, in Madison, proposed an electrical warning system for tornado-prone areas. It would have depended on an arc of telegraph wire to the south and west of a town (tornadoes in the Northern Hemisphere typically travel from the southwest to the northeast) at a radius of 3 to 4 kilometers.

Grounded at each end, the wire was to be connected to the local telegraph office and have drop-offs at houses along the way. Each house would have been outfitted with an apparatus containing a bell that used a coiled spring (similar to one in an alarm clock) and an electromagnet that would have prevented the bell from ringing as long as current flowed through the wire. A battery at the telegraph office would have kept a constant current passing through the line. But if an approaching tornado snapped the wire, the current would have stopped and the bell would have rung, warning residents to take shelter.

Not only was the system never built, but also use of the word *tornado* in weather forecasts was banned by the U.S. Weather Bureau from 1885 to 1938. The bureau feared it would panic people or discourage them from settling in tornado-prone areas. What's more, business owners complained of the financial losses caused by tornado warnings when customers and employees stayed home and took shelter. Despite such misgivings, an experimental tornado-warning program began using radio in 1943 to alert listeners in St. Louis and Kansas City, Mo., and in Wichita, Kan. In 1948, a radio broadcast warned of a tornado that touched down near a residential area of Wichita. The tornado caused a lot of destruction but no fatalities.

Even though lives were undoubtedly saved, businesses complained. H.M. Van Auken, general manager of the Wichita Chamber of Commerce, denounced the broadcast. He criticized the Weather Bureau for creating "unfavorable publicity" and jeopardizing the community's industrial development by using the word *tornado*. Even after the Weather Bureau lifted its restriction on using that word in a weather report, the Federal Communications Commission continued for another 16 years—until 1954—to ban television and radio from broadcasting tornado warnings.

But technology marched on. Developments in radar and in computer modeling led to the next major advances in the detection and warning of severe weather.

ON TO RADAR

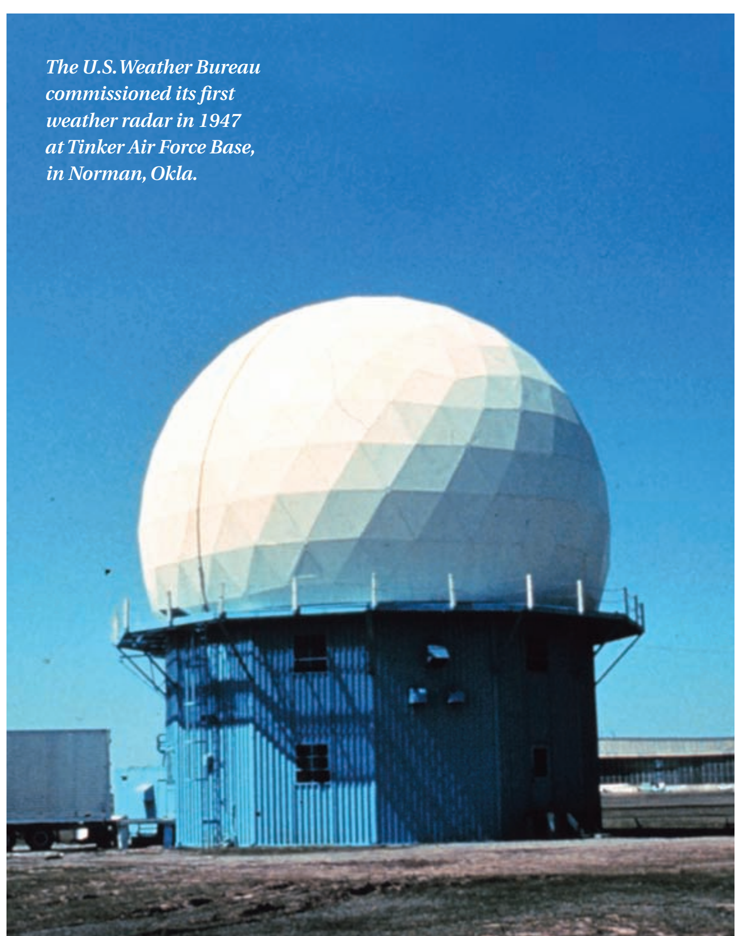
In 1946, the U.S. Army Signal Corps began modifying surplus World War II gun-laying radars for use in weather detection. The Weather Bureau commissioned its first weather radar in 1947. The following year, two Air Force officers, Capt. Robert Miller and Maj. Ernest Fawbush, observed that weather conditions around Tinker Air Force Base, in Norman, Okla., were similar to conditions that had spawned a tornado in the area. They then tracked an approaching storm on radar and were able to issue a warning before the tornado touched down.

As radar technology improved, so did severe-weather predictions. In 1953, Glenn Stout and other engineers at the Illinois State Water Survey, in Champaign, noticed a distinctive hook-shape echo on their radar screens and were able to correlate it with a tornado.

Japan's Mount Fuji Weather Radar System is an example of a sophisticated detection and warning apparatus. Almost immediately after it began operation in 1964, it detected an approaching typhoon more than 800 km away. The radar system, which was planned by the Japan Meteorological Agency and built by Mitsubishi Electric Corp., was named an IEEE Milestone in 2000.

In 1971, 10-centimeter pulsed Doppler radars became operational. Such radars were designed to detect anything that moves and measure its velocity. Because the radars can measure relative wind velocities, they are able to detect tornadoes even when the hook signature itself is not visible. They cannot show whether the vortex is aloft or touching the ground, however. At about that time, seismographs—long used for detecting earthquakes—were being developed to detect the characteristic vibrations produced by a tornado funnel when it touches the ground.

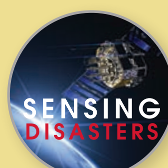
Satellite-based remote-sensing systems, which became more advanced in the 1980s, have also been used for the detection and warning of disasters, including floods and tsunamis.



The U.S. Weather Bureau commissioned its first weather radar in 1947 at Tinker Air Force Base, in Norman, Okla.

NSSL/NOAA

QUESTION OF THE MONTH



Cities Versus Mother Nature

After natural disasters sweep through cities, it can take months or years to recover. Since 2000, weather- and climate-related disasters have cost the global economy US $2.5 trillion, including losses to infrastructure, according to a report from the U.N. Office for Disaster Risk Reduction.

With damage from last year's Hurricane Sandy in mind, New York mayor Michael Bloomberg [above] recently unveiled a $20 billion, 400-page plan for safeguarding the city that includes building floodwalls and upgrading telecommunications. And when a flood in Copenhagen in 2011 left it with $1 billion in damage, the Danish capital began implementing a plan that features building larger sewers and developing systems to warn of torrential downpours.

Are cities doing enough to protect themselves against natural disasters? If not, what should they be doing?

Respond to this question by commenting online at http://theinstitute.ieee.org/opinions/question. A selection of responses will appear in the December issue of The Institute *and may be edited for space. Suggestions for questions can be sent to institute@ieee.org.*

RESPONSES TO JUNE'S QUESTION

Has Technology Made Your Life Better?

IEEE members are working on ways to improve the quality of life for the elderly and for people with disabilities. For example, they're developing robots to help with chores around the house and assist in rehabilitation, as well as smart wheelchairs that can be steered by brain waves or sense their surroundings. And older technologies have for years enhanced the daily lives of many.

If you're disabled, which technology has most improved your quality of life, and how?

The following response was selected from comments that appear at http://theinstitute.ieee.org/opinions/question/has-technology-made-your-life-better.

MUSIC TO HER EARS

Even though she is profoundly deaf, my 8-year-old daughter, Ayate, can hear, speak, and even sing thanks to the cochlear implant she received when she was just 18 months old. The surgery was done in 2006 by Dr. Karl Horn at Presbyterian Hospital, in Albuquerque. Speech and audiology specialists helped her learn to hear with and operate the device, and at age 5 she was able to start first grade in a mainstream school.

The technology has helped Ayate function as well as any hearing child. The cochlear implant works so well, I almost forget that she's deaf until she takes the device off to sleep and I no longer get an answer when I call her name. Today, when I teach my students [at California State University, Fresno] about how transistors work, I can't help but think about the thousands of transistors in my little girl's head working together to transmit sound data to her brain.

Zoulikha Mouffak

ICON PHOTO: EVGENY TERENTEV/GETTY IMAGES; EDWARD REED

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PRESIDENT'S COLUMN

Let's Get Together

Collectively we can accomplish a great deal

ONE OF THE most memorable and productive activities I have been fortunate enough to engage in during 2013 has been our board's work in setting IEEE's strategic priorities. The work brought out the best in our differing perspectives, unique backgrounds, and individual insights.

We recognized immediately the value inherent in what we had done, for we—as IEEE members and volunteers—have been sharing our views with one another informally throughout our careers. Our passion for our profession and all it offers brings us together to exchange ideas, critique approaches, and undertake new initiatives. In recognition of that, we created an IEEE strategic priority that calls on all of us to "expand nimble, flexible, disbandable IEEE communities, allowing individuals from all around the world to share, collaborate, network, debate, and engage with one another."

This may be one of our easiest priorities to implement, for it is at the core of much of what we do. Consider, for example, the call to action in my June column ["'Futurecasting' IEEE"]. I asked members to work in concert to identify "disruptive" trends and activities that could impact IEEE in the coming years—a request that requires individuals to collaborate and debate and engage one another, activities plainly in keeping with this priority.

We have seen this occur at both the macro and micro levels. Earlier this year, I led a delegation that visited Zambia, Kenya, and the African Union in Ethiopia to identify opportunities for IEEE to aid professionals in those countries as they seek to increase engineering education capacity nationwide. The preparatory work for this initiative drew on the knowledge and expertise of IEEE members and strong volunteer leadership in many sections, IEEE's top-level leadership, and professional staff support from across the organization, as well as a newly formed Ad-Hoc Committee on Africa Activities.

Our goal was to determine ways in which IEEE can aid in increasing engineering capacity in Africa, using to our advantage the local IEEE volunteer strength and experience in Zambia and Kenya. We knew that increasing engineering capacity would mean more graduates with engineering degrees, more lifelong learning opportunities for existing graduates, and a stronger presence in preuniversity education. Our combined efforts, with different emphases, enhanced not only these areas but others as well. Our mutual efforts at the macro level had begun to yield a picture; more detail, however, would be added only through work and networking at the local level.

From a number of interactions and discussions with volunteer leaders and key professional engineering, business, and national and regional organizations, a picture of IEEE's future in Africa is emerging. That future will undoubtedly be country-specific because of the diversity of economic readiness within the countries of Africa. That future will also require varying levels of focus on, among other initiatives, expanding our technical communities, extending programs like TISP and EPICS in those countries, and increasing the reach and collaborative effect of our technical journals and magazines to educational institutions. Much work lies ahead, and the details will require the assistance and participation of nimble, flexible, and collaborative IEEE communities across the world, focused on Africa and its future.

At no time before has communication and collaboration been easier. At no time has it been more extensively applied for improving the human condition. When members, volunteers, and professional staff collectively focus on a matter of concern, there is nothing that cannot be accomplished. One hundred years ago, collaboration and networking helped chart a course for the electrification of cities and towns around the world. Slightly more than 50 years ago, the first planar semiconductor integrated circuit appeared, and within five years the exponential growth of the Information Age was launched. I, for one, cannot wait to see where our combined efforts will take us.

The possibilities that arise when we work together are many. Through collaborative efforts, the obstacles we encounter will be few. Our history is rooted in partnerships, and I believe that we will find our future there as well. Some of our colleagues have already begun to write that future, and I urge all of us to join in these efforts.

Please feel free to share your comments and thoughts with me at president@ieee.org or through my blog at http://sites.ieee.org/pstaecker.

Peter Staecker
2013 IEEE President and CEO

PRODUCTS AND SERVICES

IEEE's First Interdisciplinary Open-Access Journal

Publication makes articles publicly available quickly

BY KATHY PRETZ

PHOTO: MARTIN BARRAUD/GETTY IMAGES

FOR THOSE looking for articles that explain how original research is being applied and for prospective authors who would like to see their articles published in a cutting-edge journal, there is now *IEEE Access.* Launched in May, it's IEEE's first free, online, open-access megajournal—with "mega" referring to a publication that covers a range of disciplines instead of a single field or topic.

And because the review process for articles in *IEEE Access* is fast, its information is not only of high quality but also very timely. The articles also include supplemental content such as video and audio clips of authors explaining their work, results of actual simulations, and access to huge data sets.

"The IEEE community has found that many high-quality articles by well-known authors are not getting published because their subjects are not in the mainstream or fall outside the narrow scope of topical journals," says IEEE Fellow Michael Pecht, the editor in chief of *IEEE Access* and a professor of mechanical engineering at the University of Maryland, in College Park. "And by the time it's published, an article may no longer be timely and is subject to restrictions that our megajournal overcomes."

The usual article, for example, is typically limited in page length and certainly does not include video and audio clips or the actual data that were developed. Authors will now have more ways to convey their message and justify their results.

"*IEEE Access* is completely online, with no page limits, and adding supplementary materials is no problem," Pecht continues. "For example, one article includes the actual simulations conducted by the authors so that others may replicate the experiments and better understand the assumptions when conducting new ones. Readers may now see the work more clearly and can work with the information in different ways."

Available from the IEEE Xplore Digital Library, the megajournal is supported by an article-processing charge to the authors of US $1750 to help cover operating costs. That fee covers content management, article submission and review systems, editorial and composition services, and marketing and other expenses.

Articles have been submitted to the journal since last November, and Pecht says he has been pleased with the quality. Articles are posted daily.

"They have been written in such a way that they appeal to a large audience," he says. "Authors have also included large reviews of the literature so readers from other engineering disciplines can understand the technology presented and its impact on current research."

YES OR NO

IEEE Access follows what is called a binary peer-review process. This means articles initially undergo the same rigorous editorial review as all other IEEE articles. But after this, the article is either accepted or rejected, as opposed to undergoing multiple rounds of revisions.

According to Pecht, the average time from submission to publication currently ranges from two weeks to two months. "This is a very fast turnaround for a publication with a full peer-review process," he notes. "Our goal is to complete the review in two weeks."

Authors are notified of the publication decision soon after the peer-review process has been completed. Those whose articles are rejected are provided with reviewer comments. They can submit new versions of their articles based on that feedback, providing they explain the changes they have made.

Authors will also be required to sign an open-access article copyright transfer form. This allows IEEE to make the article available at no cost to readers and outlines the many ways readers can use it, including for data or text mining. The form also allows IEEE to protect the author's content by registering the paper with the U.S. Copyright Office and gives IEEE the authority to resolve any issues that may arise, such as plagiarism.

Once an article is accepted, it will appear in IEEE Xplore in PDF format within a few days. After a week, the article will also be available in HTML format, which is more interactive.

MORE MODELS

IEEE also offers other options, or publishing models, for making articles available at no cost. One is the open-access model in IEEE's hybrid publications, which publish both traditional, subscription-based content and open-access, author-pays content.

For an article processing charge of $1750 paid by the author, the article will be offered free via IEEE Xplore. Content must, of course, fall within the scope of the hybrid and undergo the same comprehensive peer-review process as other articles.

IEEE also has topical electronic journals that publish open-access articles only. These focus on either an overarching theme or a narrow topic within a specific engineering discipline. They include the monthly *IEEE Journal of the Electron Devices Society*, the semiannual *IEEE Transactions on Emerging Topics in Computing*, and the quarterly *IEEE Journal of Translational Engineering in Health and Medicine.* Article processing charges for these start at $1350 per article.

"*IEEE Access* and the other open-access journals provide an outlet where researchers can display their work in varied, nontraditional formats," Pecht says. "Authors come from many different IEEE fields of interest; the desire for open access is widespread in the engineering community."

For more information about IEEE Access, *visit http://www.ieee.org/publications_standards/publications/ieee_access.html. To read more about IEEE's policy on open access, read "Options for Open-Access Publishing" [p. 18].*

SENSING DISASTERS

CONFERENCES: SEPTEMBER–OCTOBER 2013

Upcoming IEEE conferences cover topics related to the remote sensing of natural disasters

European Radar Conference

NUREMBERG, GERMANY; 9–11 OCTOBER

TOPICS: Environmental and remote-sensing applications for radar, radar subsystems, meteorology, high-resolution image processing, multisensor systems and data fusion, antenna systems, radar for traffic monitoring, and over-the-horizon radar. Held in conjunction with European Microwave Week.

SPONSORS: IEEE Electron Devices and IEEE Microwave Theories and Techniques societies
VISIT: http://www.eumweek.com/2013/eurad.asp

Oceans 2013

SAN DIEGO; 23–26 SEPTEMBER

TOPICS: Remote sensing, underwater acoustics, oceanography, meteorology, ocean-observing platforms, ocean data visualization, modeling and information management, sonar signal and image processing.
SPONSOR: IEEE Oceanic Engineering Society
VISIT: http://www.oceans13mtsieeesandiego.org

International Symposium on Ocean Electronics

KOCHI, INDIA; 23–25 OCTOBER

TOPICS: Remote sensing, tsunami warning systems, seismic signal processing, underwater sensor technology, ocean exploration systems, sonar technology, underwater and surface communications, marine measurements and data logging, marine bioelectronics, and acoustic holography.
SPONSOR: IEEE Oceanic Engineering Society
VISIT: http://sympol.cusat.ac.in/index.php

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PEOPLE

PART-TIME PASSIONS

Victor Skowronski

Going for Baroque

PASSION
English country dancing

OCCUPATION
Systems engineer

HOMETOWN
Woburn, Mass.

VICTOR SKOWRONSKI

IEEE MEMBER VICTOR Skowronski discovered he had a penchant for contra dancing in the 1980s. With its easy-to-follow footwork and the custom of changing partners with each dance, it allowed him to show up alone, without a partner, and still participate.

As time went on, Skowronski—a systems engineer who works with Jacobs Technology Engineering and Technology Acquisition Support Services, in Lincoln, Mass.—progressed in his ability and moved to a more difficult style known as English country dancing, which originated around the time of the Age of Exploration. Its patterns are more complex than those of contra dancing, and that appeals to the engineer in him, he says.

He has since taken his hobby to a still higher level by choreographing dances. His engineering career and hobby have much in common, he says, noting that developing dance steps helps him stay inspired between engineering projects.

"I need to do something creative on a regular basis," he says. "If my technical work is at a lull, I end up choreographing dances."

Creating a dance to fit a specific tune and presenting it in a clear format so that people can follow it add a problem-solving aspect to the process, he says. After writing the choreography, he tests it at the end of organized dances with fellow dancers and choreographers who volunteer their time.

"Every English dance has its own tune," he says. "I am particularly enamored of Baroque music, which lends itself well to English country dancing. There are many danceable tunes in this genre."

Skowronski looks for tunes that are still to be choreographed. "The problem has yet to be solved for that tune," he says.

He spends about four hours each week on some aspect of English country dancing, he says, whether it's dancing, organizing events, or working on choreography. "My time spent on choreography varies greatly," he says. "I might go months without working on a dance. Then suddenly I get an inspiration and have something ready in a week or two."

He attends country dances around New England. He's a member of the Country Dance Society, Boston Centre, and is on the organizing committee for its Harvard Square English country dance section, which focuses on introducing the style to new participants.

Skowronski posts his choreography and tunes using a program called MusiXTeX, which helps people understand how the two are in sync. He offers free downloads of his choreography, with music that's in the public domain, at http://www.math.uconn.edu/~troby/skowronski.

"I just ask that if a group uses one of my dances in a program, they spell my name right," Skowronski says. "That's no small feat."

—Susan Karlin

Scott Olsen

Tool Time

PASSION
Woodworking and furniture making

OCCUPATION
Energy efficiency engineer

HOMETOWN
Madison, Wis.

AS A CHILD, IEEE Member Scott Olsen loved to visit his grandfather's garage, where he would watch his granddad wield woodworking tools as he modified and repaired his home. But it wasn't until his mid-20s that Olsen became friends with a full-time furniture craftsman and realized he wanted to make woodworking a lifetime hobby.

As a senior engineer for Madison Gas and Electric Co., Olsen spends his days troubleshooting how buildings can use energy most efficiently. He finds the hands-on aspect of woodworking a complement to the thinking processes involved in his job.

"There's something satisfying about working with your hands and having an end product," he says. "Furniture making has a lot in common with an engineering project. There's the concept design phase, visualizing the building process, securing or making the tools to build it, selecting the materials, and building and finishing the piece."

And he adds: "I like improving my technique with time and making a valued, high-quality piece so that people will be using and talking about what I've made long after I'm gone."

Olsen is mostly a self-taught woodworker. He relies on a combination of his grandfather's pointers, a high school shop class, and woodworking magazines and videos, along with an engineer's penchant for solving problems. Along the way he developed a passion for figured woods with ornate grains and textures, and he learned how the characteristics of different woods respond to his tools.

He spends 10 to 15 hours each week making furniture. First, he sketches his designs on paper, sometimes incorporating into the design wood he finds on the street. He prefers the rounded-edge, streamlined midcentury modern and Danish modern styles and uses mostly local hardwoods such as maple, oak, cherry, and walnut. "I also like to use figured woods with more ornate grains—curly maple, walnut burls, quarter-sawn white oak, and curly cherry—and burls as accents," he says.

His apartment is furnished with his work, and he's thinking about starting a sideline business selling wooden picture frames, tables, bookcases, headboards, and desks.

The hobby can get pricey. Start-up costs range from US $3000 to $5000 for power tools, plus the ongoing costs of equipment maintenance, workspace rental, and material.

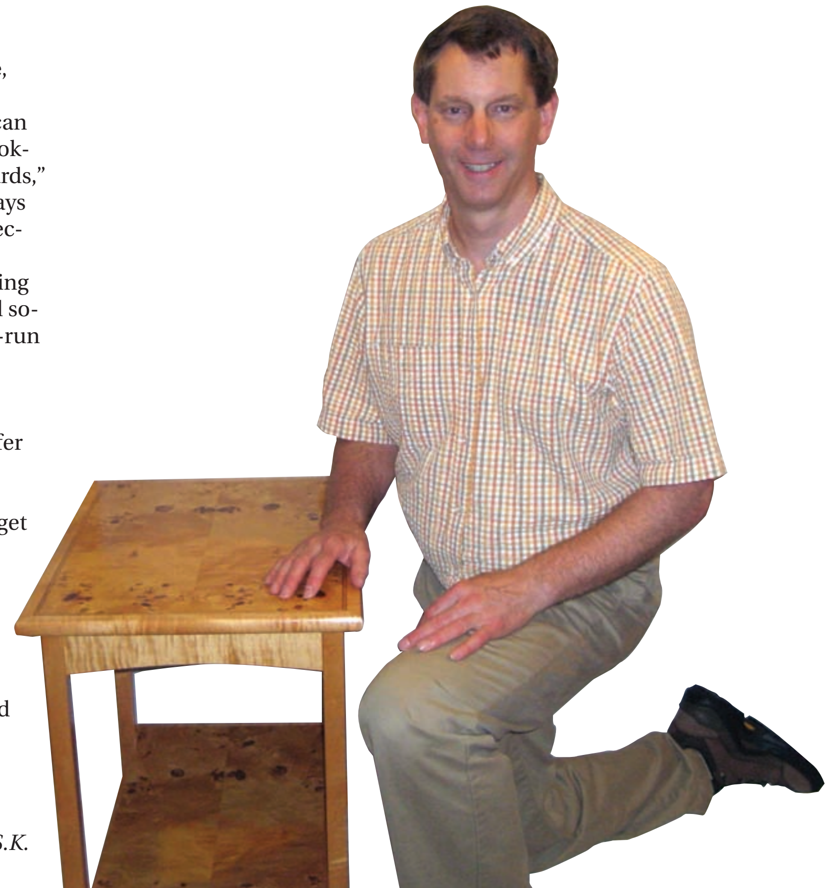
"Cherry lumber, for example, can cost $50 to $80 a board, and a bookcase usually requires 20 to 30 boards," says Olsen, who is looking into ways to incorporate LEDs and other electronics into his furniture.

Olsen recommends that aspiring artisans start with local clubs and so-called hackerspaces: community-run workshops where woodworkers socialize and collaborate.

The hackerspaces often rent shop space and tools and can offer guidance, Olsen says. "And as a craftperson improves, there is a need for high-precision tools to get high-quality results," he adds.

Olsen believes his hobby has benefited him in his day job. "It's made me a better engineer," he says. "Parts of what I do can be fairly rote. But making a new piece of furniture—and trying new processes to make it look good and work well—show me the advantages of pushing myself to do better."

—S.K.



SCOTT OLSEN

PROFILE

James Smith: Modeling Earth's Biosphere

His love of nature fueled his research

BY SUSAN KARLIN

ICON PHOTO: EVGENY TERENTEV/GETTY IMAGES; DAVID RADLOFF

IEEE FELLOW JAMES SMITH occasionally ditched class as a kid to wander with friends in the woods of rural Michigan. As he got older, his love for nature remained, and it became part of his work.

Merging his studies in math and physics with his passion for the outdoors, Smith found a career in remote sensing that allows him to study nature from space. His research helped pioneer remote sensing of Earth to study the effects that changes in flora and fauna have on one another.

Smith was one of the guest editors of last October's *Proceedings of the IEEE* special issue on the remote sensing of natural disasters.

"Computers and spectroscopy have been used in the past in astronomy to determine the elements that make up stars," Smith says. "More recently we have been pointing our sensors toward Earth, using remote sensing to better understand the properties of plants and changes in ecosystems. Initially we were doing things on local and regional levels. But the idea was that eventually we would do things from space on a global scale."

Scientists employ active and passive sensors that exploit the complete electromagnetic spectrum. Laser spectroscopy and radar and optical satellite imaging sensors are routinely used to identify the material composition of plants and changing ecosystem patterns over time.

After earning bachelor's and master's degrees in math and a Ph.D. in high-energy physics from the University of Michigan, in Ann Arbor, Smith moved into biology and environmental science. His 40-plus years in the field began in 1970 as a faculty member at Colorado State University, in Fort Collins. He held his first position there as an assistant professor at the College of Forestry and Natural Resources, teaching graduate courses in remote sensing and computer applications in natural resources.

"This was the time, in the '70s, of the burgeoning environmental movement, and I was trying to move into that area," he says.

While he was teaching, he built computer models for radiative transfer and energy balance in vegetation to help him understand how forests and grasslands changed the way they reflected sunlight and radiated heat. His findings helped map natural plant communities and monitor forest health in Colorado at the Pawnee National Grassland on the state's Eastern Plains and at old mining sites in Leadville.

"I always had an interest in nature. While getting my degrees and taking breaks from writing my thesis, I would sit in on lectures on wildlife and biology at the University of Michigan's Matthaei Botanical Gardens. I just saw beauty in math and nature," he says.

THE NEXT STEP

In 1985, NASA recruited Smith to head the Biospheric Sciences Branch at its Goddard Space Flight Center, in Greenbelt, Md., and develop a biospheric remote-sensing program in preparation for NASA's expansion into Earth systems science.

"A lot of the students I was teaching were getting jobs at NASA, and I just followed," he says.

Smith and his colleagues helped pioneer projects that evaluated how plants and natural elements reflected solar radiation at visible and infrared wavelengths, as well as how factors such as water and stress affected that reflection. He also studied how changes in the environment could be better detected using the new remote-sensing techniques.

When he entered the field, it was a nascent area of study. Today the technology is being used among other applications to help prevent famine in Africa, monitor deforestation in the Amazon, track polar ice shelf melting, and determine why honeybees are disappearing.

"A farmer can look at a field and say, 'Of course I know it needs water,'" Smith says. "But when you're able to develop the technology to do this in a semiautomatic fashion over a broad area and capture this in computer algorithms, then you can use that knowledge, for example, to combat potential famine in certain countries."

In the early 1990s, while at NASA, Smith spent evenings working toward a master's degree in computer science from Johns Hopkins University, in Baltimore. "The course of study had a major impact on my research," he says. "I learned new techniques in neural networks and artificial intelligence that I could bring to my work."

MAKING CONNECTIONS

One of Smith's novel applications was creating computer models of bird species' migration patterns, which included information on wind currents and ecosystems where the birds landed to refuel. He could observe how the birds altered their migration routes when their feeding grounds changed. That offered clues as to how birds might modify their migration in response to climate change. He received a NASA Special Act Award in 2007 for leadership in advancing the new field of satellite ornithology—the study of birds from space.

He retired from NASA last year and is entering a new chapter of his life at the University of Maryland, Baltimore County, where his research is taking him in a new direction. At the Center for Hybrid Multicore Productivity Research, helmed by IEEE Member Milton Halem, Smith is working on a "human sensor network," which uses the cloud and high-performance computing to analyze social media and extract what people are reporting on Facebook, Instagram, and Twitter about bad weather, biohazards, and other environmental anomalies they're seeing in their neighborhoods. The idea is to apply the information to drive geophysical and environmental models of impending or spreading emergencies.

"The work has potential applications in disaster mitigation, such as providing better updates in storm-surge and flooding predictions and identifying impacted areas," Smith says. As storms advance, engineers and computer scientists run thousands of storm-surge models based on different parameters. The ability to assimilate time-varying, geocoded social media data might help hone the most viable models. For areas already affected, social media can provide near-real-time information to enhance recovery operations.

Smith says his IEEE involvement helps inspire his work. He is the chief financial officer for the IEEE Geoscience and Remote Sensing Society, which presented him with an award in 1999 for outstanding service, and he was editor of *IEEE Transactions on Geoscience and Remote Sensing* from 1991 to 1995 and 2001 to 2003. He is also an IEEE program evaluator for ABET, the organization that accredits college and university programs in applied science, computing, engineering, and engineering technology. He finds that observing what is taught in schools broadens his awareness of engineering techniques, he says.

He gives high marks to his involvement with IEEE: "You meet people from every field, from all over the world, and come together in teams to accomplish things bigger than yourself."

BUSINESS

Options for Open-Access Publishing

Three choices are now available for authors BY GIANLUCA SETTI

IEEE HAS ALWAYS believed an important part of its mission is to make its scholarly articles widely available. So we are proud that more than 6200 academic institutions, companies, and government agencies around the globe now have access to our publications through the IEEE Xplore Digital Library—an increase of almost 60 percent in the past five years. And with the concept of open-access publishing growing in popularity, IEEE is supporting the wishes of its authors by adding the open-access option for them and the institutions funding their work.

This year IEEE introduced a three-part open-access program. First, it offers an open-access option in all its traditional transactions and journals, making them hybrids of paid subscriptions and open access. Second, several IEEE societies have created open-access-only publications in specific areas (so-called topical journals). Finally, in May, the open-access mega-journal *IEEE Access* was launched to attract interdisciplinary, applications-oriented articles across all of IEEE's fields of interest [see "IEEE's First Interdisciplinary Open-Access Journal," p. 13]. In all three cases authors, or their funding organizations, pay article processing fees so that all readers have immediate access to their articles for free. (For more details, visit http://open.ieee.org.)

SUSTAINABILITY

An equally important principle for IEEE is that its publishing program operates in a financial manner that is as fair as possible to both authors and readers yet is also completely sustainable. This is essential if IEEE is to continue to provide an impartial forum for the discussion of ideas, independent of influence by any sponsor or benefactor. Providing modern publishing services—from the infrastructure that supports the thousands of unselfish volunteers in the fundamental peer-review and editorial processes to convenient online delivery—is not inexpensive, however. So IEEE's Publication Services and Products Board (PSPB) is continually reevaluating its policies and operating practices to provide world-class scientific publications at a self-sustaining and reasonable cost.

Maintaining this balance has driven the need for imposing article processing charges (APCs) for authors wishing to make their articles available via open access. The APCs cover the expense of several value-added steps—from copyediting and page formatting to reference checking, online posting, and XML conversion. Authors who pay the charges can refer anyone to the IEEE Xplore Digital Library, where readers can obtain for free the final published version of the open-access article in PDF format or read the HTML version online.

An important criticism of open access is that it favors authors with greater financial means over authors who are forced, for budgetary reasons, to opt for the traditional reader-pays model. To alleviate this concern and give all authors a fair chance to disseminate the results of their activities, IEEE follows two paths.

First, in the spirit of making its articles widely available, IEEE continues to allow authors to post their final accepted manuscripts on their own or their employers' websites, thus maintaining its status as a "green open-access" publisher (see http://www.sherpa.ac.uk/romeo). Second, IEEE will waive open-access article charges for authors who must publish an open-access paper but who lack the financial means to do so. Such authors can apply to the editor of the journal and explain the nature of their financial hardship.

COPYRIGHT

To ensure appropriate reuse of its articles, IEEE has developed and is making available a revised version of its copyright transfer form. It still asks authors to transfer copyright, but in return it promises to make the article freely available and makes clear the many ways readers are permitted to use the article. New permissions will allow researchers to use articles as part of data- or text-mining experiments.

These changes allow, in particular, IEEE to fight plagiarism on the author's behalf. They are also meant to deter others from creating derivative commercial products from articles the author paid IEEE to publish as open access. This is important because, unfortunately, there are reports of disreputable publishers republishing articles from open-access journals in order to give their own new publications the credibility to attract authors. These are two areas where IEEE is better equipped than authors to monitor systematically for inappropriate activity and take corrective action.

To take into account all possible author preferences as well as the requirements of specific funders and agencies, PSPB has also approved the possibility of publishing open-access articles under the Creative Commons Attribution (CC BY) license. Under it, users are free to share, copy, distribute, and transmit the work and to remix and make commercial use of it. The authors retain copyright (and the need to enforce it) while the users must simply properly attribute the work.

The world of open access is rapidly evolving. In addition to the activities of publishers like IEEE, several government bodies and private institutions that fund research direct that articles resulting from their research grants pass to open access after an embargo period.

The IEEE PSPB, along with its professional publishing staff, is constantly evaluating the changing environment and will make adjustments as necessary.

We on the IEEE PSPB are committed to providing choices that make sense to authors, readers in the technology community, and IEEE. Through such actions, we can ensure that IEEE's publishing program continues to contribute in the best possible way to IEEE's goal of advancing technology for humanity.

Setti is vice president, IEEE Publication Services and Products.

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