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SEPTEMBER 2011 • THEINSTITUTE.IEEE.ORG
IEEE

Going Electric

A roundup of IEEE's involvement with electric vehicles

GOING ELECTRIC

BRIEFINGS

REGION NEWS

REGION 1 NORTHEASTERN UNITED STATES

■ **New York Section** establishes IEEE Circuits and Systems Society chapter.

REGION 2 EASTERN UNITED STATES

■ **Washington, Baltimore,** and **Northern Virginia sections** establish joint IEEE Instrumentation and Measurement Society chapter.

REGION 3 SOUTHEASTERN UNITED STATES

■ **Atlanta Section** establishes IEEE Communications Society chapter.

■ Student branch formed at **Caldwell Community College and Technical Institute, Hudson, N.C.**

REGION 4 CENTRAL UNITED STATES

■ **Southern Minnesota Section** establishes Consultants Network (CN) affinity group.

■ Women in Engineering (WIE) affinity group formed at **St. Ambrose University, Davenport, Iowa.**

■ Student branch at the **University of Nebraska, Lincoln,** establishes chapters of the IEEE Power & Energy and Power Electronics societies.

REGION 5 SOUTHWESTERN UNITED STATES

■ Student branch formed at **DeVry University, Houston.**

REGION 6 WESTERN UNITED STATES

■ **Alaska Section** establishes IEEE Geosciences and Remote Sensing Society chapter.

■ **Buenaventura (Calif.) Section** establishes IEEE Power & Energy Society chapter.

■ **San Fernando Valley (Calif.) Section** establishes Graduates of the Last Decade (GOLD) affinity group.

■ **San Francisco Section** establishes Life Member (LM) affinity group.

■ **Santa Clara Valley (Calif.) Section** establishes LM affinity group.

REGION 7 CANADA

■ **Toronto Section** establishes IEEE Systems, Man, and Cybernetics Society chapter.

■ **Montreal Section** establishes IEEE Power & Energy Society chapter.

■ Student branch at the **University of British Columbia, Vancouver,** establishes IEEE Power & Energy Society chapter.

■ Student branch formed at the **University of Northern British Columbia, Prince George.**

REGION 8 EUROPE, MIDDLE EAST, AND AFRICA

■ **Greece Section** establishes IEEE Consumer Electronics Society chapter.

■ Student branches formed in Greece at **Technological Educational Institute of Messolonghi; European University, Cyprus;** and **International Hellenic University, Thessaloniki**.

■ **Western Saudi Arabia Section** establishes chapters of the IEEE Computer and IEEE Photonics societies.

■ **Serbia and Montenegro Section** establishes IEEE Electromagnetic Compatibility Society chapter.

■ **Sweden Section** establishes IEEE Society on Social Implications of Technology chapter.

■ **Austria Section** establishes IEEE Robotics & Automation Society chapter and joint chapter of IEEE Industry Applications, Industrial Electronics, and Power Electronics societies.

■ WIE affinity group formed at **Birla Institute of Technology and Science, Dubai.**

■ Student branch at **Istanbul Technical University, Turkey,** forms WIE affinity group.

■ Student branch at **Middle Eastern Technical University, Turkey,** forms IEEE Power & Energy Society chapter.

■ Student branch formed at **South Valley University in Aswan, Egypt.**

REGION 9 LATIN AMERICA

■ **Argentina Section** establishes IEEE Oceanic Engineering Society chapter.

■ **Ecuador Section** establishes IEEE Engineering in Medicine and Biology Society chapter.

■ Student branch formed at **Universidad Católica de Cuenca, Azuay, Ecuador.**

■ **Western Puerto Rico Section** forms IEEE GOLD affinity group.

■ Student branch at **Universidad Incca de Colombia, Bogotá,** establishes IEEE Robotics & Automation Society chapter.

■ Student branch at **Javeriana University, Bogotá,** establishes IEEE Industry Applications Society chapter.

REGION 10 ASIA AND PACIFIC

■ Student branches formed in India at **BS Anangpuria Institute of Technology and Management, Knowledge Institute of Technology, MEA Engineering College, Sanghvi Institute of Management and Science, Turbomachinery Institute of Technology and Sciences, Zakir Hussain College of Engineering and Technology, Indian Institute of Technology Bhubaneswar, Maharashtra Institute of Technology, Motilal Nehru National Institute of Technology, Adichunchanagiri Institute of Technology, Angel College of Engineering and Technology, Kings Engineering College, Saintgits College of Engineering, Sardar Vallabhbhai Patel Institute of Technology, Shri Balwant Institute of Technology, Techno India NJR Institute of Technology, Truba College of Engineering and Technology, Ilahia College of Engineering and Technology, Poornima College of Engineering, Anna University of Technology, Edayathangudy G.S. Pillay Engineering College, Latha Mathavan Engineering College,** and **University of Allahabad.**

■ Student branch at **Amity University, Noida, India,** establishes IEEE Microwave Theory and Techniques Society chapter.

■ Student branch at **Muffakham Jah College of Engineering and Technology, Hyderabad, India**, establishes IEEE Computer Society chapter and WIE affinity group.

■ Student branch at **Aurora's Technological and Research Institute, Hyderabad,** establishes IEEE Computer Society chapter.

■ Student branch at **Royal College of Engineering and Technology, Akkikavu, India,** forms WIE affinity group.

■ Student branch at **VIT University, Vellore, India,** establishes IEEE Professional Communication Society chapter.

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Online

Available 9 September at theinstitute.ieee.org

BOOKS OF INTEREST
A selection of free e-books available to members.

IEEE JOURNAL RANKINGS
Several IEEE journals ranked at the top of the latest *Journal Citation Reports.*

NEWS

Visit *The Institute*'s Revamped Website

CHECK OUT *The Institute*'s new look at http://theinstitute.ieee.org. To make things easier to find, we've separated the site into channels: People, Tech Focus, Benefits, Briefings, Opinions, Region News, and Career and Education.

And we've introduced several features, including a blog, multimedia, RSS feeds, an automated way to comment on articles and respond to our Question of the Month, and a form for submitting news about your region. Let us know what you think by e-mailing us at institute@ieee.org.

Ballots Due Soon

THE ANNUAL ELECTION ballot should have arrived in members' postal mailboxes in August. In addition to the two candidates for 2012 IEEE president-elect, there are 38 others running for office in various IEEE divisions and regions, as well as in the IEEE Standards Association, IEEE Technical Activities, and IEEE-USA. If you prefer to access and return your ballot electronically, visit http://www.ieee.org/elections.

2012 Dues Notice

THE BASE IEEE membership dues for 2012 will be US $138, an inflation-based $2 increase. But for the fifth straight year, regional assessments charged to members for local activities will not change. For U.S. members, an additional assessment for IEEE-USA and ABET, the accrediting body in the United States for academic programs in applied science, computing, engineering, and technology, will be $43, an increase of $1.

Dues for student and graduate student members will not change. The fee for society affiliates, which is set at half the base IEEE dues, increases to $69. Affiliates, who can belong to one or more IEEE societies but are not IEEE members, pay that fee for each IEEE society they join plus the membership dues charged by the society.


Angela Burgess

Herz Award Goes to Burgess

ANGELA BURGESS, executive director of the IEEE Computer Society, has received the 2011 IEEE Eric Herz Outstanding Staff Member Award. She was cited "for outstanding leadership in improving IEEE Computer Society cooperation and reintegration with IEEE and TAB [Technical Activities Board], and successfully transforming operations, improving the financial strength of the society."

Burgess began her career with IEEE as a magazine editor at the society's office in Los Alamitos, Calif. She went on to become managing editor, executive editor, and then publisher before becoming executive director of the society in 2007. She now oversees 96 staff members in Los Alamitos and Washington, D.C. As executive director, she has reduced the society's operating expenses and worked on reversing membership decline. She has also helped develop several resources for computing professionals.

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 past or present staff member who has 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 2012 Herz Award is 31 January 2012. For more information, visit http://www.ieee.org/about/awards.

CALENDAR

September

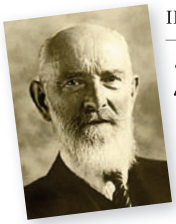
6 1901: Birth date of Ernst Weber, IEEE's first president after the merger of AIEE and IRE in 1963.

7 1912: Birth date of David Packard, IEEE Fellow and cofounder of Hewlett-Packard Co.

8 1987: Microsoft ships its first CD-ROM application, a collection of reference books called MS Bookshelf.

11 1845: Birth date of Jean-Maurice-Émile Baudot, inventor of the Baudot code, an ASCII predecessor.

20 1954: Fortran, a high-level programming language, runs for the first time—on an IBM 701 computer.



23 1861: Birth date of Robert August Bosch, inventor of the magneto for automobiles.

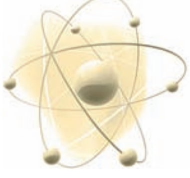
21–23 IEEE Region 7 meeting in Mississauga, Ont., Canada.

24 1960: Bulova begins selling its Accutron, the first commercial electronic wristwatch.

October

2 1903: Commonwealth Edison Co., in Chicago, begins operating the first large-capacity steam turbine to generate electricity.

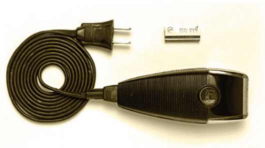
7 1885: Birth date of Niels Bohr, recipient of the 1922 Nobel Prize for Physics, whose research led to a better understanding of electron behavior.



18 1922: The British Broadcasting Co. is formed.

19 1862: Birth date of Auguste Lumière, coinventor of the cinematograph, a movie camera and projector.

November



6 1923: Jacob Schick receives a patent for the first electric shaver.

7 1867: Birth date of Marie Curie, recipient of the 1903 Nobel Prize in Physics and the 1911 Nobel Prize for Chemistry. She developed X-rays for medical diagnosis.

8 1910: William H. Frost receives a patent for an "electronic insect destroyer," predecessor of the modern bug zapper.

10 1951: Direct-dial, coast-to-coast telephone service begins in the United States.

16–21 IEEE Meeting Series in New Brunswick, N.J.

29 1849: Birth date of John Ambrose Fleming, inventor of the diode valve, which was named an IEEE Milestone in 2004.

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

CLOCKWISE FROM TOP RIGHT: TONY TREMBLAY/ISTOCKPHOTO; SSPL/GETTY IMAGES; CHALONER WOODS/HULTON ARCHIVE/GETTY IMAGES; SSPL/GETTY IMAGES; EVGENIY IVANOV/ISTOCKPHOTO; HULTON ARCHIVE/GETTY IMAGES; PAUL THOMPSON/THE HUNTINGTON HOUSE PHOTOGRAPHY; APIC/GETTY IMAGES

TECHNOLOGY

Going Electric: Things to Consider

What you should know before you buy an all-electric vehicle

BY **KATHY KOWALENKO**

THERE'S A LOT of excitement about those new all-electric automobiles, but you may experience several drawbacks if you do buy one, according to Saifur Rahman, an IEEE Fellow and director of Virginia Tech's Advanced Research Institute, in Arlington. For instance, several electric vehicles on one residential street can contribute to a brownout or even a blackout by overloading the local distribution transformer. If you are on the road, you may find it difficult to recharge your vehicle because even though EV charging stations are being built, they are still few and far between. And there are significant environmental concerns about the disposal of used up EV batteries in landfills.

TRANSFORMER TROUBLE

Buy an all-electric and you may also have to pay for a home charging station to recharge your battery. The stations come in three varieties. A Level 1 charger plugs into a regular 110/120-volt, 20-ampere outlet. But it may take longer than one night to do its job. Anywhere from 10 to 21 hours is more like it, depending on the car model and the battery.

A Level 2 unit is heftier, a dedicated 220/240-V, 40-A unit that must be installed by an electrician. This is the type EV automakers recommend you use. It could take about three hours to charge a battery that's half depleted and about eight hours to charge a battery that's dead, depending on the car model. Rahman estimates a Level 2 charger will cost about US $2000 in the United States, plus the electrician's fee.

Level 3 chargers will go into the quick-charging, 480-V stations that owners of all-electrics hope will be popping up everywhere. Chargers at such stations could bring a half-charged EV battery to full capacity in 10 to 30 minutes. Such setups, said to be in the planning stages in many cities, will be the "gas stations" for all-electrics.

But if your neighborhood has too many all-electrics plugged in and if no load-control programs are added, there is a chance the local transformers could be overloaded. Most pole-mounted transformers in the United States are rated at 50 000 volt-amperes (50 kVA) and typically serve four to eight homes. At any time, each home could be pulling in about 8 kilowatts, but plug in two or three EVs drawing 5 kW or more each, turn on a few 240-V appliances such as air conditioners, electric ovens, or clothes dryers—each of which draws from 5 to 7 kW—and you and your neighbors could be sitting in the dark.

"The impact of electric vehicles will be felt at the local distribution point—the home," says Rahman, who does see a bright side. "Because the number of EV owners will be small at first and spread across different time zones, transmission- or generation-level overloads will not be a problem, as some claim."

Installing larger pole-mounted transformers providing 100 kVA or more could help. Installed, each of these would cost several thousand dollars, but the question is, Who will pay for that? It's unreasonable to ask consumers without an EV to come up with the money, Rahman says. Nor is it feasible to ask the few initial electric car owners. Rahman suggests that rather than upgrading the transformer, it makes more sense to add a control device on each charging station that turns off other 240-V appliances in the home when the EV needs to be charged, or delay charging the car.

"This station could be made intelligent enough to sense when other 240-V devices are running," he explains. "If it senses two appliances are on and there's not enough capacity in the transformer, it will either turn off the appliances or not charge the car. This will make the electric car transparent to the power company." Such a feature, he says, could be added at a small cost.

CHARGING DILEMMA

Another problem is finding a place to put the charging station. If you live in a house with a garage, charging your car should be relatively simple. But you'll have a real problem if you live in an apartment or town house and don't have an assigned parking spot with room for a charging station.

The options are limited. A Level 2 home charging station would be hard-wired to your house, so you couldn't take it with you to your sister's or bring it to your workplace and plug in your car. That means you'll probably need a public charging station. These will be expensive, so don't expect to see them anytime soon in public garages, in your company parking lot, or sprouting along highways. Public stations will require a new infrastructure, involving 240-V lines with several hundred amperes of spare capacity for EVs—which might not always be available. A roadway station that can charge four to eight EVs at a time could cost upward of $25 000 to build, Rahman says.

"Running the lines costs money, and existing garages may not have the physical space and/or spare electrical capacity to add stations," says Rahman, who calls building such stations "a significant bottleneck" to EV sales, one that will likely be overcome only by government incentives.

The slow speed of charging the battery will also affect the infrastructure, with cars potentially tying up Level 2 charging stations for several hours, though it's expected that the roadway stations will use 480 V.

BATTERY BRIEFING

Cars such as the Chevrolet Volt, Ford Focus Electric [below], and

Ford says its Focus Electric can go 160 kilometers with a full charge.

FORD MOTOR CO.

Nissan Leaf warranty their proprietary battery packs for eight years or 161 000 km, whichever comes first. The Volt relies on a 16-kilowatt-hour manganese spinel lithium-polymer prismatic battery pack for its 64-km range. The Leaf uses a 24-kWh lithium-nickel-manganese polymer battery for a 160-km range. The Focus Electric can go 160 km with its 23-kWh lithium-ion battery pack.

But battery capability fades with time. A battery delivers less range after a couple of thousand charge-discharge cycles. Battery life is also affected by how people drive, whether the battery is charged in minutes or hours, and the climate. An EV's range will decrease as it ages—and the more aggressively it is driven, the faster that happens.

As the batteries are improved, they could last 10 years, longer than the life of many vehicles. But replacing a failed battery could cost from $3000 to $12 000, depending on the car model.

"And if your battery goes dead, you can't simply run to your local garage for a replacement," Rahman points out.

Then there's the dilemma of what to do with spent batteries. According to the U.S. Environmental Protection Agency, rechargeable batteries are not an environmental hazard if they are not dumped in landfills. But the European Union has a battery recycling law requiring vendors to reclaim for recycling at least a quarter of the batteries they manufacture and sell, including lithium-ion.

"Because the ion of lithium is not a benign metal, it will have an impact on the environment," Rahman says.

As the EV batteries age, their ability to hold charge will diminish, but they can still be useful in homes and offices as backup sources of electricity, Rahman points out. "For example, if homeowners or small businesses want to have high-quality power for short durations (maybe several hours) for whatever reason or to avoid peaking charges by not using as much electricity when the power company faces supply crises, these discarded EV batteries can meet those needs. As these opportunities are identified and the value of such applications are realized, a secondary market will grow to trade for such batteries."

Read more in this issue to learn what IEEE is doing in the area of all-electric and hybrid vehicles, including conferences and standards as well as projects undertaken by IEEE student members. ■

IEEE

HISTORY

A Road Trip Through Time

A look back at the history of electric vehicles

BY **ANIA MONACO**

WITH THE RELEASE of the Nissan Leaf and Chevrolet Volt, more electric and hybrid vehicles are hitting the streets these days. Electric cars are not a new development, though. You might be surprised to learn that such vehicles date back to the late 1800s.

As we look to the future of EVs in this special issue, *The Institute* did some digging into their past with the help of the IEEE History Center and an article written by Carl Sulzberger—a former member of the IEEE History Committee who wrote the two-part "An Early Road Warrior" [*IEEE Power & Energy Magazine*, May/June 2004 and September/October 2004]. He is now associate editor of history for the magazine.

REPLACING HORSES

EVs have certainly had a bumpy ride. Numerous inventors in Europe and North America were developing self-propelled automobiles in the late 1800s to replace the horse and buggy. They focused on steam, internal combustion, and electric-powered alternatives. The introduction of electric power generation and distribution systems in the 1880s further spurred interest in electric cars. Several were built in the 1890s. The cars were silent, clean, and simple to operate, according to Sulzberger. But their range was limited by the charge on their batteries. "Thus, electric cars were restricted to areas where they could easily return home to recharge or where recharging facilities were made available by a local electric power company," he wrote. Sound familiar? That is the same hurdle today's all-electric vehicles face.

The early electric cars were much slower than their steam- or gasoline-powered competitors. Typical cruising speed was less than 32 kilometers per hour. Going faster cut down the cars' range, which at the time was only 40 to 64 km. The batteries were very heavy and prone to problems, too, requiring frequent maintenance.

EARLY SUCCESS

The first successful electric car in the United States was built in 1891 by William Morrison, Sulzberger wrote, adding that it was equipped with a 4-horsepower motor and a 24-cell battery weighing 348 kilograms—more than half of the vehicle's total weight. Its top speed was 22 km per hour.

A few years later, Pope Manufacturing Co. of Hartford, Conn., became the first U.S. manufacturer to sell electric cars in large numbers. Its cars also topped out at around 22 km per hour and could travel up to 48 km between battery charges. In Belgium, one electric car proved it could go much faster, setting a speed record of 109 km per hour.

By the late 19th century, EVs had a couple of advantages over the primitive gas-powered cars of the time. They were more reliable and didn't need to be hand

Thomas A. Edison [left], circa 1910, with a Bailey Electric after a 1000-mile [1609-km] endurance run using Edison's new battery, which was recharged nightly.

cranked to start. In 1900, 28 percent of the 4192 cars produced in the United States were electric, according to Sulzberger.

In the meantime, Thomas A. Edison had become a proponent of EVs and spent years trying to invent a more efficient and less corrosive battery than the lead-acid one used at the time. He developed a nickel-iron-alkaline battery that "had a power density of some 14 watt-hours per pound, resulting in a battery weight of 53.3 pounds per horsepower-hour," Sulzberger wrote. "This was some 233 percent better than contemporary lead-acid batteries."

But soon after the battery went on sale in 1904, reports of leaks and other problems prompted Edison to discontinue it. He dedicated the next few years and spent more than US $1 million of his personal fortune on improving the battery, which he reintroduced in 1909. It extended the range to 160 km between charges.

Edison said he believed the battery would revolutionize the electric vehicle industry, but it failed to catch on with most manufacturers, which continued making cars with lead-acid batteries. Because those batteries continued to be problematic, the success enjoyed by EVs was soon over.

GAS PREVAILS

Even though DC power stations were being built around the United States, distribution of electricity was slow and uneven. "As such, the necessary widespread infrastructure for recharging electric vehicle batteries, either at home or at a nearby location, simply did not exist," Sulzberger wrote.

In addition, people wanted to travel longer distances in their cars. Cross-country trips became possible as more roads were built. EVs simply were not suited for such excursions. That fact, combined with the introduction of low-cost, gas-powered cars such as the Ford Model T, drove many electric car makers out of business. At the same time, improvements were made to gas-powered cars.

The need to crank a gas engine had been a major shortcoming. Charles Kettering was the first to develop and manufacture an electric self-starter system, which was introduced in the 1912 Cadillac.

"And the rest, as they say, is history," Sulzberger says. The gas-engine car went on to become the standard.

Interest in electric cars never disappeared, however, and electric vehicles were zipping around major cities well into the 1920s.

A SECOND CHANCE

By the early 1970s, as gas prices soared and concerns about the environment mounted, developers renewed their interest in EVs. Numerous models were built, but they had little success. One of them, the CitiCar from Sebring-Vanguard, sold about 2000 units in the United States. And in 1996, General Motors began producing but soon discontinued the EV1, the first mass-produced electric car of the modern era made by a major automaker.

Despite advances over the decades, the limitations of the batteries remained a problem. Even the best electric cars could travel only a fraction of the distance of gas-powered cars.

Engineers began rethinking the electric car. And so the hybrid vehicle was born. It uses both electricity and gasoline. In the mid-1990s, Toyota Motor Corp. worked on building the first commercial hybrid, the Prius. It was launched in Japan in 1997 and then worldwide in 2001. By 2010, Toyota had sold 2 million units.

Today, other hybrids and all-electric cars are on the market. The Chevrolet Volt has a gas engine ready to take over when its electric charge runs out after 64 km. The Honda Insight competes with the Volt in the hybrid market. Nissan's all-electric Leaf can go 160 km before needing a recharge, and an all-electric Ford Focus should be available soon. The high-performance $109 000 Tesla Roadster electric car debuted in 2008.

With increasingly innovative cars and countries pushing for more fuel-efficient vehicles to lessen their reliance on fossil fuels, will EVs soon have a second heyday? Respond to the Question of the Month [p. 9] to let us know what you think. ■

For more information about the history of electric cars, visit the IEEE Global History Network at http://ghn.ieee.org, or visit the IEEE Xplore digital library at http://ieeexplore.ieee.org to read "An Early Road Warrior."

QUESTION OF THE MONTH

Early EV Adopters

Despite the buzz about Nissan's recently launched all-electric Leaf automobile [above], only 1025 were sold this year through April. Nissan, which blames the slow sales on a temporary lack of supply, says it hopes to sell 10 000 of the US $32 000 vehicles by year's end. By that time, an all-electric Ford Focus should be available. And then there's the high-performance $109 000 Tesla Roadster, first delivered in 2008.

U.S. purchasers can get a $7500 federal tax credit, but many people hesitate to buy an EV for a number of reasons, including the cars' limited range, the lack of charging stations, the time it takes to charge the car, and the possibility that severe cold and using the heater or air conditioner will drain the battery.

Do you plan to buy an all-electric car? Why or why not?

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.*

NISSAN

RESPONSES TO JUNE'S QUESTION

Open vs. Closed

Google recently pulled 21 free apps from its Android Market after finding that they were malware. Downloaded by at least 50 000 people, the apps were able to gain access to devices such as smartphones, gather data including the owner's mobile-service provider and user ID, and secretly download more malicious code to the devices.

The news has added fuel to the debate on which type of app distribution model is better: Android's less controlled model or Apple's closely monitored approach. Proponents of Android like the fact that app developers have more freedom and say that the ability to customize a device's features outweighs the occasional piece of malware. Fans of Apple's system say it is more secure and they prefer its more monitored system, despite the lack of customization.

Do the benefits of an open app distribution system outweigh the possible consequences? Which system do you prefer?

KEEP OUT

Because a smartphone is a very personal device in which sensitive data is often stored, I prefer Apple's model, which is more controlled in terms of the applications available to the end user. I would not want to open the door to any malicious developer.

Julio Balderas
Ciudad Victoria, Mexico

CREATIVE CONTROL

People who like to tinker generally prefer an open model. It gives them access to enough of the system's settings to make it work just the way they want it to. Those who like a system to just work and never want to fuss with it will prefer a closed model.

As a Linux fan, I prefer an open model. I have an iPhone, and I had to "jailbreak" it to customize it. My next phone will be an Android.

Luke Swasey
Burlington, Vt.

A NECESSARY EVIL

I find the need to obtain Apple's approval before distributing an application to be somewhat disturbing. However, there is so much junk out there that I feel its model is justified. We have learned to deal with the threat of viruses and spyware in our computers, but no one wants malware on a smartphone.

Felipe M. Pait
São Paulo, Brazil

LET FREEDOM RING

Freedom has its costs. I prefer open source, which includes access to the source code if I want or need to inspect or modify it. On the other hand, the less tech-savvy user might prefer closed source.

W. Schultz
Beachwood, Ohio

PLAYING IT SAFE

One reason for companies to make their software open source is to get others to improve it and fix bugs. Another reason is that they may not want to support or warranty their software. Some people may thrive in the open-source anarchy, but I'd rather have software that works in the first place. When there is a problem, I want a software vendor that will answer my questions and fix its products.

Scott Kurtz
Mount Laurel, N.J.

ILLUSION OF SECURITY

The Android system is better. The Apple system gives the illusion of higher security at the cost of exclusivity. Just as there is no bug-free software program larger than 10 lines, there is no entirely safe smartphone application. It is better for users to just be cautious about what they download or click on.

Carl-Mikael Zetterling
Stockholm

APPLE ALL THE WAY

Apple's iOS wins my vote. I just want my portable device to work. Without question, freedom from worrying about malware trumps the ability to customize. Several years ago, I switched from being a long-term user of Microsoft OS—beginning with DOS—and almost immediately felt as if I'd been cured of a debilitating disease. Looking back, I rue the day I bought my first PC!

James Longshore
Chesterfield, Mo.

PRESIDENT'S COLUMN

Meeting and Greeting the Giants

ONE OF THE important (and complex) functions of IEEE is to recognize excellence in our fields of interest. We do so in three principal ways. We recognize high-quality work in progress by giving awards to authors of exceptional papers presented at our conferences or in our publications. We honor living inventors by presenting them with IEEE's technical field awards, IEEE-wide awards, and IEEE medals. We honor discoverers and thinkers from the past (as well as many who are still with us) by conferring on their work the status of an IEEE Milestone in Electrical Engineering and Computing.

Recognizing excellence is seldom straightforward. Inventions often are developed in parallel by more than one group or person. Sometimes there are conflicting claims about the date of an invention; for example, a discovery may have been prevented from being announced to the public due to government security restrictions.

Did Alexander Graham Bell really invent the telephone? Is Guglielmo Marconi truly the father of wireless telegraphy? Is Thomas A. Edison the designer of the lightbulb? Although those three individuals are certainly celebrated inventors, there was no lack of controversy surrounding their original claims to new discoveries. The disputes sometimes led to years of litigation over patents and intellectual property rights.

While the competition for the ultimate honor for an invention is often quite passionate, we know that almost every new invention results from the work of many. Each player builds on the findings and discoveries of predecessors; ideas and designs are copied, adapted, and adopted. Entrepreneurial prowess is often as important as scientific prowess. I was reminded of these observations in April, when I participated in the unveiling of an IEEE Milestone at Villa Griffone, outside Bologna, Italy. The Milestone commemorates Marconi's early experiments in wireless telegraphy.

The genius of Marconi is unassailable. Time after time, he was the first to build working telegraphy devices and demonstrate their successful operation over increasingly long distances. Yet his work was rooted, and in some cases borrowed from, the efforts of at least half a dozen other inventors. That Marconi used some of their work does not diminish his greatness—often he was the only person able to integrate into practical, functioning devices the pieces that others had discovered in isolation. In fact, IEEE has recognized in other Milestones some of the work of those from whom Marconi borrowed. The aim of our recognition programs is not to determine the "winner." Rather, we wish to highlight and promote the many contributors whose intellect, hypotheses, approaches, and experiments gave rise to the ultimate outcome. In our profession, success almost always has many fathers and mothers.

KELLY & MASSA PHOTOGRAPHY

Each IEEE Honors Ceremony is more meaningful than all the Oscars and Emmys bundled together

Throughout the year, we dedicate new IEEE Milestones at the places where discoveries were made (http://www.ieeeghn.org/wiki/index.php/Milestones:IEEE_Milestones_Program) and present technical field awards to thinkers and developers at major conferences. Once a year, we gather for the IEEE Honors Ceremony, where we introduce the most recent recipients of IEEE's major recognitions. This year's ceremony was held in August in San Francisco (it is available to view on IEEE.tv at http://ieeetv.ieee.org). I am always awed by the caliber of the individuals and groups we recognize, and I hope that more members, especially student members, will have the opportunity to attend or watch the event.

Through those ceremonies, I had the opportunity to meet the true leaders of our profession, including Andrew Viterbi, Amar Bose, Ray Dolby, Ingrid Daubechies, Marcian Hoff, and A.P.J. Abdul Kalam. For me, each of the annual gatherings is a thousand times more important, more meaningful, and more emotionally moving than all the Oscars and Emmys bundled together. I and other attendees get to meet and greet the giants.

How can you become part of our awards activities? If you are an instructor or professor in one of IEEE's fields of interest, try to find some time in one of your classes to speak about the annual IEEE Honors Ceremony and the award recipients. Perhaps show a clip or two from the ceremony. I do this regularly with my students at Drexel University, and I find that the show always has a positive impact—especially on undergraduate students still searching for their role in the profession.

If you have worked with, heard of, or read the work of one of the yet-unrecognized giants, please go to http://www.ieee.org/about/awards and nominate (and, if necessary, renominate) him or her for an IEEE major recognition. Our awards program is only as strong as the quality of the nominees, and you—our members and patrons—are the ones who submit the nominations.

Moshe Kam
IEEE President and CEO

the institute

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IEEE OPERATIONS CENTER
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TELEPHONE: +1 732 562 6825
FAX: +1 732 562 1746
E-MAIL: INSTITUTE@IEEE.ORG
WEB: HTTP://WWW.THEINSTITUTE.IEEE.ORG

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PRODUCTS AND SERVICES

Understanding What's Under the Hood

BY KATHY KOWALENKO

IEEE HAS A variety of publications and services to help you learn more about electric and hybrid vehicles. Here's a sample of what's available.

PUBLICATIONS

The IEEE Xplore digital library offers a host of magazines, journals, and conference proceedings that cover the topics. The library has more than 8800 articles on electric vehicles and over 3100 that cover hybrid vehicles. These are just some of the journals:

- IEEE Aerospace and Electronic Systems Magazine
- IEEE Spectrum
- IEEE Transactions on Industrial Electronics
- IEEE Transactions on Industry Applications
- IEEE Transactions on Power Delivery
- IEEE Transactions on Power Electronics
- IEEE Transactions on Power Systems
- IEEE Transactions on Magnetics
- IEEE Transactions on Vehicular Technology
- Proceedings of the IEEE

COURSES

Available from IEEE Xplore or the IEEE eLearning Library:

Hybrid Electric Vehicles: Exploring the Electronic Continuously Variable Transmission (e-CVT)

This course focuses on the dynamics of electronic continuously variable transmissions and compound split systems, with examples of both, and on power variators.

It begins with a historical perspective of hybrids. The course then explains the fundamentals of the input split e-CVT and discusses the operation of transmissions of various car models. Energy storage systems and their cost are also covered.

IEEE.TV VIDEOS

IEEE.tv offers a series of lectures by experts produced by the IEEE Vehicular Technology Society. The lectures include:

Dynamic Response of Electronic Structures to Shocks and Vibrations, and the Role of Predictive Modeling

BY EPHRAIM SUHIR; UNIVERSITY OF CALIFORNIA, SANTA CRUZ

Suhir explains the principles of designing portable and vehicular electronics. He also covers the role played by modeling, the mathematical versus numerical linear response of electronic components, and the effects of vibration and impact. Furthermore, he discusses nonlinear response characterization, repetitive load effects, and shock protection of electronics.

Grounding for Hybrid Vehicles

BY JAMES GOVER; KETTERING UNIVERSITY, FLINT, MICH.

Hybrid and plug-in electric vehicles with systems supporting up to 500 volts and 500 amperes present new challenges for electrical and electronics system designers. They must understand the concept of robust grounding of the power electronics circuits and cabling to prevent electromagnetic interference with the vehicle's control system. Gover explores such topics as magnetic and electrostatic shielding, transmission of noise through shielding, and single-point versus multipoint grounding of shields.

Hybrid and Plug-in Electric Vehicle Systems

BY CHRIS MI; UNIVERSITY OF MICHIGAN, DEARBORN

Mi explains the inner workings and systems design of commercial EVs. He covers power-train coupling mechanisms, electric drivetrain components, energy storage options, battery management systems, and battery chargers. He also discusses converting conventional vehicles into EVs.

Hybrid Electric Vehicles Power Train Fundamentals

BY MENGYANG ZHANG; CHRYSLER GROUP, AUBURN HILLS, MICH.

Zhang provides an industry view of EVs and hybrids, including discussions of vehicle dynamics, performance, and design. He begins with an introduction to general vehicle dynamics for power trains and goes on to cover performance, drivability, fuel economy, emissions, and the AUTOSAR architectural standard.

Hybrid Vehicle Electronics Design

BY JAMES GOVER

Engineers must design very high-power circuitry to supply the 20 to 40 kilowatts of power needed by EVs. The lecture covers power systems and controls, rectifiers and converters, single-phase inverters, battery chargers, single-ended primary inductance converters, waveform analysis, and distortion.

In-Vehicle Networking: The Evolution from Multiplex to Systems Engineering

BY BRUCE EMAUS; VECTOR CANTECH, NOVI, MICH.

Electronic multiplexing of signals for the controls, sensors, infotainment, and safety features found in today's vehicles allows for reliable operation and the ability to add myriad electronic systems. This lecture covers the beginnings of multiplexing and moves on to distributed embedded systems and distributed functions.

Thermal Stress Failures in Electronic and Photonic Systems

BY EPHRAIM SUHIR

Thermal stress on complex electronics and photonics is not easily understood, yet it is a major cause of faulty operation of today's devices and systems. This course provides both a micro and macro understanding of thermal stress and how it can be avoided during the design process.

CONFERENCES: OCTOBER 2011–MAY 2012

Several upcoming IEEE conferences deal with topics related to electric and hybrid vehicles

IEEE International Electric Vehicle Conference

GREENVILLE, S.C.; 4–8 MARCH 2012

Presentations cover topics including electric vehicle component design, motor drives, controllers, heating and cooling systems, and high-voltage wiring. Also discussed are power grid and renewable energy resource interfacing for mass deployment of EVs as well as the development of global standards for EVs and their impact on EV R&D and manufacturing.

SPONSORS: IEEE Electric Vehicle Committee and IEEE-USA
VISIT: http://electricvehicle.ieee.org

IEEE Power & Energy Society Conference on Innovative Smart Grid Technologies, Latin America

MEDELLÍN, COLOMBIA; 19–21 OCTOBER

Provides a forum for discussing smart-grid technologies and their potential applications in Latin America. Topics include plug-in hybrid vehicles; power and energy system applications; communications, control, and information systems supporting the smart grid; smart sensors; advanced metering infrastructure; and cybersecurity systems.

SPONSOR: IEEE Power & Energy Society
VISIT: http://www.ieee-isgtla.org

Innovative Smart Grid Technologies, Europe

MANCHESTER, ENGLAND; 5–7 DECEMBER

Topics include grid and communications systems, modeling and deployment, virtual power plants, energy storage, and architectures and models for the smart grid. Also discussed are regulation and market operations of smart-grid technology, load forecasting, and network and service management.

SPONSOR: IEEE Power & Energy Society
VISIT: http://www.ieee-isgt-2011.eu

IEEE International Conference on Power Electronics and Drive Systems

SINGAPORE; 5–8 DECEMBER

Topics include motor drives, motion control, analysis and design of electric machines, power quality issues, traction and automotive systems, renewable energy technologies, biomedical power electronics, telecommunications power supplies, and microelectromechanical systems.

SPONSORS: IEEE Industrial Applications, Industrial Electronics, Power Electronics, and Power & Energy societies
VISIT: http://rpsonline.com.sg/peds

IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies

AMMAN, JORDAN; 6–8 DECEMBER

Covers potential applications of technology in Jordan and other developing countries. Topics include power quality issues related to smart grids and electric vehicles, electric power generation, renewable energy sources and technology, and smart networks' reliability. Also discussed are motion and mechatronics control systems, wired and wireless networks, satellite and optical communications, and cloud computing.

SPONSOR: IEEE Jordan Section
VISIT: http://www.ewh.ieee.org/r8/jordan/AEECT2011

IEEE Power & Energy Society Transmission and Distribution Conference and Exposition

ORLANDO, FLA.; 7–10 MAY 2012

Focuses on electric vehicle standards development, integrating wind and solar energy into transmission systems and distribution grids, energy storage systems, transmission and distribution system analysis and software tools, and smart-grid protection and control.

SPONSOR: IEEE Power Electronics Society
VISIT: http://www.ieeet-d.org

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PROTERRA

JAMES PROVOST

IEEE SOCIETIES

Society Spotlights

Many IEEE societies are involved in technologies for electric and hybrid vehicles. Here's what some are doing

IEEE Computational Intelligence Society

HTTP://WWW.IEEE-CIS.ORG

The society is helping develop software approaches to support large-scale integration of hybrid and plug-in EVs into the power grid. The society's interests include tools for optimizing large-scale systems under dynamic and uncertain environments, such as those resulting from widespread integration of hybrid vehicles into power systems. Members of the society have helped create techniques for optimum control and optimization of components, processes, and systems for electric vehicles.

IEEE Instrumentation and Measurement Society

HTTP://IEEE-IMS.ORG

The theory and application of measurement involves sensing phenomena, processing signals and data, and interpreting information. Consequently, the society is involved in many fields, including power generation and distribution, communications, and transportation. Its members are pushing the frontiers of electric-drivetrain cars. The EVs' batteries and high-voltage systems require constant monitoring and control to ensure safety and drivability and to minimize the cost of ownership.

IEEE Intelligent Transportation Systems Society

HTTP://WWW.EWH.IEEE.ORG/TC/ITS

Many of the society's members deal with electronics development, control, sensing, and battery-charging issues in hybrids and EVs. Also, a lot of research is reported in the society's publications on real-time information transmittal for in-vehicle energy management, route planning, and energy pricing. One of the society's annual conferences, the International Conference on Vehicle Electronics and Safety, is a venue for EV, plug-in hybrid EV, and hybrid vehicle-related presentations.

IEEE Vehicular Technology Society

HTTP://WWW.VTSOCIETY.ORG

This society is involved with the electrical and electronics engineering technology required to design and develop the new breed of hybrids and EVs. To get members up to speed, a series of DVDs has been created based on lectures given by experts from the automotive industry and academia [see Products & Services, p. 11]. The DVDs cover the design of circuitry, power electronics, propulsion batteries, and motors, as well as requirements for emissions, performance, and durability.

STANDARDS

THE IEEE STANDARDS Association (IEEE-SA) recently signed a memorandum of understanding with the Society of Automotive Engineers International to collaborate on vehicle-electrification standards related to the smart grid.

As more plug-in EVs are added to the grid, more power will be needed at peak times—which will require an expanded infrastructure. That calls for closer collaboration between the two organizations to develop standards supporting plug-in electric and hybrid vehicles and their power requirements and enabling vehicle-to-grid communications.

SAE International, whose standards focus on the vehicle, currently has 46 related to electric vehicles, with more than 30 new ones in the works. IEEE-SA has more than 100 standards relevant to the smart grid, with others in the planning stages.

Standards developed by SAE and IEEE-SA will spell out how vehicles can be charged at off-peak hours and help utilities better manage the grid during peak hours, thus minimizing cost and impact to the grid.

Under terms of the agreement, each organization will share its relevant draft standards with the other.

Here are a few of the applicable IEEE standards:

IEEE P2030.1

The IEEE Guide for Electric-Sourced Transportation Infrastructure provides guidelines that can be used by utilities, manufacturers, transportation providers, infrastructure developers, and even those who drive EVs to develop and support systems that allow increased use of electric and hybrid vehicles.

To reduce the amount of new power that has to be generated and better use existing power, the document outlines efficient methods for electric transportation based on an end-to-end systems approach. It also includes standards that have already been approved, as well as openings where new standards are needed, and describes research that is presently under way. The document is designed to help utilities plan the most economical ways to support increasing transportation loads. It provides terminology for methods and equipment and planning requirements for EV transportation, including its impact on systems for generating, transmitting, and distributing electric power.

IEEE 1901

The IEEE Standard for Broadband Over Power Lines specifies the sophisticated modulation techniques required for transmitting data over standard AC power lines of any voltage at transmission frequencies of less than 100 megahertz. The specifications address a wide range of applications, including smart energy, transportation, and local area networks (LANs).

In the transportation sector, for example, the standard spells out what's needed to deliver audiovisual entertainment to the seats of airplanes, trains, and other forms of mass transit. It also describes how EVs can download new entertainment playlists while their batteries charge overnight. Networking products complying with IEEE 1901 will deliver data rates in excess of 500 megabits per second in LAN applications. In first-mile/last-mile applications, such devices will achieve ranges of up to 1500 meters.

IEEE 1547 Series

Known as the Standards for Interconnecting Distributed Resources with Electric Power Systems, this series highlights interconnections that include both distributed generators and energy storage systems. The series establishes requirements and provides a standard for interconnecting distributed resources with electric power systems and electric and hybrid vehicles. It also includes requirements relevant to the performance, operation, testing, safety, and maintenance of the interconnection.

For more information on these and other standards, visit http://standards.ieee.org.

PROFILE

Perpetual Motion

Ali Emadi keeps busy with all things EV

BY SUSAN KARLIN

SUSTAINABLE ENERGY is an appropriate field for Senior Member Ali Emadi, considering the nonstop research, published articles, and edited manuscripts he has managed to cram into the past 11 years—not to mention the conferences he helped organize.

First, at the Illinois Institute of Technology (IIT) in Chicago—where he was a chaired professor of engineering—he turned his lab into a world-class power electronics research center. Then he founded a company in 2005 to commercialize the technologies developed in the lab, including a new kind of electric motor. In late 2009, his hard work caught the attention of McMaster University, in Hamilton, Ont., Canada. McMaster offered him a job as a research chair in hybrid power-train systems. He accepted, starting this past May, and things haven't slowed down for him.

Before he had even unpacked all the boxes in his new office, he was planning the IEEE Power Electronics Society's Transportation Electrification Conference and Expo (ITEC)—IEEE's first transportation-industry-focused conference on sustainable energy. It is scheduled for June 2012 in Dearborn, Mich. Emadi is the conference chair.

All the work has been a juggling act, which leaves him more giddy than overwhelmed, he says. "When you have fun, having so much work is okay," he explains. "I'm lucky in that regard. I've been fascinated by electronics, systems, and cars since I was a kid. Sometimes I can't believe I'm getting paid for what I'm doing."

IDEAS EXCHANGE

What he's doing is working toward the lofty goal of shifting vehicles from petroleum products to electricity. And he's focusing increasingly on electricity from cleaner sources than coal, such as the sun, wind, and water. With ITEC, Emadi says he hopes to get the makers of cars, off-road vehicles, trains, ships, and even spacecraft together with academics so they can exchange ideas to expedite that transition.

"Our conference is heavily industry-oriented, although it will facilitate interaction between companies and researchers," he says. "It's unique in its focus on the intersection of all types of transportation products and components and ways to leverage technologies between them. There will be more than 200 presentations and research papers by industry representatives.

"Electric power, over time, will come from more renewable energy sources. Clean coal plants, which have better filters and technologies and less emissions, are also part of the solution."

A major component of ITEC is its Educational Bootcamp, in which engineers and managers from industry offer classes on the basics of transportation electrification.

"There's a desperate need to educate engineers on the new technologies as well as on the fundamentals of power electronics and electric machines," Emadi says. "These classes are focused on industry fundamentals and won't interfere with company secrets."

EFFICIENT MOTORS

Emadi has been interested in power electronics converters and systems since he began his academic training. He earned bachelor's and master's degrees from Sharif University of Technology, in Tehran, in 1995 and 1997 and a Ph.D. in 2000 from Texas A&M University, in College Station.

Immediately after graduating, he joined IIT as a professor of electrical and computer engineering and went on to develop its Electric Power and Power Electronics Center and Grainger Laboratories, which aims to develop more efficient electric motors.

His research there led to nine automotive application patents (with three others pending). In 2005, he founded Hybrid Electric Vehicle Technologies to commercialize the university lab's creations. One of the most promising technologies involves a reconfigured switched-reluctance electric motor that improves efficiency without permanent magnet materials (used to generate the magnetic flux that creates torque).

"The electric motors of most hybrid and electric cars use permanent magnets," he says. "Aside from being expensive, most of these permanent magnets are made from rare earth materials, whose refining is not a clean process."

Meanwhile, Emadi has authored or coauthored more than 250 journal and conference papers as well as half a dozen books, most recently *Integrated Power Electronic Converters and Digital Control* (CRC Press, 2009). He is chair of three IEEE committees and is the North American editor of the *International Journal of Electric and Hybrid Vehicles*. He has been a guest and associate editor on half a dozen other publications and special issues, and he chaired two other IEEE conferences. Along the way, he garnered seven awards and recognitions, including three from IEEE, and was named a 2009 Chicago Matters Global Visionary, an award for area residents who help shape the region's future and global reputation.

Canada came calling in 2009 as part of a government initiative to attract some of the world's top researchers in 19 scientific areas to 13 universities. Each appointment receives up to US $10.2 million in federal funding over seven years. Emadi's is the only position related to the automotive industry, which, he notes, accounts for a significant portion of Canadian exports. His duties include directing the university's Institute for Automotive Research and Technology, which encompasses roughly 75 researchers and gets $100 million in funding.

"No matter what your viewpoint, sustainable energy is something you should support," he says. "Our current transportation system is too heavily dependent on fossil fuels and is at the mercy of oil prices. If you care about the environment, you'll want to reduce emissions." ■

RYAN MANERI/OYSTERCATCHER MEDIA

PART-TIME PASSIONS

Born to Ride

Scratch an engineer and you'll often get…a bit of a rebel. Over the years, The Institute *has received dozens of e-mails from members who are motorcycle riders—hence, our biker doubleheader this month*

BY SUSAN KARLIN

Kristi Brooks

JOB
Electrical engineer

HOMETOWN
Thompson, N.D.

ONE OF Senior Member Kristi Brooks's favorite childhood memories is riding with her dad on his motorcycle as they tooled around the southwestern Minnesota countryside. One day, she thought, she'd get a bike of her own.

Four years ago, she had her chance. Her three children were getting older, and she'd just completed her motorcycle safety course and passed the written test for the motorcycle endorsement on her driver's license. "If I didn't get a bike then, it would have been one of those things I just kept putting off," she says.

She started with a small, relatively inexpensive Yamaha 650, then two years ago stepped up to a more stylish and powerful Harley-Davidson Softail Classic [above]—complete with fringed saddlebags and a rhinestone-studded gas cap. She uses the bike for long weekend trips as well as to commute to her engineering job at Ideal Aerosmith, an aerospace systems test facility in Grand Forks, N.D. "I call it my chick bike," she says.

Her weekend rides are usually hundreds of kilometers, scenic jaunts around the back roads and lakeshores of nearby northwestern Minnesota. "I'll go with a group of riders, grab a burger, and take in the scenery," she says. "It brings back memories of riding with my dad. And it's a chance to take a break from the 'to do' list. You can't text or talk on the phone while you ride. You're just out there with your thoughts."

In August 2010, Brooks was among the half million bike enthusiasts at the Sturgis Motorcycle Rally in South Dakota. "I love to see how riders customize their bikes with paint jobs," she says.

"People have this funny perception of bikers," she adds. "Some look grizzled and nasty, but they're the sweetest people. I was in a convenience store in my leather riding gear once, and a mother grabbed her son and pulled him toward her. I have kids of my own—I'm not that scary!"

Brooks's engineering background has facilitated her riding. "At first I was a little afraid of the bike tipping over, and my innate desire to keep the bike upright impeded me," she says. "But knowing how the physics of forces works along curves helped me relax and lean into them." Her engineering job also helps her keep pace when the guys talk bike tech. "I worked for General Motors for a few years, which exposed me to the workings of internal combustion engines," she says. "Plus, I have a natural curiosity and ask a lot of questions."

Her riding came full circle in July, when she and her father journeyed together through South Dakota's Black Hills on separate bikes for the first time since she began riding.

"My youngest child rides with me, but the teenagers don't think it's cool to ride with their mom," she says, laughing. "Luckily, their friends think it's really cool, which makes up for my dorkiness!"

Kenyon Kluge

JOB
Director of electrical engineering

HOMETOWN
Santa Cruz, Calif.

IEEE MEMBER Kenyon Kluge was 11 when he first tried his cousin's dirt bike and got hooked. At age 16, Kluge tried to persuade his parents to let him get a motorcycle license, but they put the brakes on that idea. He didn't buy his first motorcycle, a Kawasaki EX500, until he was 21.

He made up for lost time. Within a year, he traded in the Kawasaki for the faster, more powerful Suzuki GSX-R750, and he began racing in 1998, the year he graduated college.

"I tend to have a competitive edge in everything else I do, so it makes sense I would turn to racing," he says. He subsidized his passion with Silicon Valley electrical engineering jobs until three years ago, when he melded the two by becoming director of electrical engineering at Zero Motorcycles, an electric motorcycle manufacturer in Santa Cruz.

Over the years, he has collected nearly 20 gas and electric motorcycles for dirt and road racing. He competes with them for his advanced amateur team, K Squared Racing of Santa Cruz. He even took a year off work to spend all of 2002 racing professionally on the American Motorcyclist Association circuit, finishing 15th in the Formula Xtreme series (motorcycles with 1000-cc engines).

Racing motorcycles hasn't been easy for Kluge. He has suffered several concussions and more than half a dozen broken bones from accidents. "My parents have still never come to a race," he says, laughing. "Racing motorcycles is very physical. You use your body to shift this 180-kilogram machine while pulling multiple G-forces going around corners. You're traveling so fast, you have to react very quickly, which requires sharp reflexes and agility.

"But," he adds, "there's nothing like getting in the zone, when everything is happening in a split second."

Today, Kluge limits himself to racing two weekends a month. He also began experimenting with electric motorcycle racing, thanks to his job at Zero.

"A gas-powered motorcycle can go much faster, up to 260 kilometers per hour during a race, but it's harder to control," he says. "My electric bike can go up to 160 km per hour, and a lot of race-ready parts need to be made from scratch, so it's more about the technology than pushing the speed limits." He favors a Suzuki GSX-R600 for gas-bike racing and recently raced an electric bike that he reconfigured on his own from a Yamaha YZF-R1.

His passion doesn't come cheap. "It's immensely expensive," he says. "Bikes start at US $10 000 and need another $5000 to $10 000 to make them race-ready." It's worth it, he says, because his hobby fits nicely alongside his career: "Both racing and engineering decisions focus on the goal at hand. In racing, it's to win. I've learned to think about the result I need to achieve at work and then focus my decisions toward meeting that goal."

TOP: STEVE HOLZER; BOTTOM: GARY RATHER

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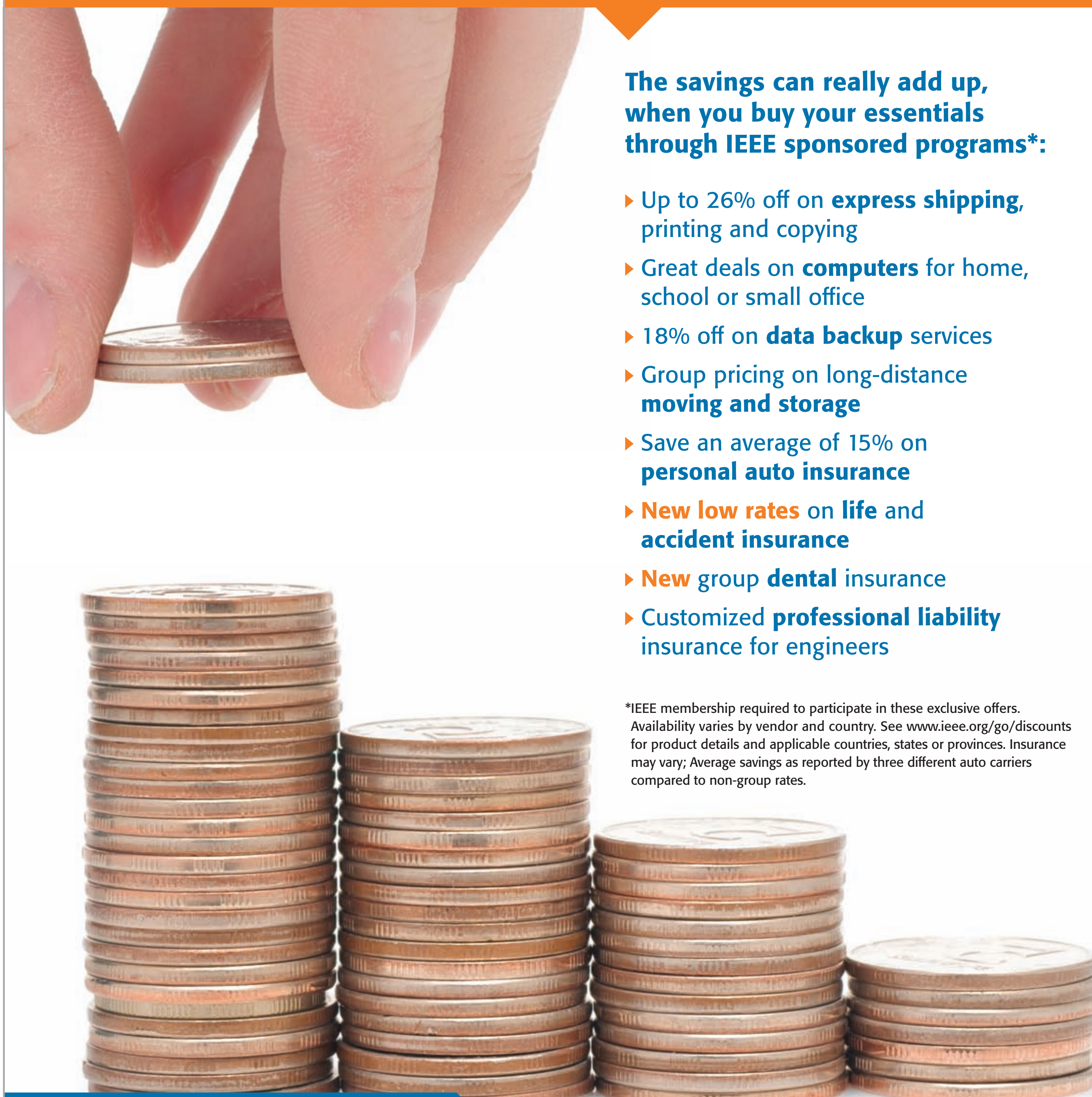

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IEEE

Students at the University of Alaska, Fairbanks, raced an electric trike at the Shell Eco-Marathon.

STUDENTS' CORNER

The Road Ahead

IEEE student members are working on a variety of EV projects

BY ANIA MONACO

IT'S NO SECRET that electric and hybrid vehicles face a bumpy road toward popular acceptance. Luckily, there's a great deal of interest among the present generation of engineering students that could make EVs the way to go.

The Institute received dozens of responses to a call for student members working on EV projects. Here's what some of them have been up to.

ELECTRIC VAN

When IEEE Student Member James Lubow started his senior design class this year at Marquette University, in Milwaukee, he knew exactly what he wanted to work on: the eLimo project begun in 2007 by students in the university's college of engineering to convert a campus Ford E350 van into an EV. The van belongs to a fleet of shuttles that carry students around campus for free.

"The goal was to decrease the cost of running the vans, which get approximately 5 miles per gallon, mainly because of all the stops they make," Lubow says. "EVs use very little energy while stopped."

Funding for the project came from various sources, including a US $65 000 grant from the Wisconsin Clean Cities program, which is part of the U.S. Department of Energy's Clean Cities initiative. The eLimo project continued each semester, with new groups of senior design-class students working to improve the van. Earlier this year, Lubow, an electrical engineering major, and a team of students set out to finish the conversion.

Previous teams had already removed the internal combustion engine, installed an electric motor, built the controls and the vacuum system for the power brakes, and performed other tasks. Lubow's team tackled the remaining technical challenges: designing the power system that drives the motor and a user interface to monitor power, speed, and odometer readings. "In addition, we had to come up with a charging station that can be used almost anywhere," he says.

An adviser was on hand throughout the project. The students got additional guidance from Wisconsin Clean Cities representatives. By the end of the semester in May, the team had completed the conversion.

Lubow sees the eLimo as an advertisement for EVs. "We hope students riding the van will start thinking about EVs as a greener alternative to gasoline power," he says. "The van will also be used as a recruitment tool at local high schools. Even if we don't pique a student's interest in attending Marquette, we're getting out the word on EVs."

SNOWMOBILES AND TRIKES

Student Member Isaac Thompson, an electrical engineering undergrad at the University of Alaska, Fairbanks, also stepped into an ongoing project this year: upgrading an electric snowmobile. Begun two years ago by a graduate student at the university, the project offers engineering students the chance to refurbish an off-the-shelf snowmobile and compete annually in the Society of Automotive Engineers' Clean Snowmobile Challenge. The goal of the contest is to reduce the snowmobile's emissions and noise while maintaining or boosting its performance.

"Each year we fix things that hadn't worked well in the previous year's competition," Thompson says. "The biggest challenge this year was setting up all the control features. It was pretty easy to install an electric motor in place of the gas engine, but to set up all of the controls, relays, and safety switches was quite a job."

Thompson's team took fourth place at the competition, held in March at Michigan Technological University, in Houghton. Seven teams competed.

A snowmobile wasn't the only EV Thompson worked on this year. He and a group of students developed an electric trike—a three-wheeled motorcycle—and competed in the annual Shell Eco-Marathon held in April in Houston [photo above]. The event challenges student teams from around the world to build and test all sorts of energy-efficient vehicles. The team whose vehicle goes the farthest using the least amount of energy wins.

By the time they had signed up for the competition, Thompson's team only had two weeks to build the trike, which started with the frame of a 2011 KMX Tornado F3.

The team placed seventh out of 12, "which we felt was pretty good for such a short build time," Thompson says. For both of his projects, "our goal was to demonstrate that EVs are much more efficient and can still be extremely sporty and useful."

ADDING SOLAR ENERGY

Graduate Student Member Adarsh Nagarajan, who is studying power electronics and systems at the University of Houston, is focusing on using renewable energy sources to help power plug-in hybrid EVs (PHEVs). For the past two years, he has been researching the feasibility and advantages of integrating PHEVs in grid-connected photovoltaic systems to optimize the flow of power to the cars as well as the residential load.

Nagarajan has finished the first part of the project, which involved using MATLAB and Simulink to figure out how a PHEV could be charged using a grid-connected photovoltaic system.

Now he is working on implementing the logic to control the charging of the battery using a digital signal processor–based microcontroller that he plans to test in a grid-connected photovoltaic system. "The controller generates switching signals for the power conditioning unit to ensure that the source from which the load is catered is right," he says.

There's no better time than now to work on a project that seeks to make use of alternative energy sources, he says: "With the rising price of fossil fuels, an increase in the use of electrical energy, and growing global awareness of our ecosystem, it's prime time to search for ways to optimize the generation, storage, and use of electric power."

POWER MANAGEMENT

Powering PHEVs is also the focus of Student Member Rohollah Dosthosseini's work. The Ph.D. student at Isfahan University of Technology, in Iran, has spent the past three years developing a computer program for determining the optimal way to manage power in HEVs.

Dosthosseini's approach involves reducing the optimal control in the vehicles to a set of algebraic equations. "Our approximating procedure makes the problem of managing power much easier, because it's less computationally complex than current methods, such as dynamic and nonlinear programming," he says. "The direct-method approach I use changes differential equations to algebraic equations." That makes solving the optimal power management problem much easier, he says.

A research paper he wrote, "Direct Method for Optimal Power Management in Hybrid Electric Vehicles," was recently accepted for publication in the *International Journal of Automotive Technology*.

Next, Dosthosseini says, he hopes to take his method out of the lab and test it on a real HEV. "I have found that there are a lot of gaps in current research in HEVs," he says. "I hope to continue my project and introduce better power management controls." ■

SHELL

ACHIEVEMENTS

Gary S. May FELLOW

Gary S. May was named dean of Georgia Tech's college of engineering, where he has been a professor of microelectronics since 1991.

May is chair of the college's Facilitating Academic Careers in Engineering and Science program, which encourages African-American students to consider careers in technology. He is founder of Georgia Tech's Summer Undergraduate Research in Engineering/Science program, a 10-week session that encourages minority students to attend graduate school in those fields. His technical interests are in computer-aided manufacturing of ICs and other electronic devices. May is the first African-American dean at Georgia Tech.

He is a member of the IEEE Components, Packaging, and Manufacturing Technology Society and the Computational Intelligence, Computer, and Electron Devices societies.

May received a bachelor's degree in electrical engineering in 1985 from Georgia Tech. He earned master's and doctoral degrees in electrical engineering from the University of California at Berkeley in 1987 and 1991.

Subramanian Ramadorai FELLOW

Subramanian Ramadorai has been appointed an adviser to India's prime minister, working with the National Development Council to help the country's students develop skills in such areas as technology, finance, and rural development.

Ramadorai is chair of Tata Elxsi, a company in Bangalore that designs software, embedded systems, and consumer electronics. He is also vice chair of Tata Consultancy Services, an IT service provider with headquarters in Mumbai, where he was CEO from 1996 to 2009. Under his leadership, TCS grew from 6000 employees to more than 143 000 employees and consultants working in 42 countries. He is a member of the IEEE Communications and Computer societies.

Ramadorai received a bachelor's degree in physics from Delhi University. He also earned a bachelor's degree in engineering and a master's degree in computer science, both from the University of California, Los Angeles.

Andrew J. Viterbi

LIFE FELLOW

Andrew J. Viterbi received the American Association of Engineering Society's 2011 John Fritz Medal, the society's highest honor. Named after a pioneer of mechanical engineering, the award is given each year to an engineer for a significant achievement in science. Viterbi was chosen for "innovations and achievements in information and communications systems, and for discovering the Viterbi algorithm."

He is president of the Viterbi Group, an equity investment fund in San Diego. In 1985, Viterbi helped found Qualcomm, a wireless telecommunications R&D company that is now the world's largest fabless chip supplier, also in San Diego. In 1967, he invented the programming algorithm for eliminating signal interference that now bears his name.

Viterbi is a member of the IEEE Communications and Information Theory societies. He was awarded the 2010 IEEE Medal of Honor for "seminal contributions to communications technology and theory."

He received bachelor's and master's degrees in electrical engineering from MIT in 1956 and 1957. He earned a Ph.D. in digital communications in 1963 from the University of Southern California, in Los Angeles.

IN MEMORIAM

Willard S. Boyle

NOBEL LAUREATE
Member Grade: LIFE FELLOW
Age: 86; *Died:* 7 MAY

Willard S. Boyle helped invent the charge-coupled device (CCD), the electronic light sensor that paved the way for digital photography.

Boyle taught physics for two years at the Royal Military College of Canada, in Kingston, Ont. In 1953, he was hired as a researcher at Bell Laboratories, in Murray Hill, N.J., where he helped develop the ruby laser, a solid-state laser that relies on a synthetic ruby crystal. Such lasers are now found in rangefinders and diamond-cutting tools. He also developed the semiconductor injection laser, used in telecommunications, bar code readers, and CD and DVD technologies.

In 1962, he was assigned to Bellcomm, a Bell subsidiary that provided technical support to NASA. He helped select landing sites on the moon as part of the Apollo space program before returning to Bell Labs in 1964. In 1969, he and IEEE Fellow George Smith, a colleague at Bell, invented the CCD, which revolutionized photography by allowing light to be captured electronically in the form of pixels rather than on film. They shared half of the 2009 Nobel Prize in Physics for the invention.

Boyle and Smith also shared the 1974 IEEE Morris N. Liebmann Memorial Award for "the invention of the charge-coupled device and leadership in the field of MOS device physics."

Boyle earned bachelor's, master's, and doctoral degrees from McGill University, in Montreal, in 1947, 1948, and 1950.

Joel Snyder

FORMER IEEE PRESIDENT
Member Grade: LIFE SENIOR MEMBER
Age: 75; *Died:* 4 JUNE

Joel Snyder, the 2001 IEEE president, began his career at IBM, where he helped develop removable disk memories. He went on to join Airborne Instruments Laboratory, in Deer Park, N.Y., where he worked on systems for evaluating navigation devices. He left to design computer circuits for Harman Kardon, a home audio equipment manufacturer with headquarters in Stamford, Conn.

In 1963, Snyder established Snyder Associates, an engineering consulting firm in Plainview, N.Y.; he was its principal engineer. He also taught part-time at three New York schools: Polytechnic Institute of Brooklyn, now the Polytechnic Institute of New York University; the New York Institute of Technology; and Long Island University.

He was IEEE Region 1 director from 1992 to 1993. From 1995 to 1996, he was vice president of IEEE Professional Activities and chair of the IEEE-USA board of directors.

Snyder was honored with the 1999 IEEE Larry K. Wilson Transnational Award for his "long-term commitment to expanding IEEE activities available to members outside the United States, and in particular for his efforts to bring a spectrum of career-oriented activities to the members of Regions 7 through 10."

During his time as IEEE president, he continued to expand offerings in those regions by establishing conferences and award programs such as the Peru Section's Elektron Award. He received an IEEE Millennium Medal, which was awarded in 2000 to IEEE members for outstanding contributions to an IEEE field of interest.

Snyder received bachelor's and master's degrees in electrical engineering from the Polytechnic Institute of Brooklyn, in New York.

Carlos Becerra

FORMER CHAIR OF IEEE PERU SECTION
Member Grade: LIFE SENIOR MEMBER
Age: 65; *Died:* 20 MAY

Carlos Becerra, an active volunteer in the IEEE Peru Section, was technical manager of T. J. Castro, a Lima manufacturer of lighting fixtures, switchboards, and electrical distribution panels. After retiring, he became a consultant.

Becerra was vice chair of the IEEE Peru Section in 1987 and 1988 and chair in 1989. He was a founding member of the IEEE-sponsored Elektron Award committee. Presented every two years, the award is sponsored by IEEE and the Asociación Electrotécnica Peruana, a professional electrical engineering society. He was chairman of the committee in 2005 and 2007.

He received a degree in electrical and mechanical engineering in 1966 from Universidad Nacional de Ingeniería, in Lima.

ACHIEVEMENTS FROM TOP: GEORGIA TECH, UNIVERSITY OF SOUTHERN CALIFORNIA, INDIA CHAMBER OF COMMERCE; IN MEMORIAM FROM TOP: MCGILL UNIVERSITY, IEEE