

**QUANTUM DOTS:
CANCER KILLERS?**
Shining a light on
malignant tumors
P. 26

**THE FUTURE OF
THE SUPERCAR**
Acura's NSX shows
the way forward
P. 32

**THE DARK SIDE OF
LED STREETLIGHTS**
Losing sleep over
"ghostly" bluish lights
P. 44

**JACK KILBY'S
OTHER INVENTION**
After the IC,
a decade-long dream
P. 50



IEEE SPECTRUM

FOR THE TECHNOLOGY INSIDER | 10.16



BASH ME IF YOU CAN

**WILL ROBOTS
HELP END
THE CRISIS OF
CONCUSSIONS
IN AMERICAN
FOOTBALL?**
P. 38

38 THE HARD- KNOCKS BOT

Engineering students at Dartmouth College wanted to make tackling practice safer for American football players. So they invented a mobile robot to take the hits. **BY ELLIOT KASTNER**

26 Fighting Cancer With Quantum Dots

Tiny chunks of semiconducting material could help extend lives.
By Imad Naasani

32 Supercar 2.0

The Acura NSX combines electric and gasoline propulsion to do things never before possible.
By Lawrence Ulrich

44 The Early-Adopter Blues

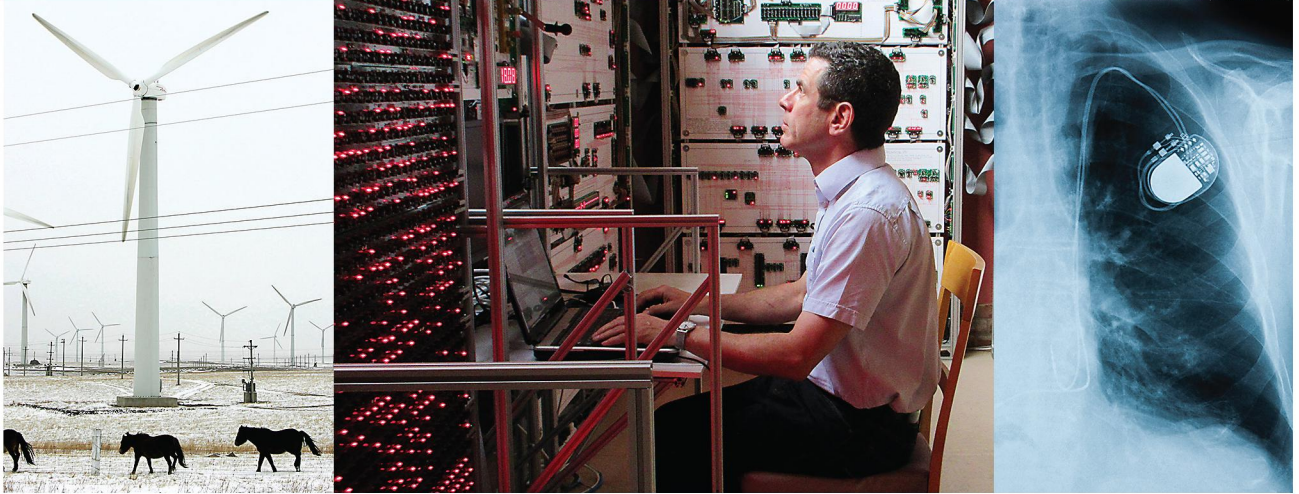
LED streetlights have riled residents and disturbed wildlife. Now, cities are taking a second look.
By Jeff Hecht

50 The Little-Known History of Jack Kilby's Misadventure in Solar Power

In his post-TI career, the coinventor of the integrated circuit toiled for years to bring solar energy to homes.
By Cyrus C.M. Mody



On the cover and above Photographs for IEEE Spectrum by Nathaniel Welch



09

News

Wind Battles Coal for Access to China's Grid

Coal interests oppose technologies and rules that would prevent the waste of pollution-free power.

By Peter Fairley

- 11 The Next High-Performance Transistor
- 12 The Internet of Fewer Things
- 14 Lidar for the Rest of Us
- 16 The Big Picture: Bot-Built Superstructure on Display

19

Resources

Integrated Circuits Are for Wimps

James Newman built his own CPU—out of 42,300 hand-soldered transistors.

By Stephen Cass

- 21 Careers: Finding and Retaining Minority Engineers
- 22 Hands On: A New Musical Instrument Is Born
- 72 Past Forward: Nuking Sandwiches, Circa 1946

08

Opinion

STEM Crisis? What About the STS Crisis?

Scientists and engineers bear responsibility for the technical futures they are creating.

By Susan Hassler

- 04 Back Story
- 06 Contributors
- 24 Numbers Don't Lie: The Successful Failure That Is Nuclear Energy
- 25 Technically Speaking: The Language of IoT

Online

Spectrum.ieee.org

Controversy Over Pacemaker Hack

A cybersecurity firm claims to have hacked cardiac devices made by St. Jude Medical to prove that they're riddled with vulnerabilities, and predicts that class-action lawsuits could cost the company US \$6.4 billion. But medical device security expert Kevin Fu says the evidence isn't strong. See his takedown at <http://spectrum.ieee.org/pacemaker1016>

ADDITIONAL RESOURCES

Tech Insider / Webinars

Available at spectrum.ieee.org/webinar

- ▶ Simulation of Planar Magnetic Components—Possible or Impossible?—4 October
- ▶ Simulation of RF Interference in Electronics—13 October
- ▶ **MASTER BOND RESOURCE LIBRARY**
<http://spectrum.ieee.org/static/master-bond-resource-library>
- ▶ **NEW PRODUCT RELEASE LIBRARY**
<http://spectrum.ieee.org/static/new-product-release-library>
- ▶ **WHITE PAPERS**
<http://spectrum.ieee.org/whitepapers>

The Institute

Available at theinstitute.ieee.org

- ▶ **SOCIAL ENGINEERING** Hackers don't always have to rely on their computer skills to break into a system—some simply ask victims the right questions to gather personal information. Researchers used this tactic to check for security vulnerabilities in one of the largest telecommunication companies in Croatia.
- ▶ **PROTECTING WHISTLEBLOWERS** When software engineers find a security flaw in a system or device, they shouldn't have to think twice about bringing it to the developer's attention. But they often face a legal dilemma.
- ▶ **FILLING A GAP** Many computer science students aren't being trained in cybersecurity. That's why IEEE Member Roy Wattanasin helped create a cybersecurity and policy program at Brandeis University, in Waltham, Mass.

IEEE SPECTRUM

(ISSN 0018-9235) is published monthly by The Institute of Electrical and Electronics Engineers, Inc. All rights reserved. © 2016 by The Institute of Electrical and Electronics Engineers, Inc., 3 Park Avenue, New York, NY 10016-5997, U.S.A. Volume No. 53, Issue No. 10, North American edition. The editorial content of IEEE Spectrum magazine does not represent official positions of the IEEE or its organizational units. Canadian Post International Publications Mail (Canadian Distribution) Sales Agreement No. 40013087. Return undeliverable Canadian addresses to: Circulation Department, IEEE Spectrum, Box 1051, Fort Erie, ON L2A 6C7. Cable address: ITRIPLLEE. Fax: +1 212 419 7570. INTERNET: spectrum@ieee.org. ANNUAL SUBSCRIPTIONS: IEEE Members: \$21.40 included in dues. Libraries/institutions: \$399. POSTMASTER: Please send address changes to IEEE Spectrum, c/o Coding Department, IEEE Service Center, 445 Hoes Lane, Box 1331, Piscataway, NJ 08855. Periodicals postage paid at New York, NY, and additional mailing offices. Canadian GST #125634188. Printed at 120 Donnelley Dr., Glasgow, KY 42141-1060, U.S.A. IEEE Spectrum circulation is audited by BPA Worldwide. IEEE Spectrum is a member of the Association of Business Information & Media Companies, the Association of Magazine Media, and Association Media & Publishing. IEEE prohibits discrimination, harassment, and bullying. For more information, visit <http://www.ieee.org/web/aboutus/whats/policies/p9-26.html>.