NEW TWISTS ON DNA • 100 YEARS AFTER THE WRIGHT BROTHERS

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SCIENTIFIC AMERICAN 50

A MICROSCOPE THAT CAN SEE objects smaller than an atom.

The first field test of a fleet of electric vehicles powered by fuel cells. A tariff to limit vehicular traffic in central London. These are but a few of the path-breaking developments that have taken place in recent months in laboratories, corporate suites and the halls of government. For the second year, the SCIENTIFIC AMERICAN 50 recognizes the singular accomplishments of those who have contributed to the advancement of technology in the realms of science, engineering, commerce and public policy. This year's selections by the Board of Editors pay tribute to individuals, teams and companies that have stood out in a wide variety of technological disciplines. It also honors Leaders of the Year for achievements in research, business and policy. Their work again demonstrates the ingenuity and resourcefulness that generate the ever more sophisticated tools and solutions for meeting society's needs.

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CHEMICALS & MATERIALS

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ECONOMIC DEVELOPMENT

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PRIVACY & SECURITY

PUBLIC HEALTH & EPIDEMIOLOGY

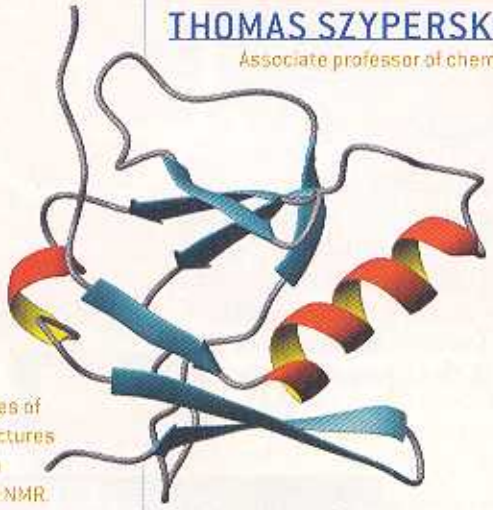
ROBOTICS

Other Research Leaders

Chemicals and Materials

THOMAS SZYPERSKI

Associate professor of chemistry and biochemistry, State University of New York, Buffalo



Quick pictures of protein structures emerge with streamlined NMR.

Adapted nuclear magnetic resonance techniques to map a protein's atomic structure in hours, not days.

NUCLEAR MAGNETIC RESONANCE (NMR) is a laboratory technique that uses magnetic fields and radio-frequency pulses to identify and locate the atoms in molecules. As a way to analyze proteins, NMR has always taken a backseat to x-ray crystallography and other methods because it is slow: picking out the connections between individual atoms in a large protein involves going through the results from thousands of radio-frequency spectra, which can take up to a week. But in January, Thomas Szyperski published a paper in the *Journal of the American Chemical Society* describing G-matrix Fourier Transform NMR, a new method to collect data gleaned from radio-frequency pulses. The process reduced the time for protein mapping from days to just hours. Szyperski is the inventor of this technique, which improves the way NMR data are analyzed.

Communications

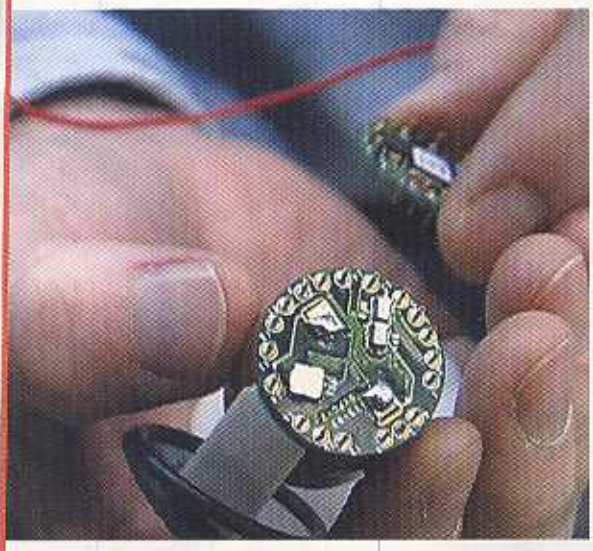
DAVID E. CULLER

Professor of computer science, University of California, Berkeley; former director of the Berkeley laboratory of Intel Research

Field-tested networks of sensors for military and environmental applications.

LAST YEAR David Culler and his colleagues began field-testing sensors that interconnect wirelessly in ad hoc networks that can describe their environment to a base station. Though dubbed "motes" by the Defense Advanced Research Projects Agency (DARPA), the sensors today are each still closer in size to a quarter than to a mote, and they cost several hundred dollars rather than small change. While reducing their size and cost, Culler and his group are trying out sample networks for tracking local stresses on the Golden Gate Bridge, the microenvironment in a redwood grove, the nesting areas of shorebirds and the rescue operations of firefighters. Because the information comes from many points, it can convey the dynamics of situations to firefighters who want, say, to determine whether a burning building is near collapse. And because the network is (or will be) cheap, it can be distributed through potential earthquake zones and battlefields, where the sensors can be consulted from a distance should the need arise.

Mini sensors can track light, temperature and humidity in a redwood grove.



Computing

ARMANDO FOX

Assistant professor of computer science, Stanford University

Showed how software could protect networks from disastrous crashes in individual servers.

COMPUTERS WILL always crash. For the average user, rebooting is a mere nuisance, but a network server crash can cost large businesses thousands of dollars. Armando Fox is a leader of a growing trend in the design of computer networks: the creation of systems designed to cope with inevitable failure. Fox and his team have developed a technique called micro-rebooting that allows the diverse software modules running on a computer at any given time to be restarted independently when a glitch is encountered. Thus, the entire suite of programs does not have to be shut down and restarted from scratch. Last year micro-rebooting was demonstrated successfully in a satellite ground station, the type of facility that often encounters failures [see "Self-Repairing Computers," by Armando Fox and David Patterson; SCIENTIFIC AMERICAN, June].

THOMAS SZYPERSKI (top); COURTESY OF UNIVERSITY OF CALIFORNIA, BERKELEY (bottom)