

June 2011

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## NSF AT WORK

### Mathematicians Advance Next Generation Auto Safety Systems

An algorithm developed by NSF-funded mathematicians has the potential to radically improve auto safety.

Today's automobiles use computer-controlled safety systems to stabilize vehicles in dangerous conditions, such as when skidding on ice. The safety system reads the vehicle's direction and speed and measures all four tire speeds. It applies braking and distributes torque differentially to each wheel, takes over the steering, and brings the car safely to rest. This safety technology uses sophisticated algorithms to apply controlling mechanisms based on sensor readings.

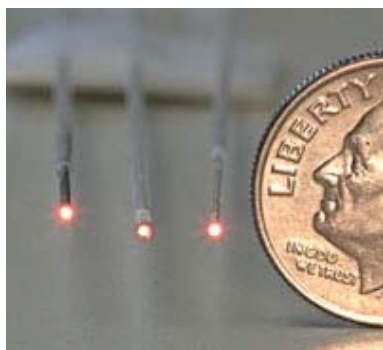


Credit: iStockPhoto.com

During a postdoctoral fellowship at the Institute for Mathematics and Its Applications, Dan Bates, now assistant professor of mathematics at Colorado State University, together with visiting scientists Ioannis Fotiou and Philipp Rostalski from the Swiss Federal Institute of Technology (ETH Zurich), came up with a breakthrough algorithm that improves upon current systems. Instead of devising a control law--a rule by which a system responds to sensor readings--they devised a computer algorithm that takes into account a succession of sensor readings to provide fast, optimal activation of vehicle control mechanisms. The advantage of this new algorithm is that it can bring a system under control faster and more efficiently than existing methods that only optimize for vehicle control.

This research was funded by award number **0439734**.

### New Nanotechnology Could Protect Emergency Responders From Toxins



Researchers from the University of California, San Diego and Tyco Electronics have developed, as described in the journal *Advanced Materials*, a carbon nanostructure that could operate as a sensor for filters in respirators. The sensor would alert emergency responders when the carbon filters in their respirators have become saturated to the point at which toxic fumes could be inhaled. The research team, led by Michael Sailor, professor of chemistry and biochemistry and bioengineering at UC San Diego, assembled nanofibers to form photonic crystals of repeating structures that reflect specific colors. The color of the sensors changes as the nanofibers absorb chemicals. Less than half the width of a human hair, the sensors

Porous microsensors on the ends of optical fibers detect organic toxins and pollutants. Credit: Brian H. King and Michael J. Sailor, University of California, San Diego

could be inserted into respirator cartridges and provide a visual indicator for when a filter needs to be changed.

The timing of filter changes is currently based on the length of time the respirator has been in use because it is difficult to accurately assess the effectiveness of a filter. As a result, emergency workers may inhale toxic chemicals while thinking that the filters in their respirators are still effective. "The new sensors would provide a

more accurate reading of how much material the carbon in the filters has actually absorbed," said Sailor.

Funding for this research was provided by NSF (award number **0806859**), the Department of Homeland Security, the Natural Sciences and Engineering Research Council of Canada, and Tyco Electronics.

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## New Writing Tablet Transforms More Than Liquid Crystals

**Kent Displays Incorporated** (KDI) has commercialized its liquid crystal display (LCD) technology in a new writing tablet. The Boogie Board™ LCD Writing Tablet uses KDI's Reflex™ No Power LCD technology for the tablet's writing surface. In January 2011, the Boogie Board tablet was launched and sold by a subsidiary, Improv Electronics, through an Internet sales website; within 20 minutes, the initial inventory sold out. Over the next several months, inventory was replenished numerous times and continued to sell out quickly, often within an hour.

KDI's first consumer technology was invented in the mid-1990s at the Liquid Crystal Institute at Kent State University in Ohio, with the support of an NSF Science and Technology Center grant funded through the Directorate for Mathematical and Physical Sciences (award number **8920147**). KDI has also been supported by Small Business Innovation Research grants from NSF (award numbers **0610809** and **0750379**). Years of research have now translated into global consumer sales ventures. The Reflex LCD in the Boogie Board tablet is produced in the United States on a specially designed roll-to-roll flexible display manufacturing line. The fact that this American-made electronic tablet is so popular overseas, particularly in Japan, China and other parts of Asia, warranted a special mention by President Obama during a visit to Cleveland in **February 2011**.



The Boogie Board™ writing tablet. Credit: Kent Displays, Inc.

The Boogie Board tablet is a paperless, electronic replacement for memo pads, sketchbooks, dry erase boards and other writing and drawing media, and the push of a button brings the tablet's user back to a blank slate. Due to its simple design, the tablet is also being used to teach younger children writing and math. KDI's technology also features no-power operation. As described in a recent interview with Albert Green, KDI's chief executive officer, "it only costs energy to switch the image on the display and not to keep the image on the display."

KDI says that the Boogie Board tablet is a less wasteful alternative to devices or media that require paper. The company is dedicated to promoting this new technology and a "greener" approach to writing and drawing.

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## DID YOU KNOW?

### Federally Funded R&D Center Expenditures Reach \$15.2 Billion in FY 2009

Federally funded research and development centers, or FFRDCs, are privately operated research and development (R&D) organizations that are exclusively or substantially financed by the federal government. These centers give the sponsoring federal agencies the ability to meet special long-term R&D needs that cannot be met by existing in-house or contractor resources.

The 39 FFRDCs in the United States spent \$15.2 billion on R&D in FY 2009, according to NSF's Survey of Research and Development Expenditures at FFRDCs. This represents a 3.5 percent increase over such spending in FY 2008. The annual increase in FFRDC R&D expenditures has outpaced the general rate of inflation in the economy for the past 3 years.

The majority of the expenditures (97.1 percent) were funded by the federal government. The remainder came from a mix of other sources, such as state and local government, industry and FFRDC discretionary funds.

More information on this topic can be found in NSF's National Center for Science and Engineering Statistics **InfoBrief**.

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## FACES OF NSF RESEARCH

### NSB and NSF Recognize Extraordinary Science, Service With Annual Awards



Pictured from left to right: NSB Chairman Ray Bowen, NSF Waterman Awardee Casey Dunn, NSF Public Service Awardee Moira Gunn, NSF Director Subra Suresh, NSB Vannevar Bush Awardee Charles Vest and NSB Group Public Service Awardee Dennis Bartels accepting for the Exploratorium. Credit: Sandy Schaeffer for NSF

In May, the National Science Foundation (NSF) and the National Science Board (NSB) paid tribute to the achievements and public service contributions of three outstanding scientists and one innovative organization at a black-tie awards ceremony in Washington, D.C.

Charles Vest, president of the **National Academy of Engineering**, received NSB's 2011 Vannevar Bush Award for distinguished public service leadership in science and technology. The Vannevar Bush Award is presented annually to an individual who, through public service activities in science and technology, has made an outstanding "contribution toward the welfare of mankind and the nation."

NSB also presented two Public Service Awards, one to an individual, and one to a group. These awards honor substantial contributions to the public understanding of science and engineering in the United States.

NSB's Public Service Award for an individual was given to Moira Gunn, the founder and host of the public radio programs **Tech Nation** and BioTech Nation. Tech Nation is heard weekly on National Public Radio and is syndicated on more than 200 domestic, public radio stations. It also is

heard three times weekly in 177 nations with international syndication via American Forces Radio.

NSB's Public Service Award for an organization went to the San Francisco-based **Exploratorium**, a hands-on learning museum that hosts more than 90,000 students and teachers on field trips each year, and another 3,500 students from San Francisco's underserved neighborhoods. Dennis Bartels, the Exploratorium's executive director, accepted the award on behalf of the museum.

NSF presented the Alan T. Waterman Award to **Casey Dunn**, a Brown University comparative biologist. His work involves understanding relationships between groups of animals, specifically using genome analyses to investigate how evolution produces life's variety. The Waterman Award recognizes a researcher under the age of 35 in any field of science or engineering supported by NSF.

Read more about the awards ceremony **online**.

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## NSF IN THE NEWS

**A System to Speed Up Forecasting Tornadoes** (*The New York Times*) The Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) is a collaboration between universities in Colorado, Oklahoma, Massachusetts and Puerto Rico. CASA is an NSF-supported research center testing a new approach to weather prediction, and aiming to reduce deaths due to tornadoes and flash flooding.

**Forecast for Processing and Storing Ever-Expanding Science Data: Cloudy** (*Scientific American*) Microsoft and NSF supported 13 research projects planning to use or study cloud computing services.



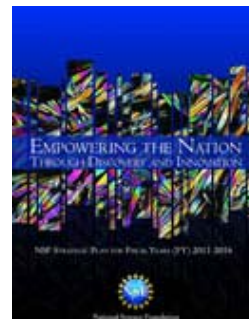
**Science, Art Combine to Reproduce Paintings From the Past** (*Reuters*) Using laser and nanotechnology, scientists in Chicago have been able to go back in time and uncover how masterpieces from artists like Homer and Van Gogh might have looked like when they were first painted.

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## THE RIPPLE EFFECT

### NSF Releases New Strategic Plan

NSF released a strategic plan to guide the agency's priorities and investments for the next five years. The new plan, titled *Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years 2011-2016* outlines three strategic goals that underpin all programs and activities during both the short term and over the long term: transform the frontiers, innovate for society, and perform as a model organization. The first two goals align with the two merit criteria that NSF applies in evaluating every research proposal the agency receives--intellectual merit and broader impacts. The third strategic goal emphasizes the importance of operational excellence to achieving NSF's vision, and it encourages experimentation in business processes in order to make the agency more efficient and effective. The plan sets performance targets to measure progress in achieving the strategic goals, and it lays out near-, mid- and long-term actions for the agency to take.



Credit: NSF

For further information and to review the 2011-2016 NSF Strategic Plan, *Empowering the Nation through Discovery and Innovation*, please visit the [NSF website](#).



Director Subra Suresh at an April 14 roundtable talk at Iowa State University. Credit: NSF

### NSF Director Begins Series of Nationwide Roundtable Talks

In April, NSF Director Subra Suresh traveled to Iowa for a two-day visit to meet with key NSF stakeholders. In meetings held at Iowa State University, Suresh met with researchers, educators, and industry and agriculture representatives, and led a series of roundtable talks on topics such as small business and science education. These talks aim to foster discussion and feedback on NSF activities, and encourage open communication between the director and the agency's partners in the research and education community.

The Iowa visit is the first of the director's Discovering Through Dialogue Tour, and additional visits will be scheduled nationwide.

### Washington Post Live Chats Feature NSF Experts

The *Washington Post* website features live question and answer sessions on a range of newsworthy topics. Recently, three NSF program managers hosted chats on scientific aspects of important current events: **James Whitcomb (aftershocks in Japan)**, **Bradley Smull (tornadoes)** and **Peter Vishton (maternal influence/Mother's Day)**. Each NSF-hosted chat drew more than 3,000 viewers during the live broadcasts, and the archived chats on [washingtonpost.com](#) continue to attract more viewers. Additional NSF-hosted chats will be proposed for future events.



*The National Science Foundation (NSF) is an independent federal agency that supports fundamental research and education across all fields of science and engineering. In fiscal year 2010, its budget is \$6.9 billion. NSF funds reach all 50 states through grants to over 1,900 universities and institutions. Each year, NSF receives about 48,000 competitive requests for funding, and makes over 11,300 new funding awards. NSF also awards over \$400 million in professional and service contracts yearly. Contact **NSF's Office of Legislative and Public Affairs** for more information or for permission to reuse newsletter images. Editor: Nicole J. Garbarini. Contributors: Kim Clark, Jackie Conciatore, Derika Fallings, Christine Hamel, Bobbie Mixon, Dana Wilson, Deborah Wing.*

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