



engineering laboratory

Newsletter • December 2010

Mission: To promote U.S. innovation and industrial competitiveness in areas of critical national priority by anticipating and meeting the measurement science and standards needs for technology-intensive manufacturing and construction in ways that enhance economic prosperity and improve the quality of life.

Vision: To be the source for creating critical solution-enabling measurement science, and critical technical contributions underpinning emerging standards, codes, and regulations that are used by the U.S. manufacturing and construction industries to strengthen leadership in domestic and international markets.

NIST Realignment

After 20 years with its research components aligned largely by scientific disciplines, the National Institute of Standards and Technology (NIST) has realigned its laboratories according to a mission-based structure, effective October 1, 2010. The realignment does not change the focus of NIST programs, but aims to make NIST more effective in delivering its products and services to its customers. This restructuring is occurring during a period of growth for NIST.

The realigned structure reduces the number of laboratories from ten to six. The new structure includes: two metrology laboratories—the Material Measurement Laboratory and Physical Measurement Laboratory; two technology laboratories—the Engineering Laboratory and Information Technology Laboratory; and two user facilities—the Center for Nanoscale Science and Technology and the NIST Center for Neutron Research.

NIST's Building and Fire Research Laboratory has been combined with the majority of NIST's Manufacturing Engineering Laboratory to form the new NIST Engineering Laboratory with NIST-wide mission responsibilities for:

- Fire Prevention and Control
- National Earthquake Hazards Reduction Program
- National Windstorm Impact Reduction Program
- National Construction Safety Teams
- Manufacturing Enterprise Integration
- Collaborative Manufacturing Research Pilot Grants Program
- Manufacturing Fellowship Program

We encourage you to visit our website for more information on ongoing activities in the new Laboratory. <http://www.nist.gov/el/>

Sincerely,
Dr. S. Shyam Sunder
Director, NIST Engineering Laboratory



NIST WTC Recommendations Are Basis for New Set of Revised Codes

Faster and more efficient evacuations from buildings—especially tall structures—and better communications between first responders during an emergency are among the safety improvements expected from 17 major and far-reaching building and fire code changes approved recently by the International Code Council (ICC) based on recommendations from NIST. The recommendations were based on NIST's investigation of the collapses of New York City's World Trade Center (WTC) towers and WTC 7 on Sept. 11, 2001.

The new changes, adopted at the ICC hearings held May 15-23, 2010, in Dallas, Texas, will be incorporated into the 2012 edition of the ICC's I-Codes (specifically the International Building Code, or IBC, and the International Fire Code, or IFC), a state-of-the-art model code used as the basis for building and fire regulations promulgated and enforced by U.S. state and local jurisdictions. Those jurisdictions have the option of incorporating some or all of the code's provisions but generally adopt most provisions.

The newly adopted code changes are the second set adopted in the past two years by the ICC based on recommendations from the NIST WTC investigation. Twenty-three changes were approved in October 2008 and incorporated into the 2009 edition of the I-Codes.

Study on Charleston Furniture Store Fire Calls for National Safety Improvements

Major factors contributing to a rapid spread of fire at the Sofa Super Store in Charleston, S.C., on June 18, 2007, included large open spaces with furniture providing high fuel loads, the inward rush of air following the breaking of windows and a lack of sprinklers, according to a draft report released for public comment October 28, 2010 by NIST. The fire trapped and killed nine firefighters, the highest number of firefighter fatalities in a single event since 9/11.

Based on its findings, the NIST technical study team made 11 recommendations for enhancing

building, occupant and firefighter safety nationwide. In particular, the team urged state and local communities to adopt and strictly adhere to current national model building and fire safety codes. If today's model codes had been in place and rigorously followed in Charleston in 2007, the study authors said, the conditions that led to the rapid fire spread in the Sofa Super Store probably would have been prevented.

For more information and links to the draft reports, see the full press release. www.nist.gov/el/fire_research/charleston_102810.cfm.



Within 36 hours of the fire, a team of fire experts was on site of a fire that occurred in the Sofa Super Store in Charleston, S.C. As a result of the fire, nine fire fighters died within the retail showrooms which were part of the 4,600 m² (49,000 ft²) structure. The team was there to document the scene and gather data, in order to allow the fire spread to be simulated using computer fire models. (Photo Credit: NIST)

International Standards Workshop

The NIST International Standards Workshop was held on June 29 and 30, 2009 to identify opportunities for standards development organizations and U.S. industry to optimize their global competitiveness through standards, codes, and practices. For the first time, researchers, practitioners and standards development organizations from across industries – fire protection, building energy, building materials, structural safety and performance, and construction – were brought to the table to compare and contrast perspectives. This two-day workshop engaged leaders from key U.S. building and fire safety standards and codes organizations (and the industries that rely on them) to: 1) gain a clear understanding of their high-level approaches to international engagement; and, 2) identify their needs for technical assistance support that fit within the NIST mission.

A total of 54 participants from 36 different organizations attended. The participant mix was intentionally designed, after consulting with technical experts in the relevant fields, to bring a representative cross-section of industry leaders to the discussion. Workshop attendees identified several priority technical needs with high potential for producing rapid changes in new technologies that could advance industry effectiveness, efficiency, and competitiveness internationally, including: 1) an online standards clearinghouse, 2) Building Information Modeling (BIM) standards, 3) communication, outreach and education, and 4) global best practices.

A key outcome of this workshop was a realization of the benefit of meeting as a cross-disciplinary community of building and construction professionals spanning academia, government, and industry to gain insight from different sectors sharing similar frustrations, needs, and stories. The sectors working separately identified overlapping needs and envisioned similar solutions—most notably the need to address lost opportunity, redundant efforts, and real barriers from disaggregated, uncoordinated data and lack of knowledge-sharing across sectors—which speaks to the broad-based nature of the issues uncovered during the workshop.

Workshop participants agreed that NIST should help drive this enhanced collaborative process. A key part of this process would be a neutral, federated repository of data, where stakeholders could find titles and abstracts of up-to-date standards and meaningful background information on an international level.

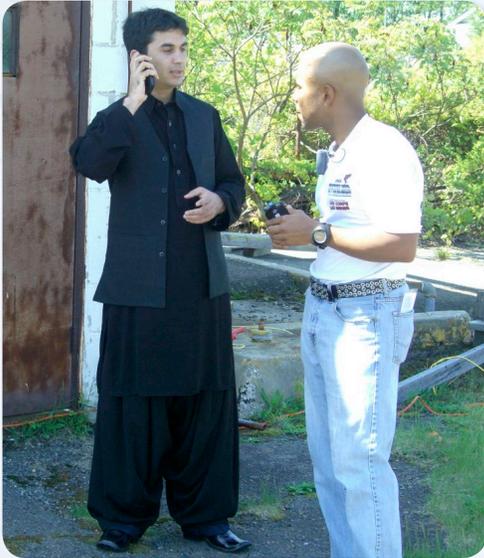
A report reflecting the collective output of the workshop attendees is available: www.nist.gov/customcf/get_pdf.cfm?pub_id=907307.

Actions appropriate for NIST to take include:

- Implementing and managing an online standards clearinghouse, including a federated Database
- Identifying priority topics, venues where standards development is occurring, where standards are needed, and covering both national and international venues
- Integrating regulator needs at both the state/local level and federal level, linking in with GSA and DOD, who have significant building portfolios that they manage
- Transitioning key research findings into standards and codes

NIST Tests Language Translation Devices

For the past four years, scientists at NIST have been conducting detailed performance evaluations of speech translation systems for the Defense Advanced Research Projects Agency (DARPA). Previous systems used microphones and portable computers. In the most recent tests, the NIST team evaluated three



A U.S. Marine and a native Pashto speaker converse using a smart phone voice translation system as part of an evaluation of the technology recently conducted by NIST for the Defense Department. (Photo Credit: NIST)

two-way, real-time, voice-translation devices designed to improve communications between the U.S. military and non-English speakers in foreign countries.

Traditionally, the military has relied on human translators for communicating with non-English speakers in foreign countries, but the job is dangerous and skilled translators often are in short supply. And, sometimes, translators may have ulterior motives, according to NIST's Brian Weiss. The DARPA project, called TRANSTAC (spoken language communication and TRANslation system for TACTical use), aims to provide a technology-based solution. Currently, the focus is on Pashto, a native Afghani tongue, but NIST has also assessed machine translation systems for Dari—also spoken in Afghanistan—and Iraqi Arabic. All new TRANSTAC systems all work much the same way, says project manager Craig Schlenoff. An English speaker talks into the phone. Automatic speech recognition distinguishes what is said and generates a text file that software translates to the

target language. Text-to-speech technology converts the resulting text file into an oral response in the foreign language. This process is reversed for the foreign language speaker. NIST researchers held focus groups with U.S. military personnel who have served overseas to determine critical communication interactions to simulate and evaluate in tests. Each scenario was performed using the three industry-developed translation devices. For each test, on-site judges observed the scenarios, and the participating Marines and Pashto speakers were surveyed about the ease of interaction with the systems. Later, a separate panel of judges fluent in English and Pashto viewed videos of the exercise and evaluated each of the three systems in terms how accurately concepts were communicated in both languages, Schlenoff says. A detailed assessment of the evaluation will be written for DARPA so they will be able to make an informed decision about where to direct funds and efforts in the TRANSTAC project.

New NIST 'Standard Cigarette' Available for Fire-Resistance Testing

NIST SRM 1196, "Standard Cigarette for Ignition Resistance Testing," consists of 10 packs of uniform cigarettes designed to be placed on a mattress, a piece of upholstered furniture or furniture components to verify if these items have been manufactured to meet mandatory and voluntary federal, state and/or industry guidelines for



resistance to ignition by burning cigarettes.

The cigarettes were developed by NIST in conjunction with the U.S. Consumer Product Safety Commission (CPSC) to replace the commercial cigarettes that had been used for 30 years of home furnishings testing but are no longer in production.

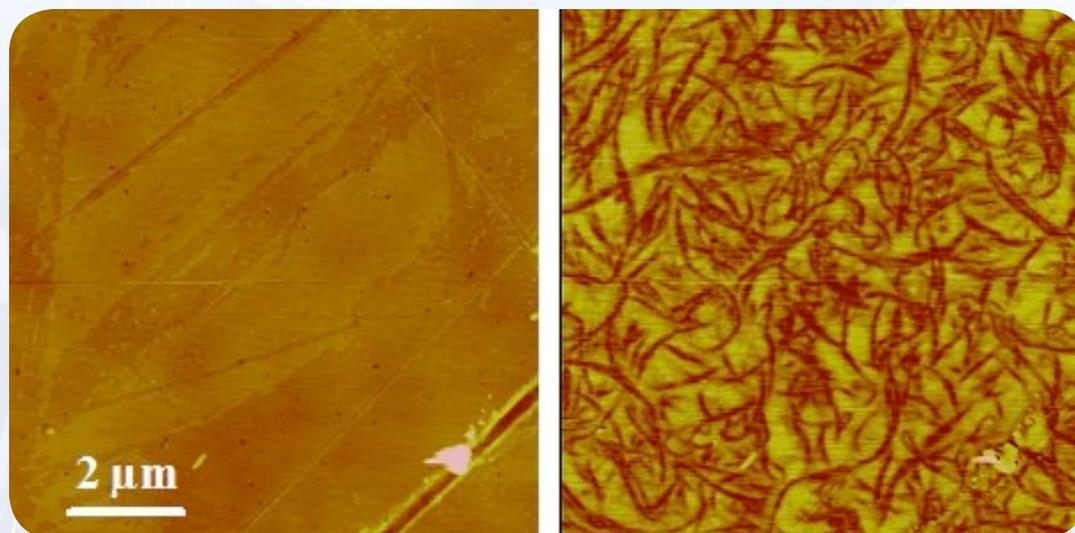
For more information on SRM 1196, including purchase data, see www.nist.gov/srm/.

Depth Charge: Using Atomic Force Microscopy to Study Subsurface Structures

Over the past couple of decades, atomic force microscopy (AFM) has emerged as a powerful tool for imaging surfaces at astonishing resolutions—fractions of a nanometer in some cases. But suppose you're more concerned with what lies below the surface? Researchers at NIST have shown that under the right circumstances, surface science instruments such as the AFM can deliver valuable data about sub-surface conditions.

NIST researchers are studying advanced materials that mix carbon nanotubes in a polymer base for a wide variety of high-performance applications because of the unique properties, such as superior strength and electrical conductance, added by the nanotubes. The material chosen by the research team as their test case, for example, is being studied by NASA for use in spacecraft actuators because it may outperform the heavier ceramics now used. The team used an AFM designed to use the stronger, longer-range electrostatic force (technically an EFM), measuring the interaction between the probe tip and a charged plate beneath the composite sample.

The team used a specially designed probe tip and a patented, NIST-designed AFM humidity chamber. "We are still optimizing this EFM technique for subsurface imaging," says NIST materials scientist Minhua Zhao. "If the depth of nanostructures located from the film surface can be determined quantitatively, this technique will be a powerful tool for nondestructive subsurface imaging of high dielectric nanostructures in a low dielectric matrix, with a broad range of applications in nanotechnology."



Electric force microscopy can be used to detail structures well below the surface. Left, AFM height image showing the surface of a polyimide/carbon nanotube composite. Right, EFM image revealing the curved lines of subsurface nanotubes.

(Photo Credit: NIST)

EL Researcher Wins Presidential Award for Green Innovation



Barbara Lippiatt is one of eight winners of the 2010 GreenGov Presidential Awards given to workers or teams across the federal government. Presented on October 7, 2010, by the White House Council on Environmental Quality (CEQ), a “Green Innovation Award” was given to Lippiatt for her work on a software tool that measures the environmental performance of building materials and biologically based products.

The GreenGov Presidential Awards celebrate extraordinary achievement in the pursuit of the Presidential Executive Order on Federal Leadership in Environmental, Energy and Economic Performance (Executive Order 13514).

The eight winners were selected from more than 300 nominations.

Lippiatt was recognized for developing the Building for Environmental and Economic Sustainability (BEES) Program. This software tool measures environmental performance in building materials by making a life cycle assessment from manufacturing through product use, maintenance, and disposal. According to the White House award citation, “Her vision has resulted in a practical tool for sustainability performance measurement that is unbiased, science-based, quantitative, transparent, and comprehensive.”

Construction of New Research Facilities

Net Zero Energy Residential Test Facility is a residence that will produce as much energy from renewable resources as it consumes on an annual basis. This facility will demonstrate that a residence can be energy self-sufficient, net-zero, on an annual basis. This research facility will also provide a test bed to develop measurement systems and protocols to measure the performance of the residence and associated equipment under actual (rather than laboratory) conditions leading to improved laboratory test procedures. It will also provide data to validate/improve computer tools used to predict energy performance.

National Structural Fire Resistance Laboratory (NSFRL) will provide a unique capability for testing real scale elements, subassemblies, and structural systems under realistic fire conditions. The facility, which is being constructed as an addition to the existing Large Fire Laboratory, will be capable of testing structures up to 9 m high and 18 m by 27 m in area. Service loads will be applied using hydraulic actuators. The facility will be capable of testing structures under fire exposures up to 20 MW. The facility will enable experimental validation of analytical models that will be used to provide the technical basis for codes and standards.

Robotics Test Facility (RTF) will house and support NIST’s work to develop performance metrics and standards that advance innovation and performance improvement in robots used for applications such as search and rescue, and homeland and national defense. The RTF will include a large high-bay test space, tool and fabrication areas, and support spaces for robot development, fabrication, and testing.

Microrobotics Challenge Seeks Miniature Medics and Maze Masters

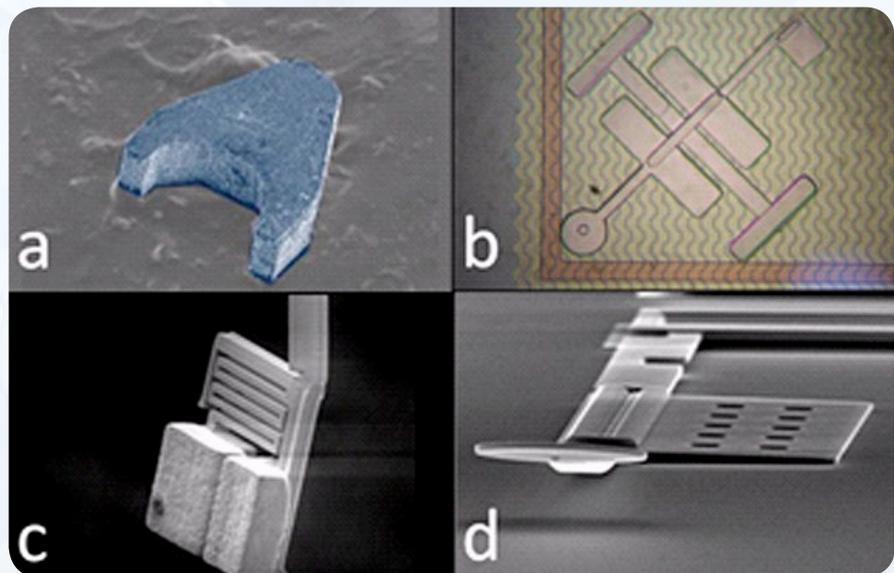
The National Institute of Standards and Technology (NIST), in collaboration with IEEE, is inviting teams currently engaged in microrobotic, microelectronic or microelectromechanical systems (MEMS) research to participate in the NIST Mobile Microrobotics Challenge 2011. The competition will be held as part of the IEEE International Conference on Robotics and Automation, May 9-13, 2011, in Shanghai, China.

The Mobile Microrobotics Challenge 2011 will pit tiny robotic contestants against each other in two events: a mobility challenge in which micro-robots will be required to navigate a planar (two-dimensional) maze having the diameter of a pin head; and a microassembly challenge where the competitors must put together multiple microscale components in a narrow channel to simulate operations within a blood vessel by a future medical applications microbot.

These events are designed to “road test” agility, maneuverability, response to computer control and the ability to move objects—all skills that future industrial robots will need for tasks such as microsurgery within the human body or the manufacture of microscopic electronic devices.

NIST’s goal in coordinating competitions between the world’s smallest robots is to show the feasibility and accessibility of technologies for fabricating MEMS, which are tiny mechanical devices built onto semiconductor chips. The contests also drive innovation in this new field of robotics by inspiring young scientists and engineers to become involved.

See our website for more information: www.nist.gov/el/isd/20101026_microbot.cfm.



Microrobots from past competitions: a) hard magnet (Carnegie Mellon), b) polymer-based electrostatic (Simon Fraser), c) resonant electromagnetic (ETH Zurich), and d) electrostatic (US Naval Academy)

EL Hires Two New Managers

Eric Letvin recently joined the Engineering Laboratory as the Director of the new Disaster and Failure Studies Program. This program supports NIST's mission under the National Construction Safety Team Act (2002) and other NIST authorities.

As Director of the Disaster and Failure Studies Program, Eric will provide national coordination for the conduct of field data collection studies. He also will be responsible for creating and maintaining a database repository related to hazard events (earthquakes, hurricanes, tornadoes, windstorms, community-scale fires in the wildland-urban interface, structural fires, storm surge, flood, tsunami) and human-made hazards (accidental, criminal, or terrorist), the performance of the built environment during hazard events, associated emergency response and evacuation procedures, and the technical, social and economic factors that affect pre-disaster mitigation activities and post-disaster response efforts. Further, he will be responsible for providing national coordination and promoting the implementation of recommendations from disaster and failure studies both to improve codes, standards, and practices and to fill gaps in current knowledge about buildings, infrastructure, emergency response, and human behavior.

Before coming to NIST, Eric was Leader of Infrastructure Research and Resiliency in the Homeland Security Group of URS, an engineering consulting firm, at its offices in Linthicum, MD. Prior to joining URS, Eric spent eight years with Greenhorne

& O'Mara managing the extremely high visibility and technically complex contract with FEMA to produce the World Trade Center Building Performance Study, which became the starting point for the NIST technical investigation into the collapse of the WTC buildings. His vast experience also includes mitigation assessment studies following hurricanes Katrina and Ike, and the Oklahoma City bombing.

Eric has bachelor's and master's degrees in engineering and a JD. He is a member of the Maryland Bar.

Nancy McNabb recently joined the Engineering Laboratory as the Manager for Building and Fire Codes and Standards. This is a new position which will greatly strengthen NIST's interactions with U.S. model building and fire codes development organizations and with U.S. and international standards development organizations.

As Manager of Building and Fire Codes and Standards, Nancy will develop and implement a NIST-wide strategy, including needed supporting research, to provide the technical basis resulting in improvements to U.S. model building and fire codes and standards, as well as relevant international standards, to support our strategic goals in areas of critical national need such as sustainability and energy efficiency, and safety and security.

An integral part of Nancy's responsibilities will be to develop, implement, and maintain strategic partnerships and strong working relationships with national and international building and fire standards and

codes development organizations in areas underpinning our strategic goals. She also will provide advice on actions required to strengthen the impact of results from the Laboratory's Building and Fire Research programs on U.S. and international codes and standards. She will be a resource to Laboratory staff in strengthen the impact of their work via standards and codes.

Nancy comes to NIST from the Washington, D.C., office of the National Fire Protection Association (NFPA) where she led successful efforts at the Federal level to alter the public discourse on more ignition resistant cigarettes, DHS grants to fire fighters, and wildland/urban-interface hazards. After first joining the New York State Division of Codes in 1990, where, among other assignments, she worked with the Governor's Office of Regulatory Reform to bring authorship and custodial responsibilities for the New York State Uniform Fire Prevention and Building Code to the Department, she worked with BOCA International and the International Code Council (ICC) in Texas, providing services throughout the southwest including conducting training and seminars on the interpretation and application of the BOCA National and ICC International Codes and acting as a liaison to the construction community on a national basis.

Nancy is a registered architect in New York and Pennsylvania with a bachelor's degree in Architecture and Masters Degree in Architecture in Structures.

Recent Publications

- Simplified progressive collapse simulation of RC frame-wall structures
- Lessons Learned in Evaluating DARPA Advanced Military Technologies
- Degradation and Nanofiller Release of Polymer Nanocomposites Exposed to UV
- Towards Information Networks to Support Composable Manufacturing
- Using Finite Element Analysis to Design a New Guarded Hot Plate Apparatus for Measuring the Thermal Conductivity of Insulating Materials
- High Throughput Techniques for Fire Retardant Materials Development
- Feasibility of an Accurate Dynamic Standard for Water Flow
- Infiltration of Outdoor Ultrafine Particles into a Test House
- The Helium Ion Microscope: A New Tool for Nanotechnology and Nanomanufacturing

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For more information about EL, please visit our website at www.nist.gov/el/

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