



ISN News

INSTITUTE FOR SOLDIER NANOTECHNOLOGIES

Enhancing Soldier Survivability

ISN Adds New Industry Partners

In May 2004, the ISN announced the addition of two new industrial partners. Zyvex Corporation joined as a Small Business Industrial Member, and Mine Safety Appliances Company joined as an Interested Industrial Participant. The purpose of the industrial partners is to transition promising results of ISN basic research into practical products that can be produced affordably in large quantities for Soldiers.



Dr. Bill Peters, ISN executive director (left), chats with industry representatives at the last ISN Industry Day.

With Consortium members now numbering twelve, Prof. Ned Thomas, ISN director, says he is pleased with the early development of the ISN's industry partnerships. "We've got a really good mix of companies representing a wide array of valuable core competencies," he says. "I think these partnerships are going to be increasingly important as our research matures."

Both companies attended the ISN's second Industry Day in March 2004, an event designed to provide companies interested in collaboration a snapshot of ISN research and partnership. After Industry Day, companies wishing to join as Major Industrial Members or Small Business Industrial Members submitted a prospectus outlining their vision for protecting the Soldier through nanotechnology, the company's core competencies relevant to that vision, and the proposed level of cost-sharing they would provide to leverage Army funding.

Zyvex Corporation, which submitted a successful prospectus for Small Business Industrial Membership, collaborates with the ISN in nanomaterial characterization and testing, carbon nanotube composites, and

microsystem assembly. Located in Richardson, Texas, Zyvex is the leading company in developing commercial applications of nanotechnology. They provide nanotechnology solutions for real-world applications with a growing product portfolio—comprised of tools, materials, and structures. Their products meet the needs of customers with applications ranging from research and development to high-volume production.

Mine Safety Appliances Company, which joined as an Interested Industrial Participant by making an annual gift of \$25,000 to the ISN, is a Pittsburgh-based manufacturer of protective equipment, including respirators, military gas masks, combat helmets, ballistic body armor, handheld gas detectors, and safety equipment for heights and confined spaces. They currently supply eyewear and gas masks, among other equipment, for Soldiers.

If your company is interested in becoming an ISN industry partner, please email us at isn@mit.edu.



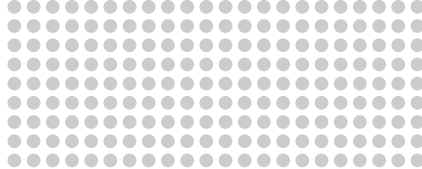
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Massachusetts Institute of Technology

September 2004



Dr. Catherine Byrne

ISN Appoints Laboratory Manager

In June, the ISN welcomed Dr. Catherine Byrne to the headquarters staff. Formerly with the Army Research Laboratory in Watertown, Massachusetts, and more recently Science Research Laboratory, Inc., in Somerville, Massachusetts, Dr. Byrne serves as Laboratory Manager, overseeing the day-to-day operation of the laboratory facilities, including equipment, safety, and training. She holds a BS in chemistry from Manhattanville College, an MAT in the teaching of science from Wesleyan University, and a PhD in organic polymer chemistry from the University of Connecticut.

She also did Postdoctoral Research in the Department of Polymer Science and Engineering at the University of Massachusetts Amherst. She has taught general and polymer chemistry at the high school and college levels.

Soldier Design Competition

The ISN kicks off the second annual Soldier Design Competition on September 16. Participants will compete for \$11,000 in prize money (from non-Army funds) while applying their engineering skill and creativity to the real problems of modern Soldiers. This year's Competition features six new design challenges originating from problems submitted by the Army, as well as an open design category. In addition to any member of the MIT community, cadets from the U.S. Military Academy have been invited to participate. This year's Competition is sponsored by Raytheon Company and by Boeing Company.

ISN Issues New Coin

In September the ISN will issue a new commemorative coin, replacing the original ISN coin issued to mark the opening of its new facilities in 2003. The back of the new coin, shown on the left side of the photo below, offers a conceptual illustration of the ISN's mission to use nanotechnology to dramatically improve the survivability of Soldiers. A carbon nanotube is shown spiraling up to the Future Warrior. Thanks go to ISN graduate student Young-Su Lee, Dr. Wayne Marsh of DuPont, and the Natick Soldier Systems Center for their contributions to the artwork for the coin.



Update on Applied Research Projects

The ISN is pleased to announce the award of four 6.2 applied research projects to its industry partner companies for fiscal year 2004. They are as follows:

Project 5.8: **Novel Protective Membranes for the Soldier**
DuPont Company

Project 3.14: **Fluorescent Sensor for Sensitive and Selective Detection of Chemical Threats to the Soldier**
Nomadics, Inc.

Project 3.15: **Nano-Based VisNIR FPA and Display Components**
Raytheon Company

Project 1.12: **Energy Absorbing Materials**
Triton Systems, Inc.

Squad Communication in Action

BY FORREST LIAU '06

After winning second place at the first annual Soldier Design Competition (SDC), Surreptiles team leader Forrest Liau visited the Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana, to observe how Soldiers use hand signals to communicate on the battlefield. Liau's team developed a system to interpret Soldiers' hand-and-arm signals and transmit the command data wirelessly to other Soldiers in the same squad. A receiving Soldier hears the issued command based on his own frame of reference.

After the SDC, my team (Surreptiles, now known as RallyPoint) had to decide what to do with our work. The easiest choice would have been to leave the project as is, and continue on with our academic lives. Yet, seeing that we had something special at hand, we agreed to continue pursuing our potentially life-saving technology.

Most of our “combat experience” came from watching documentaries, reading magazine articles, analyzing movies, playing paintball and computer games, and talking to our Army mentors. To be sure that we were heading in the right direction, I wanted to observe a field training exercise to see how modern American Soldiers communicate and fight in hostile environments.

Thanks to individuals at Fort Polk, I was able to stay on the field for a few days with the standing Opposing Forces (OPFOR) Infantry unit. With the motto, “give ‘em their worst fight ever,” the OPFOR continuously engaged the training Blue Forces (BLUEFOR) with guerilla and terrorist tactics to help them prepare for the worst condition that humans can inflict on fellow humans—war.

Through the experience, I had the opportunity to witness excellent military leadership. The exercise also allowed me to gain insight on joint full spectrum operations. Most importantly, I got to see squad communication in

action. Hand-and-arm signals seemed to work well as BLUEFOR fire teams maneuvered through the woods towards their objective. But as some Soldier teams entered the combat zone, they began resorting to, as one Soldier describes it, “a whole lot of shouting,” which I could hear from a good distance away.

The urban setting encouraged fire teams to take unconventional formations to ensure good all-around security. To make a directional reference, Soldiers needed to get the team's attention first by hissing, snapping, or patting themselves, after which the Soldiers could point towards the intended direction. Such communication was especially challenging when Soldiers were busy covering their respective fire sectors or visually separated by cover/concealment.

I also saw that vehicle-top gunners contributed significantly to the situational awareness of nearby troops. Often would a gunner yell and wave to get the troops' attention, and then point at a direction of interest. Being at an elevated position, the gunners had better views of the situation. This and other valuable new knowledge will help my team design a better communication system for our Soldiers.



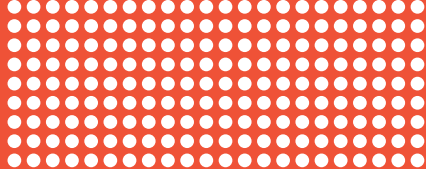
Photo by Jim Walker/Cambridge Chronicle

MIT junior Forrest Liau demonstrates the sensor-embedded glove his team invented to help Soldiers communicate. Liau is majoring materials science and engineering.

Improving Soldier team reaction time by cutting communication lag and reducing mental burden would undoubtedly help Infantry Soldiers' survivability and effectiveness on the field. RallyPoint is committed to making a difference for the brave Soldiers, homeland defenders, and law enforcement officers who risk their lives for public safety. We are grateful for having had the opportunity to get in touch with those we are working hard to protect.

*Liau's team has founded a company called **RallyPoint** to further develop and commercialize their invention. For more information, contact [<info@GestureCommunication.com>](mailto:info@GestureCommunication.com).*

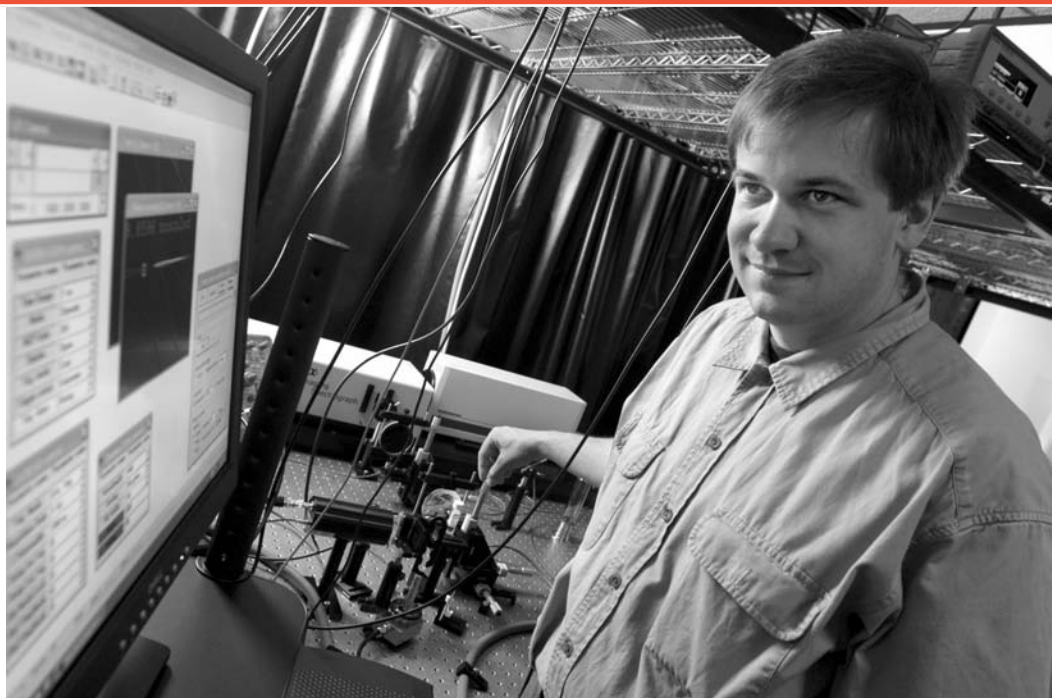




Laser table delivery.



Dr. Steve Kooi, ISN research engineer, with the wavelength-tunable laser system.



Laser Lab Comes to Life

The ISN completed its state-of-the-art laser facility earlier this year, and testing and characterization experiments are now underway in the lab. The process began in late January when four research-grade vibrationally damped optical tables were delivered by crane through a window on the fifth floor. Half the lab is dedicated to a wavelength-tunable femtosecond pulsed laser system, currently being used to

perform fluorescence and excited-state lifetime measurements on a variety of novel nanoscale materials. A high-power ultrashort pulse laser system occupies the other half of the lab, and is currently being used to test materials' response to a laser-induced shock wave. An additional laser light scattering table in the characterization lab is used for measuring nanoparticle size and molecular weight of polymers.



The high-power laser system.

Undergraduate researcher Ashley Cousineau at the laser light scattering table.

ISN STUDENT PROFILE



LaShanda James-Korley

Hometown: Macon, Georgia

Stats: PhD Candidate, Chemical Engineering; Profs. Paula Hammond/Gareth McKinley, advisors.

Research project: New Mechanically Enhanced, Functional Nanostructured Polyurethane Systems for Soldier Applications (project 1.4)

What that really means: Our goal is to create tear- and puncture-resistant materials that are also breathable. To do this, I'm using polyethylene oxide-segmented copolymers as soft segments in polyurethane multiblock copolymers to create high-performance, water-transmissive textile fibers.

What motivates her: I love what I'm doing. I love the fact that my project is so interdisciplinary. I get to interact with so many people, and the ISN is the perfect place for that.

On becoming an engineer: By the 9th grade, I knew I wanted to be an engineer. By the 11th grade, I knew I wanted to be a chemical engineer.

Her passion in life: For me, community service is very big. Three years ago, six of us got together and organized a huge graduate student volunteer day. The first year we had more than 100 students and their families volunteer for things like Habitat for Humanity, the Red Cross, homeless shelters, and reading for the blind. It was wonderful.

The value of mentorship: I think we can all be role models to a huge spectrum of people. So many people helped me shape my career, just by saying, "LaShanda, you can do it." You hear so many youngsters say, "I can't do it." And sometimes it just takes a simple word: "This is possible for you."

Ten years from now: Tenured professor. Where? I'm not quite sure.

RECENT AWARDS

INFINITE MILE AWARD

Seven members of the ISN headquarters staff recently received an Infinite Mile Award for their teamwork on the 2003-2004 Soldier Design Competition. The Award was presented by Vice President for Research and Associate Provost Prof. Alice P. Gast, who said, "Together this fine group of MIT employees designed and executed the Soldier Design Competition in a manner that was simply first class in every respect." Congratulations to the ISN staff.



left to right: Franklin Hadley, Josh Freedman, Steve Kooi, Amy Holden, Eve Downing, Joanne Maxwell, Jeff Baur, and Alice Gast.

CARL S. MARVEL AWARD

Prof. Tim Swager, ISN associate director, has been awarded the Carl S. Marvel Creative Polymer Chemistry Award, presented by the American Chemical Society. The award recognizes accomplishments of unusual merit in the field of basic or applied polymer science by a scientist under age 45. Prof. Swager will present an address at a symposium organized in his honor at the national meeting next March in San Diego, California. Previous recipients include Prof. Ned Thomas, ISN director, and Caltech Prof. David Tirrell, a member of the ISN's Science Advisory Board.

TELLY AWARD

The ISN's short video, "Soldier of the Future," won the top award for video animation at the 2004 Telly Awards, which honor outstanding local, regional, and cable TV commercials and programs, as well as the finest video and film productions. Running 12 minutes, "Soldier of the Future" profiles the ISN's mission and illustrates three of its research projects, including animated sequences showing how the technology might help the Soldier of the future. Congratulations to video producers Diginovations' North Bridge Productions and Boston Animation.

ISN Group Visits Fort Leonard Wood

In May, staff and faculty from the ISN visited Fort Leonard Wood, Missouri, home of the Army's Chemical School, Engineer School, and Military Police School. Several representatives from the Army and the ISN's industry partners also attended. The visit host was Mr. Mike Cress from the Army's Battlelab Integration Team.



ISN visitors get a briefing on the Biological Integrated Detection System (BIDS), which is a suite of biological detection equipment mounted on a vehicle. **Left to right:** SFC Tim Meadors, Army Chemical School; Dr. Jeff Baur, ISN; Dr. Steve Kooi, ISN; Prof. Paula Hammond, ISN; Dr. Martin Leuschen, Nomadics; Prof. Tim Swager, ISN.

At the Army Chemical School, the group saw training models of the Fox Nuclear, Biological, and Chemical Reconnaissance System and the Biological Integrated Detection System (BIDS), both equipment the Army currently uses to detect the presence of nuclear, biological, or chemical threats on the battlefield. Gaining firsthand knowledge of these systems' equipment, training, and typical use was valuable to the team members, many of whom work on next-generation sensing technology.

The group also toured the highly controlled facility where live-agent training is conducted. "I admire these Soldiers for doing this live-agent training," said Dr. Kateri Paul, an employee of ISN industry partner Nomadics. "It's good to know they are gaining these skills, but hope they will never have to use them."

During the visits to the Engineer and Military Police Schools, attendees observed training exercises and toured facilities, including the Stem Village, a simulated urban environment for basic law enforcement and special tactics training, and an indoor weapons training simulator. The trip concluded with visits to the Engineer and Chemical School Museums, as well as a WWII-era barracks complex with related artifacts.

Members of the group were consistently impressed with the quality of the training programs and instructors at Fort Leonard Wood. ISN Director Ned Thomas said, "I have the greatest respect for the young NCOs (non-commissioned officers) we met on this trip. Their professionalism and confidence were outstanding. Overall, this was a very informative trip."

Members of the ISN group examine a training model of the Army's Fox vehicle, a nuclear, biological, and chemical reconnaissance system. **Counter-clockwise from lower left:** Prof. Ned Thomas, ISN; Dr. Roland Lee, Carbon Nanotechnologies, Inc.; Dr. Jeff Baur, ISN; Ms. Lisa Shaler-Clark, Army Research Office; and SSG Humphrey Hills, Army Chemical School.



VISITS



LTG Yakovac with ISN graduate student Joe Lowery at the scanning electron microscope.

Army and Marine Corps Generals Visit ISN

Lieutenant General Joseph Yakovac visited the ISN in August. LTG Yakovac, who is the military deputy to the Assistant Secretary of the Army for Acquisition, Logistics, and Technology (Mr. Claude Bolton), also visited the U.S. Army Soldier Systems Center in Natick, Massachusetts, as well as MIT's Auto-ID Center.

Bridagier General Thomas Waldhauser, U.S. Marine Corps, visited the ISN in April to see how the ISN's research on behalf of Soldiers might be extended to Marines. BG Waldhauser, who serves as the commander of the Marine Corps Warfighting Laboratory in Quantico, Virginia, and Vice Chief of the Office of Naval Research, saw demonstrations of ISN partner company Nomadics' sensor technology for explosives and chemical agents.



BG Waldhauser and Mr. Kip Schultz of Nomadics.

LTC Dean Continues Soldier Load Study

Lieutenant Colonel Charles Dean, who serves as Army Uniformed Liaison to the ISN, is on deployment for six weeks in August and September to Iraq and Afghanistan to continue his groundbreaking study of Soldiers' combat loads.

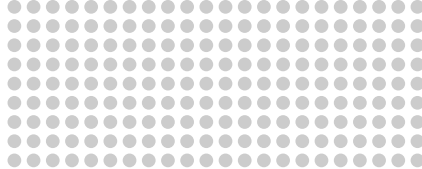
Dean's current tour focuses specifically on the loads of Army aviators, including helicopter pilots, crew chiefs, door gunners, flight engineers, and flight medics. The current Modern Aviators' Combat Load study is the second of three combat load studies. The third study, to take place next winter, will address the mounted vehicle crewman.

Dean's earlier load study, conducted in 2003 in Afghanistan, found that Infantry Soldiers routinely carry loads ranging from 100 to 150 pounds based upon missions and specific Soldier job requirements. Dean's report, entitled "The Modern Warrior's Combat Load," closely details the specific items that modern American Soldiers carry into battle and why.

We wish LTC Dean and the seven other Soldiers and civilians that compose his team a speedy and safe return home.



LTC Charles Dean in Afghanistan, Spring 2003.



ISN in the Media

The ISN has appeared in the media over the past few months, including these stories:

Future Warrior Exhibits Super Powers, about the Army's plans for Soldier modernization, including work being done at the ISN, was released by the American Forces Press Service on July 27, 2004.

Build a Liver, story and video about Prof. Linda Griffith's artificial liver chip research, released by ScienCentral News on June 24, 2004 and aired on ABC-TV affiliates nationwide (see www.sciencentral.com).

Flexing Muscles and Minds, about the ISN's artificial exomuscle project, appeared in the June 2004 edition of the *MIT Technology Insider*.

Infantry Innovations, about the MIT Soldier Design Competition, appeared in the June 2004 issue of *Technology Review*.

The Seven Marvels of Military Technology, about the ISN's research, aired on the Discovery Channel on May 19, 2004.

Uncle Sam Wants Nanotech, about military uses for nanotechnology, appeared in the April 9-15, 2004, edition of *Silicon Valley Biz Ink*.

Nanotech Relief for G.I. Joe, about the ISN, appeared in the April 2004 edition of the *Forbes/Wolfe Nanotech Report*.

ISN News is published three times a year by MIT's Institute for Soldier Nanotechnologies. Please forward comments or suggestions to isn@mit.edu.

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Find out more about the ISN on the web at <http://web.mit.edu/isn>.

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