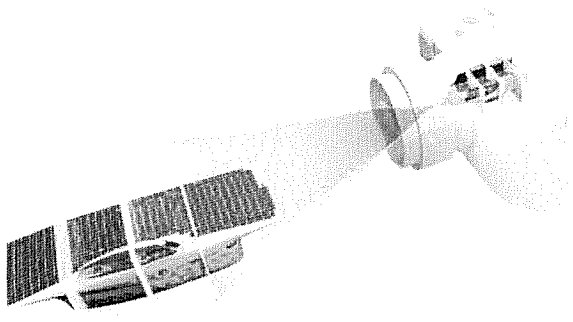
A better 3D camera with clear, graphene light detectors

3 March 2016, by Katherine Mcalpine



An illustration showing how a new 3D camera will be designed to work. Here, it takes a 3D photo of a University of Michigan solar car. In this new method, objects at different distances from the lens will come into focus at different points inside the camera. Credit: Stephen Alvey, Michigan Engineering

A camera that can record 3D images and video is under development at the University of Michigan, with $1.2 million in funding from the W.M. Keck Foundation.

While other 3D cameras are currently on the market, the new design should be smaller and able to achieve higher resolutions.

3D cameras are useful for a variety of applications including 3D movie filming and, eventually, virtual reality. While 3D films are currently made using multiple cameras to reconstruct each frame, this new type of camera could record in 3D on its own. Images and video recorded by 3D cameras might one day be projected as holograms—although projection is a different challenge entirely.

In photography, 3D images enable users to decide the depth of focus after taking the photograph. Attached to microscopes, a 3D camera can image cells and tissues for more accurate analysis of biopsies and medical cultures, as well as for fundamental research. 3D video recording could give robots depth perception and eventually lead to a bionic eye.

"When the light hits the detector inside a camera, it can come from different directions, and this spatial information can be used to reconstruct 3D images," said Zhaohui Zhong, an associate professor of electrical engineering and computer science.

"Normally, that information is lost because the detector only measures intensity," he added, which is why 3D images made with traditional recording methods must be constructed from multiple shots.

One-shot 3D cameras available now rely on a micro-lens array to divert the light after it has been focused by the main lens. This array of smaller lenses essentially tears up the picture to recover the directional information from the rays of light, and then the camera's software reconstructs the image along with the depth information.

The design—to be developed by Zhong and colleagues Theodore Norris and Jeffrey Fessler, both professors of electrical engineering and computer science—does away with the micro-lens array. Instead, their camera will record the light as it passes through a series of transparent light detectors.

"The microlens approach involves an inherent trade-off between resolution and the ability to refocus or resolve depth," Norris said. "Our stack approach enables more information to be acquired without losing image resolution."

This method works because objects at different distances from the lens will come into focus at different points inside the camera, the researchers say. Objects will appear brightest where they are most in focus. Using this principle, it is much easier

for the computer to reconstruct the images. The faster processing makes it possible to produce high speed and high-resolution video.

The concept is simple, but the challenge is making those transparent light detectors, they say. Typically, the detector needs to absorb as much light as possible to give the most detailed image. However, a material called graphene, which is a single layer of carbon atoms, can be fashioned into a highly sensitive light detector that allows much of the light to pass through.

"Ordinarily, you want the light detector to absorb as much light as possible for high sensitivity, to produce a clearer picture," Zhong said. "Graphene detectors can offer very high sensitivity, so you don't really sacrifice the clarity by making them transparent."

The team is considering an SLR-sized camera to begin with, but Norris thinks it may be possible to squeeze 3D-camera capability into a smartphone.

Norris is also a professor of applied physics. Fessler is also a professor of applied physics, biomedical engineering and radiology.

Provided by University of Michigan

APA citation: A better 3D camera with clear, graphene light detectors (2016, March 3) retrieved 4 March 2016 from http://phys.org/news/2016-03-3d-camera-graphene-detectors.html

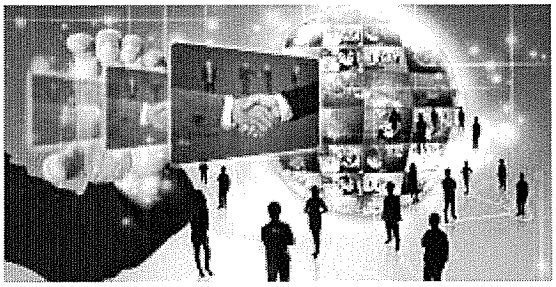
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Acquisition and Contracting

Hidden Treasures Within the TechNet Air Agenda

March 3, 2016

By Katie Helwig



AFCEA International's TechNet Air 2016 is fast approaching and the agenda gets stronger by the day. When you dig deeper, attendees will find golden nuggets that can provide industry with tangible information and tips for that *je ne sais quoi* needed to write winning proposals.

Southwest Research Institute to Develop Geolocation Technology

March 2, 2016

The U.S. Air Force has awarded a team led by Southwest Research Institute (SwRI) a $9.4 million contract to develop a component of a novel geolocation system that will detect and locate communications and other high-frequency signals with unprecedented accuracy. The program, funded by the Intelligence Advanced Research Projects Activity (IARPA), will integrate a high-fidelity ionospheric model with a geolocation system for the first time to achieve this level of precision.

U.S. Army Purchases Joint Chemical Agent Detectors

March 2, 2016

Smiths Detection, Edgewood, Maryland, was awarded a $17,262,861 modification (P00061) to contract W911SR-07-C-0080 to purchase 2,092 M4A1 Joint Chemical Agent Detectors; 2,088 communication adapter kits; and 10 platform interface kits. Work will be performed in Edgewood, Maryland, with an estimated completion date of September 30, 2016. Fiscal 2016 other procurement (Army); operations and maintenance (Army); and research, development, testing and evaluation funds in the amount of $17,262,861 were obligated at the time of the award.

Lockheed to Provide Submarine Situational Awareness System

March 2, 2016

Lockheed Martin Mission Systems and Training, Liverpool, New York, is being awarded an $8,046,094 modification to previously awarded contract N00024-14-C-6227 to exercise options for the production of two low cost conformal array (LCCA) production units, spare modules and spare outboard electronics canisters. The LCCA is a passive planar array mounted on the aft submarine sail structure that is integrated with the Acoustic Rapid Commercial Off-The-Shelf Insertion AN/BQQ-25 system to provide situational awareness and collision avoidance for improv

Rockwell to Provide E-6B Bandwidth Expansion

March 2, 2016

Rockwell Collins Inc., Cedar Rapids, Iowa, is being awarded $9,201,304 for modification 0041 to a previously awarded firm-fixed-price contract (N00019-13-C-0004) to exercise an option for the installation of one Block I modification aircraft kit, to include the Internet Protocol Bandwidth Expansion and Very Low Terminal kits, on one E-6B aircraft. Work will be performed in Oklahoma City, Oklahoma (95 percent); and Richardson, Texas (5 percent), and is expected to be completed in March 2017. Fiscal 2016 aircraft procurement (Navy) funds in the a

L-3 to Provide Hawklink Common Data Link

March 2, 2016

L-3 Communications, Communication Systems-West, Salt Lake City, Utah, is being awarded $16,930,838 for modification PO0022 to a previously awarded firm-fixed-price contract (N00019-12-C-2024) to exercise an option for the manufacture, test, delivery and support of 29 AN/ARQ-59 radio terminal Common Data Link Hawklink systems in support of the MH-60R aircraft. Work will be performed in Salt Lake City, Utah (60 percent); Atlanta, Georgia (14 percent); Mountain View, California (6 percent); Exeter, New Hampshire (2 percent); and Phoenix, Arizona; El Cajon,

Rockwell Collins to Provide Night Vision Cueing

March 2, 2016

Rockwell Collins-ESA Vision Systems, Fort Worth, Texas, is being awarded $18,500,550 for modification P00004 to a previously issued firm-fixed-price, indefinite-delivery/indefinite-quantity contract (N00019-15-D-0024) to exercise an option for night vision cueing and display system hardware, support equipment, non-recurring engineering, testing and technical data for the Joint Helmet Mounted Cueing system. Work will be performed in Merrimack, New Hampshire (79 percent); Wilsonville, Oregon (15 percent); Atlanta, Georgia (4 percent); and Fort Wo

Northrop Awarded Airborne Laser Mine Detection Funds

March 2, 2016

Northrop Grumman Systems Corp., Aerospace Systems, Melbourne, Florida, is being awarded a $20,144,483 firm-fixed-price, cost-plus-fixed-fee modification to previously awarded contract (N00024-15-C-6318) for the exercise of options for Airborne Laser Mine Detection Systems (ALMDS); depot services and software support; and peculiar support equipment in support of Program Executive Office, Littoral Combat Ships. ALMDS is a laser-based system which uses streak tube imaging light detection and ranging to detect, classify and localiz

U.S. Navy Procures Archerfish Mine Destructors

March 2, 2016

BAE Systems Surface Ships Ltd., United Kingdom, is being awarded a $22,172,442 firm-fixed-price contract for the production and delivery of Archerfish Destructors and fiber optic spools. The Archerfish Destructors are a component of the airborne mine neutralization system. The Navy has a mission need to neutralize bottom, close tethered and moored sea mines.

Northrop Receives Advanced Hawkeye Support Funds

March 2, 2016

Northrop Grumman Systems Corp., Aerospace Systems, Melbourne, Florida, is being awarded $50,762,901 for modification 0026 to a previously awarded fixed-price-incentive, firm target, cost-plus-fixed-fee contract (N00019-13-C-9999) for non-recurring engineering, product support, engineering investigations and software sustainment in support of the full-rate production Lot 4 E-2D Advanced Hawkeye aircraft. Work will be performed in Melbourne, Florida (52 percent); Syracuse, New York (13.6 percent); St.

Boeing to Deliver Two P-8A Aircraft

March 2, 2016

The Boeing Co., Seattle, Washington, is being awarded a $276,261,820 modification to a previously awarded fixed-price-incentive, firm target contract (N00019-14-C-0067) for the production and delivery of two full-rate production Lot III P-8A Multi-mission Maritime Aircraft. Work will be performed in Seattle, Washington (80 percent); Baltimore, Maryland (3 percent); Greenlawn, New York (2.8 percent); Cambridge, United Kingdom (1.7 percent); North Amityville, New York (1.1 percent); Rockford, Illinois (0.9 percent); Rancho Santa Margarita, California (0.7

Northrop Grumman Awarded Fire Scout Task Order

March 2, 2016

Northrop Grumman Corp., Aerospace Systems, San Diego, California, is being awarded $7,280,560 for cost-plus-fixed-fee task order 1269 against a previously issued basic ordering agreement (N00019-15-G-0026) in support of the MQ-8 Fire Scout unmanned aircraft systems. This test support effort for the MQ-8C includes software verification; software regression; cybersecurity; dynamic interface; and other requirements in preparation for, but not including, initial operational test and evaluation.

Three Companies to Provide Manpack Radios

February 29, 2016



Harris, Rockwell Collins and General Dynamics have been awarded task orders for Manpack radios, accessories and related services.

IBM Awarded IT Contract Modification

February 29, 2016

IBM Corp., Reston, Virginia, was awarded a $12,500,000 modification (BA0133) to contract W91QUZ-06-D-0010 for information technology services and support to the Program Executive Office Enterprise Information System Product Lead-Acquisition, Logistics and Technology Enterprise Systems and Services. Work will be performed in Radford, Virginia, with an estimated completion

date of June 28, 2016. Fiscal 2016 operations and maintenance (Army) funds in the amount of $6,250,000 were obligated at the time of the award.

Lockheed Receives Funds for Undersea Warfare System

February 29, 2016

Lockheed Martin Corp., Missiles and Fire Control Technical Services, Orlando, Florida, is being awarded a $10,415,856 cost-plus-fixed-fee and cost modification to previously awarded contract N00024-13-D-5250 for the Navy's fiscal 2016 AN/SQQ-89A(V)15 installation support. The AN/SQQ-89A(V)15 is a surface ship undersea warfare combat system with the capabilities to search, detect, classify, localize and track undersea contacts, and to engage and evade submarines, mine-like small objects and torpedo threats. Work will be performed in Honolulu, Hawai

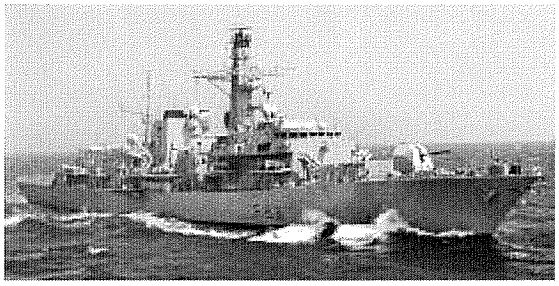
SRI Awarded DARPA Contract

February 26, 2016

SRI International, Menlo Park, California, has been awarded an $8.5 million contract by the Defense Advanced Research Projects Agency (DARPA) Brandeis program through the Space and Naval Warfare Systems Command (SPAWAR) to explore how privacy-preserving technologies can be applied to enable information sharing while safeguarding sensitive data across large-scale enterprises. The vision of the Brandeis program is to break the tension between the need for maintaining privacy and sharing data for collaboration.

Thales to Provide Royal Navy Communications Systems

February 26, 2016



Thales, Neuilly-sur-Seine, France, has been awarded a £19 million ($26,527,677) contract by the United Kingdom Ministry of Defensce to perform a midlife update to the External Communications Voice Distribution and Management System (KMY) for the Royal Navy Type 23 frigate fleet.

U.S. Army Awards IT Support Contract

February 26, 2016

Advanced Alliant Solutions Team, Fairfax, Virginia, was awarded an $11,741,615 cost-plus-fixed-fee, incrementally funded contract with options for information technology support services to meet Army Test and Evaluation Command Headquarters and the following subordinate commands' mission requirements: Operational Test Command, Army Evaluation Center, Aberdeen Test Center. Bids were solicited via the Internet, with 13 received. Work will be performed at Aberdeen Proving Grounds, Maryland, and Fort Hood, Texas, with an estimated completion date of Feb

DRS to Upgrade Advanced Display Systems

February 26, 2016

DRS Laurel Technologies, Johnstown, Pennsylvania (N63394-16-G-0002) and Lockheed Martin Mission Systems and Training, Manassas, Virginia (N63394-16-G-0001) are each being awarded a cost-plus-fixed-fee basic ordering agreement with a potential combined value of $9,890,837 as a follow-on to a previous multiple award contract (N63394-16-G-1240). The agreement is for engineering services, overhaul, repair and upgrade in support of the AN/UYQ-70 (Q70) advanced display system. The intent of this procurement is to provide necessary personnel, materials and service

Narrow Your Partner Search with AFCEA's Corporate Directory

February 26, 2016

By Katie Helwig

Corporate members of AFCEA International can advertise their companies' overview, clients, products, services, contract vehicles, NAICS codes and small business status in AFCEA's corporate directory—a searchable resource that provides a member benefit worth every penny of membership costs.

Japan Procures Above-Water Sensors

February 26, 2016

Systems Planning and Analysis Inc., Alexandria, Virginia, is being awarded a $13,544,903 cost-plus-incentive-fee, cost-only contract for engineering, technical and professional support services for above-water sensor systems development. This contract includes options that, if exercised, would bring the cumulative value of this contract to $35,062,087. This contract combines purchases for the Navy (93.2 percent) and the government of Japan (6.8 percent) under the Foreign Military Sales program. Work will be performed in Washington, D.C.

Harris to Provide Commercial Broadband Systems

February 26, 2016

Harris Corp., Melbourne, Florida, is being awarded a $10,276,458 modification to a previously awarded, firm-fixed-price contract (N00039-13-C-0001) to exercise an option for Commercial Broadband Satellite Program systems, including two Force Level Variant (FLV) dynamic shipboard systems, three FLV dual antenna/dual channel systems and one FLV dynamic shipboard system with radar cross-section reduction. Work will be performed in Melbourne, Florida, and is expected to be completed by January 30, 2017.

General Dynamics to Support DARPA Office

February 26, 2016

General Dynamics C4 Systems Inc., San Antonio, has been awarded a $25,440,610 cost-plus-award-fee contract with options for classified network support services for the Defense Advanced Research Projects Agency's (DARPA's) Mission Services Office, Information Technology Directorate. The support services include classified office computing, networking, communications services, desktop support, technical support, infrastructure, equipment, software and data.

Vergis Group Awarded Information Assurance Contract

February 26, 2016

Vergis Group LLC, Vienna, Virginia, is being awarded a $33,350,607 firm-fixed-price contract to provide responsive and high-quality information assurance services to all customers and stakeholder on behalf of the Washington Headquarters Services, Joint Services Provider, the Office of the Secretary of Defense and other Department of Defense agencies. Work performance will take place in multiple locations in the national capital region, primarily at the Pentagon, Mark Center and Crystal City in Arlington, Virginia, with an expected completion date of February 28, 2019.

Army Awards $5 Billion Enterprise Technology Contract

February 23, 2016

Affigent,* Herndon, Virginia (W52P1J-16-D-0005); Telos, Ashburn, Virginia (W52P1J-16-D-0006); Unicom, Suite 100, Herndon, Virginia (W52P1J-16-D-0007); IBM, Maryland (W52P1J-16-D-0008); Dynamic Systems,* El Segundo, California (W52P1J-16-D-0009); Dell, Round Rock, Texas (W52P1J-16-D-0010); GTRI,* Denver, Colorado (W52P1J-16-D-0011); Hewlett-Packard, Herndon, Virginia (W52P1J-16-D-0012); CDW-G, Vernon Hills, Illinois (W52P1J-16-D-0013); Iron Bow,* Chantilly, Virginia (W52P1J-16-D-0014); Wildflower,* Santa Fe, New Mexico (W52P1J-16-D-0015); WWT, St.

U.S. Navy Modifies Sensor Netting System Contract

February 23, 2016

Raytheon Integrated Defense Systems, St.

Lockheed Awarded MAD-FIRES Phase I Option

February 22, 2016

Lockheed Martin Corp., Missiles and Fire Control, Grand Prairie, Texas, has been awarded an $8,433,827 agreement modification (P00004) to previously awarded other transaction agreement HR0011-15-9-0008 exercising Phase I option for the Multi Azimuth Defense Fast Intercept Round Engagement System (MAD-FIRES) program. The Phase I option will involve preliminary risk reduction demonstrations to identify and mature critical enabling technologies. The modification brings the total cumulative face value of the agreement to $14,879,792 from $2,229,051.

Raytheon Receives MAD-FIRES Funds

February 22, 2016

The Raytheon Co., Raytheon Missile Systems, Tucson, Arizona, has been awarded a $17,228,124 modification (P00003) to previously awarded contract HR0011-15-C-0081, exercising option one for the Multi Azimuth Defense Fast Intercept Round Engagement System (MAD-FIRES) program. The modification brings the total cumulative face value of the contract to $18,944,780 from $1,716,656.

Modern Technology to Provide Technical Engineering

February 22, 2016

Modern Technology Solutions Inc., Alexandria, Virginia, is being awarded a $22,623,656 firm-fixed-price contract to provide technical engineering support services in support of the Strategic Capabilities Office of the Department of Defense. Work performance will take place in Arlington, Virginia, with an expected completion date of February 24, 2021. Fiscal 2015 research, development, test and evaluation funds in the amount of $1,000,000 are being obligated at time of the award.

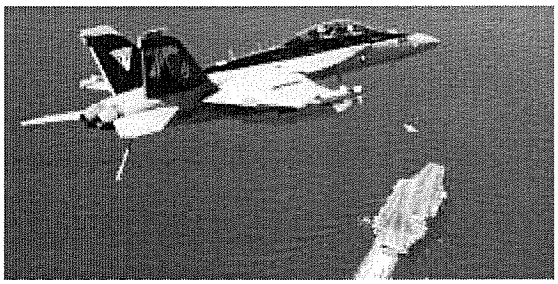
General Dynamics Supports Taiwan's Mobile Subscriber Equipment

February 22, 2016

General Dynamics C4 Systems Inc., Taunton, Massachusetts, was awarded a $34,700,000 firm-fixed-price, multi-year, foreign military sales contract (Taiwan) with options for follow-on logistics support to the improved Mobile Subscriber Equipment System. One bid was solicited with one received. Work will be performed in Taiwan with an estimated completion date of December 28, 2019. Fiscal 2010 other procurement funds in the amount of $34,700,000 were obligated at the time of the award.

Northrop Grumman Supports EA-18G Electronic Attack System

February 16, 2016



Northrop Grumman Corp., is being awarded $9,272,555 for ceiling-priced delivery order 7492 under a previously awarded basic ordering agreement eight line items of repair for the Advanced Electronic Attack System used in support of the EA-18G aircraft.

Block MEMS to Develop Chemical Detection Technology

Februrary 16, 2016

Block MEMS LLC, Marlborough, Massachusetts, has been awarded a $9,408,808 cost-plus-fixed-fee contract for research and development. Contractor will develop a portable system for real-time standoff detection and identification of trace chemical residues on surfaces using active infrared spectroscopy at a 30-meter range. Work will be performed at Marlborough, Massachusetts, and is expected to be completed by October 16, 2020. This award is the result of a competitive acquisition, with 17 offers received.

ManTech Awarded U.S. Navy IT Contract

February 16, 2016

ManTech Systems Engineering Corp., Fairfax, Virginia, is being awarded a $9,080,803 modification to a previously awarded contract (N00024-14-C-4110) for the accomplishment of the uninterrupted enterprise support to the Navy Ship Maintenance and Logistics Support Information Systems Program. ManTech Systems Engineering Corp.

Cameron Bell to Support SSC Pacific

February 16, 2016

The Cameron Bell Corp., doing business as Gov Solutions Group, Daniel Island, South Carolina, is being awarded a $13,199,621 indefinite-delivery/indefinite-quantity, cost-plus-fixed-fee contract for project management and technical support services to develop and sustain the Space and Naval

Warfare Systems Center Pacific (SSC Pacific) Navy Enterprise Resource Planning and Business Intelligence Reporting Analysis Systems. This three-year contract includes one two-year option period thatwhich, if exercised, would bring the potential value of this contract to $22

SAIC Supports U.S. Navy C4ISR Efforts

February 16, 2016

Science Applications International Corp.

General Dynamics Receives C4I Support Contract

February 16, 2016

General Dynamics Information Technology Inc., Fairfax, Virginia, is being awarded a $14,269,353 option year under a previously awarded indefinite-delivery/indefinite-quantity, cost-reimbursement type contract (N66001-12-D-0060) for support of technology insertion; software and systems engineering; modeling and simulation; system level and systems integration testing; and integrated logistics in support of communications, information technology and other command, control, communications, computers and intelligence efforts. Work will be performed

A Few Salient Takeaways from CEO Panel to Small Businesses

February 11, 2016

By Katie Helwig

Sometimes, it's the simplest of ideas that can draw out the biggest change. This week, AFCEA International hosted a small business event that fostered some great conversations on hiring, business focus and capture strategies.

U.S. Commerce Department Announces Grant Awardees

February 8, 2016

The U.S. Commerce Department has announced 25 awardees that will receive $10 million under the 2015 Regional Innovation Strategies program, which is designed to advance innovation and capacity-building activities across the country through two different competitions.

U.S. Navy Modifies Test and Evaluation Contracts

February 8, 2016

Gryphon Technologies, Washington, District of Columbia (N00189-13-D-0021- Mod P00007); CGI Federal, Fairfax, Virginia (N00189-13-D-0022- Mod P00009); Alion Science and Technology Corp., Burr Ridge, Illinois (N00189-13-D-0023- Mod P00009); Wyle Lab, Huntsville, Alabama (N00189-13-D-0023- Mod P00009

Small Businesses Get the Inside Scoop on How to Grow a Business

February 8, 2016

By Katie Helwig

AFCEA International hosts an event February 9 that offers theoretical and practical information on how to move from being a subcontractor to a prime contractor in the federal market space.

- See more at:
http://www.afcea.org/content/?q=taxonomy/term/5367&page=1#sthash.HBMIPEkv.dpuf

Posted: Mar 11, 2016

Spray-on coating could ice-proof airplanes, power lines, windshields

(*Nanowerk News*) On your car windshield, ice is a nuisance. But on an airplane, a wind turbine, an oil rig or power line, it can be downright dangerous. And removing it with the methods that are available today--usually chemical melting agents or labor-intensive scrapers and hammers--is difficult and expensive work.

That could soon change thanks to a durable, inexpensive ice-repellent coating developed by University of Michigan researchers. Thin, clear and slightly rubbery to the touch, the spray-on formula could make ice slide off equipment, airplanes and car windshields with only the force of gravity or a gentle breeze. This could have major implications in industries like energy, shipping and transportation, where ice is a constant problem in cold climates.

The new coating could also lead to big energy savings in freezers, which today rely on complex and energy-hungry defrosting systems to stay frost-free. An ice-repelling coating could do the same job with zero energy consumption, making household and industrial freezers up to 20 percent more efficient. The coating is detailed in a new paper published in the journal *Science Advances* ("Designing durable icephobic surfaces").

Made of a blend of common synthetic rubbers, the formula marks a departure from earlier approaches that relied on making surfaces either very water-repellent or very slippery.

"Researchers had been trying for years to dial down ice adhesion strength with chemistry, making more and more water-repellent surfaces," said Kevin Golovin, a doctoral student in materials science and engineering. "We've discovered a new knob to turn, using physics to change the mechanics of how ice breaks free from a surface."

Led by Anish Tuteja, associate professor of materials science and engineering, the team initially experimented with water-repelling surfaces as well, but found that they weren't effective at shedding ice. But during their experiments, they noticed something unexpected: rubbery coatings worked best for repelling ice, even when they weren't water-repellent. Eventually, they discovered that the ability to shed water wasn't important at all. The rubbery coatings repelled ice because of a different phenomenon, called "interfacial cavitation."

Golovin explains that two rigid surfaces--say, ice and your car windshield--can stick tightly together, requiring a great deal of force to break the bond between them. But because of interfacial cavitation, a solid material stuck to a rubbery surface behaves differently. Even a small amount of force can deform the rubbery surface, breaking the solid free.

"Nobody had explored the idea that rubberiness can reduce ice adhesion," Tuteja said. "Ice is frozen water, so people assumed that ice-repelling surfaces had to also repel water. That was very limiting."

The new approach makes it possible to dramatically improve durability compared to previous icephobic coatings, which relied on fragile materials that lost their ice-shedding abilities after just a few freeze-thaw cycles. The new coatings stood up to a variety of lab tests including peel tests, salt spray corrosion, high temperatures, mechanical abrasion and hundreds of freeze-thaw cycles.

The team has also found that by slightly altering the smoothness and rubberiness of the coating, they can fine-tune its degree of ice repellency and durability. Softer surfaces tend to be more ice-repellent but less durable, while the opposite is true for harder coatings. Golovin believes that that flexibility will enable them to create coatings for a huge variety of applications.

"An airplane coating, for example, would need to be extremely durable, but it could be less ice-repellent because of high winds and vibration that would help push ice off," Golovin said. "A freezer coating, on the other hand, could be less durable, but would need to shed ice with just the force of gravity and slight vibrations. The great thing about our approach is that it's easy to fine-tune it for any given application."

The team has already designed hundreds of ice-repelling formulas. Some are rough to the touch, some smooth; some shed water while others don't.

"I think the first commercial application will be in linings for commercial frozen food packaging, where sticking is often a problem. We'll probably see that within the next year," Tuteja said. "Using this technology in places like cars and airplanes will be very complex because of the stringent durability and safety requirements, but we're working on it."

Source: *University of Michigan*

Read more: Spray-on coating could ice-proof airplanes, power lines, windshields

Posted March 5, 2016 - 8:32am**Updated** March 5, 2016 - 3:24pm

You know Area 51, but just what in the world is Area 6?



By KEITH ROGERS
LAS VEGAS REVIEW-JOURNAL

The asphalt runway stretches for a mile on Yucca Flat, deep in the Nevada National Security Site about 80 miles northwest of Las Vegas.

Built in 2005, the runway covers a dirt landing strip from the 1950s, when the wide, flat valley was used for atomic bomb test shots. A small complex of buildings dominated by a large hangar with unusual clamshell doors dominates the southern end of the asphalt strip.

The complex has no official name. Not many people even know it's there.

As secret airbases go, the single runway in the test site's Area 6 is easily overshadowed by the world's most famous secret military base, Area 51, a dozen miles northeast. Area 51's existence was only recently acknowledged, even after decades of speculation by UFO enthusiasts that the aircraft development and test facility also houses space aliens and extraterrestrial technology.

Unlike Area 51, which is protected by shoot-to-kill security and shielded from outside view by mountain ranges, Area 6 has only fences and visitor checkpoints. It can be seen at a distance from tour buses on the highway to historic bomb craters at the northern end of Yucca Flat.

But exactly what goes on at the much smaller and much newer Area 6 is still top-secret defense research-and-development work. It's so hush-hush that the security site's spokesman can say little about it.

Darwin Morgan, a spokesman for the National Nuclear Security Administration, said the low-key Area 6 facilities have been used by the Defense and Homeland Security departments.

"They come here to test their own sensors," he recently said after spending months fending off questions about the Area 6 runway from the Review-Journal.

LITTLE-KNOWN OPERATION

Other than a few "Above Top Secret" forum posts from 2009, and a Wikipedia blurb that cites a 2011 Flightglobal story saying the runway is part of an unmanned aerial vehicle test facility, little has been written about the Area 6 runway.

Flightglobal, an aviation industry website, noted a five-sentence description of the Area 6 "aerial operations facility" found in a 7,500-page safety report on the proposed Yucca Mountain nuclear waste project.

"The purpose of this facility is to construct, operate, and test a variety of unmanned aerial vehicles. Tests include, but are not limited to, airframe modifications, sensor operation, and onboard computer development. A small, manned chase plane is used to track the unmanned aerial vehicles," reads the report Energy Department contractor Bechtel SAIC prepared in 2008 for the Yucca Mountain repository license application.

The National Nuclear Security Administration is a semi-autonomous branch of the Energy Department. Its Nevada field office, based in North Las Vegas, runs the security site.

What it costs to operate Area 6 is difficult to determine. Funding is buried in the Nevada field office's Strategic Partnership Program, which was part of the $84 million budgeted for the entire security site in fiscal year 2015. Program funding was about 13.5 percent of the field office's $622 million total budget that year.

The program's activities include research and development of sensors for detecting explosive materials, deadly gases and chemicals, and radioactive sources that could be used in "dirty bombs."

Biological weapon sources aren't allowed at the security site, according to its environmental impact statement.

Portable radiation monitors and some sensors used in airports and at ports of entry have evolved from the program.

Morgan said agencies in the Strategic Partnership Program take advantage of the security site's restricted airspace to test sensor-equipped aircraft work without public interference or spying from space.

"We have controlled airspace and that gives them opportunities to test various types of platforms," he said.

Most of the strategic partnership money comes from Defense Department branches: the Air Force, Army, Navy, Marines, Defense Threat Reduction Agency and the Defense Advanced Research Projects Agency.

"We do a wide variety of work for others ... supporting people with sensor development activities," Morgan said. "It evolved from the nuclear testing program. We had to have very good sensors to collect data in a split second before they were obliterated."

Morgan said the Area 6 runway and its apron were built by Bechtel Nevada, the site's management and operations contractor at the time, at a cost of $9.6 million. The buildings were constructed over several years, and cost figures aren't immediately available.

As seen from above on Google Earth, the complex is dominated by the clamshell-door hangar and four smaller outbuildings connected by what appear to be covered walkways. Two smaller modern hangars and an older one used during atomic test days round out the facility. Morgan said antennas were installed to allow ground operators to control the flight of unmanned aerial system aircraft.

LOOKING FOR 'EVILDOERS'

The National Nuclear Security Administration has kept Area 6 so low profile that even defense industry experts were unaware of it.

"I had not heard about it," said John Pike, director of GlobalSecurity.org, an Alexandria, Va.-based defense information website.

But Pike's associate, imagery analyst Tim Brown, has estimated the hangar complex could hold about 15 MQ-9 Reaper remotely piloted spy planes.

Pike said the length of the runway suggests Area 6 is used for small planes or remotely piloted aircraft such as Predator and Reaper reconnaissance drones.

Bigger spy planes, such as the jet-powered RQ-170 Sentinel unmanned aircraft system, are flown from the Tonopah Test Range by the 30th Reconnaissance Squadron assigned to a Creech Air Force Base wing. It's unclear if the Sentinel or smaller versions would be flown from Area 6, but Pike said the runway is too small for large jets and bombers. Takeoffs and landings would be tight for an F-16, for example, and an F-15 would need an even longer strip for safe maneuvers.

Pike said aircraft likely in use at Area 6 are best suited for surveillance of hidden targets, weapons or personnel on the ground, particularly in sparsely populated areas. The security site's high-desert terrain is similar to what might be found in the "boondocks" of Libya, he noted.

"There is a well-founded fear that evildoers are stalking around out there — ISIS and al-Qaida," he said of Libya. "You have to imagine that trying to develop targeting signatures in this type of mountainous desert terrain. That's got to be a really high priority ... not constrained by funding."

"I can't think about a better place to do it where you wouldn't have civilians stumbling on what you're doing," he said in reference to the security site.

So what would stray civilians see if they could stumble in?

Pike offers an educated guess: Sensor arrays made up of more than 350 smartphone cameras mounted on an MQ-9 Reaper that can record and archive movements of people and vehicles over an area of about 40 square miles.

It is known in the unmanned aerial vehicle community as the "Gorgon Stare," derived from Gorgon monsters of Greek mythology whose gaze was so dreadful it was said to turn a person into stone. While the sensors can't do that, they can keep terrorist targets from evading the sights of U.S. weapons.

According to the Defense Advanced Research Projects Agency website, sensor development has soared to new heights under ARGUS, or the Autonomous Real-time Ground Ubiquitous Surveillance program.

The goal is to "provide at least 130 independently steerable video streams to enable real-time tracking of individual targets throughout the field of view. The ARGUS-IR system will also provide continuous updates of the entire field of view for enhanced situational awareness," the defense tech agency website says.

Pike said improving ARGUS and similar sensor capabilities might be among the activities taking place at Area 6.

"The thing you get with ARGUS is time-lapse photography. If there's a rock out there that's moving, maybe that's a rock you ought to be paying attention to. Maybe it has to do with evildoers," he said.

"I would assume they have airplanes and UAVs (unmanned aerial vehicles) they're flying around out there to see what they can see," Pike said.

"If they would let me run the thing, I'd tell (special operation troops) to go out and do the best in terms of infiltration," he said. "Then turn loose the sensors and see if we could find them, play hide-and-seek."

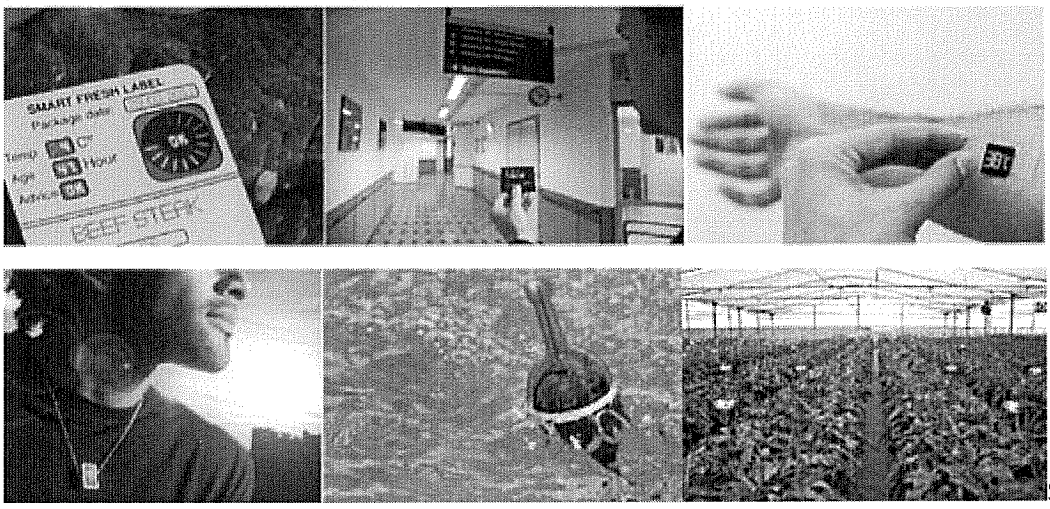
Contact Keith Rogers at krogers@reviewjournal.com or 702-383-0308. Find him on Twitter: @KeithRogers2

Vezi: http://www.reviewjournal.com/news/nevada/you-know-area-51-just-what-the-world-area-6

Posted: Mar 10, 2016

Three new developments for smarter sensor chips

(*Nanowerk Spotlight*) Sensors have evolved from simple measuring tools to smart appliances that are connected through the internet to the cloud and to each other. At the recent ISSCC-conference, researchers from imec & Holst Centre have presented a number of remarkable developments. These may pave the way to a world where sensors assist us to drive more safely, live healthier, and make the planet more sustainable. **Sensors Become the Senses of Our Environment** Our environment will slowly but surely evolve into an 'Internet of Things', where chips and sensors are integrated invisibly in the environment to assume their manifold tasks. Think of sensors that detect the presence of individuals and adapt the light in a building accordingly, resulting in serious energy savings. Those sensors will be, in a sense, the eyes, ears, and noses of our environment. Ubiquitous sensors will make their mark in many domains—smart buildings, self-driving cars and automated industrial and logistic processes to name a few. And, essential for a more sustainable future, sensors will be of great help to tackle environmental issues. If we are able to measure the quality of air and water continuously and in a fine-grained way, and we can collect the data centrally, it may be possible to take better-directed actions, and immediately measure the results. But also in the domain of healthcare, there are great opportunities. Think of simple tools such as weighting scales, blood pressure monitors, or heart and activity monitors that will send their data (secured!) to the cloud. There, the data may be analyzed and become the basis for new services to coach patients to lead a healthier life. This type of connected healthcare is already applied on a small scale with high-risk patients. But as the technology becomes smarter and cheaper, it could serve many more.



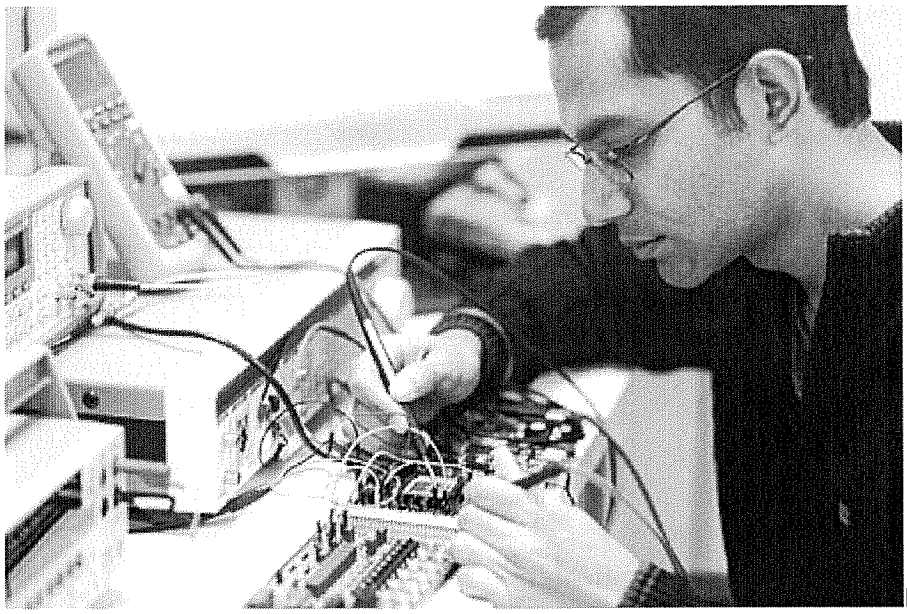
Sensors will have an influence in many sectors. Here are some artist impressions of possible applications of integrated sensoring: smart food labeling, personal signage using LEDs, thermoflex patches, air quality necklace, water poution monitoring, plant health monitoring. **TREND 1: Sensor Fusion—Combining Sensors for a Better Result** Sensors won't have an easy time. As they have to function day in, day out, they will have to leave their comfort zone and get used to highly variable temperatures, humidity, aridity, and vibrations. They will have to keep on working in harsh conditions and still deliver reliable results. One of the possibilities is sensor fusion: measuring the same physical parameter with a number of different sensors (e.g. someone's heartbeat that can be monitored electrically, optically and even acoustically). By combining the results of the sensors and interpreting the result, it is possible to arrive at a robust and reliable result. Context awareness could also be added. For example, a sensor that 'feels' a person has started sleeping communicates this result to a second sensor that has the task to monitor the heart at rest so one sensor flags the ideal moment for the other sensor to start work. At ISSCC, researcher Mario Konijnenburg from Holst

Centre/imec presented some remarkable results. Together with a colleague, he developed a chip that is able to measure several body parameters at the same time: an electrocardiogram (ECG), bio-impedance (BIO-Z, electrical conductivity of the body revealing the composition of body tissues), galvanic skin response (GSR, changes in the electrical properties of the skin due to e.g. stress), and photoplethysmogram (PPG, changes in the blood circulation in tissues due to changing light absorption). Because these data are collected on one chip, it is perfectly possible to synchronize them and look for correlations. In this example, the combination of measurements allows for a reliable way to deduce heartbeat and heart rate variability while (relative) blood pressure can be deduced by interpreting the ECG- and PPG measurements.

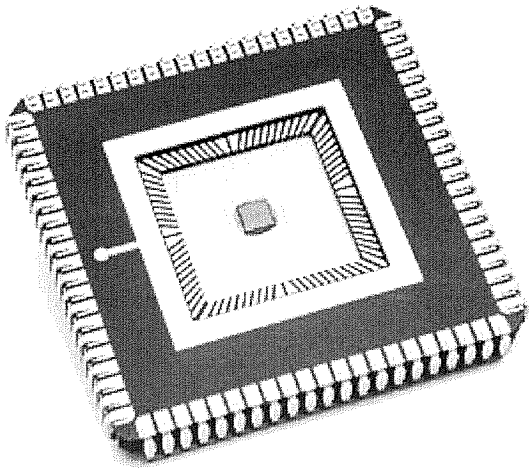


Mario Konijnenburg with his multi-sensor chip. **TREND 2: Local Processing: Processing Data on the Chip is Energy Efficient**

Data from the sensors chip are wirelessly sent to the cloud (e.g. through a smartphone or laptop). In the cloud, the data are processed and interpreted. Presently, 80% of the energy consumed by the sensors is used by the wireless link. So if the sensor has to be made more energy-efficient, it should send less data. This can be done by processing and interpreting the data partly on the sensors, only sending the results to the cloud. Of course, processing on the chip will also consume energy, so part of the researchers' task is to find the optimal balance between on-chip processing and sending data to the cloud. If the sensor has to do more local processing, it will need one or more additional processing cores. Advanced chip technologies are ideal to integrate more powerful processing on an already very small chip. But, as the world is analog, we still need to add analogue interfaces to our sensors. And these don't scale so well into the newest technology nodes. In his ISSCC paper, imec researcher Rachit Mohan describes a sensor readout chip made in 40nm CMOS. The new chip operates with a time-based technique instead of the traditional voltage- or power-based techniques. Such time-based circuits may operate on a lower supply voltage. Also, the transition to the digital domain in the amplifier chain is much faster, and filtering can be done digitally. This makes the technique attractive to implement in the deeply-scaled technologies that also allow implementing more powerful data processing.



Rachit Mohan with his sensor readout chip made in 40nm CMOS, operating with a time-based technique. **TREND 3: Adaptive & Compressive Sampling: Monitoring Only When it is Needed** Another technique to save energy and send as little data as possible through the wireless link of a sensor is adaptive and compressive sampling. With this technique, signals are not measured and sent at fixed time intervals, but according to the characteristics of the signal that is monitored. Consider e.g. the ECG heart monitoring. At the moment of the ECG peak, there is much more information to measure than during the intervening intervals between the peaks. As a result, the sensor can sample the heart signals at short intervals during the peak and at longer intervals in between. All in all, there will be a reliable ECG monitoring with fewer measuring points and fewer data to send. At ISSCC, imec researcher Pamula Venkata Rajesh showed a readout chip for photoplethysmogram measurements (PPG) based on LED-light and using compressive sampling. The PPG results deduce both heart beat and heart rate variability. They are a nice alternative for ECG monitoring because they don't require the use of electrodes on the patient's chest. The downside is the sensor's LED light that shines through the skin needing additional energy, which is a serious drain on the energy budget of the small sensor chip. Therefore, it is important that the measurements can be done with compressive sampling, measuring less but smarter data points.



© imec

Readout chip for

photoplethysmogram measurements using compressive sampling. **The future** Thanks to these and other developments, sensors improve every day, ready to take their place in our environments and lives. Other technologies that will be needed in this IoT-scenario are collecting and interpreting big data in the cloud, flexible electronics, and new standards for low-power radios. Looking at the 16 ISSCC-contributions, we are well on our way to bringing the Internet of Things to reality. *By Nick Van Helleputte. Nick received his MS degree in electrical engineering in 2004 from the Katholieke Universiteit Leuven, Belgium. He received his Ph.D. degree from the same institute in 2009 (MICAS research group). His PhD research focused on low-power ultra-wide-band analog front-end receivers for ranging applications. He joined imec in 2009 as an Analog R&D Design Engineer. He initially worked in the space and extreme electronics group working on among others ESA projects and design of radiation hard, space-grade ASICs. He later moved to the biomedical circuits and systems design team which he is currently leading. His research focus is on ultra-low-power circuits for biomedical applications. He has been involved in analog and mixed-signal ASIC design for wearable and implantable applications. Nick is an IEEE member and served on the technical program committee of VLSI circuits symposium.*

Read more: Three new developments for smarter sensor chips

Cyber Threats - Telecommunications | WI-FI | Audio & Video

TSCM America provides technical countermeasures to detect and verify vulnerabilities and all active eavesdropping threats on telecommunications devices including analog, digital, and VoIP systems. We are one of only a few companies to have the technology developed for this specific purpose including proprietary technologies to detect immediate threats. Telecommunication analysis is a complex process to validate all types of phone and conference phone systems and we can do them all.

Communications Channels

- Telecommunications
- Fax Transmissions
- Blue Tooth
- BYOD Policy
- Analog, Digital, VoIP
- Speaker Phones
- Headsets

Wireless Technology

- Wi-Fi
- Rogue Access Points
- Wireless Printing
- Copy Center
- White Boards | Sound Boards
- Microphones Wireless

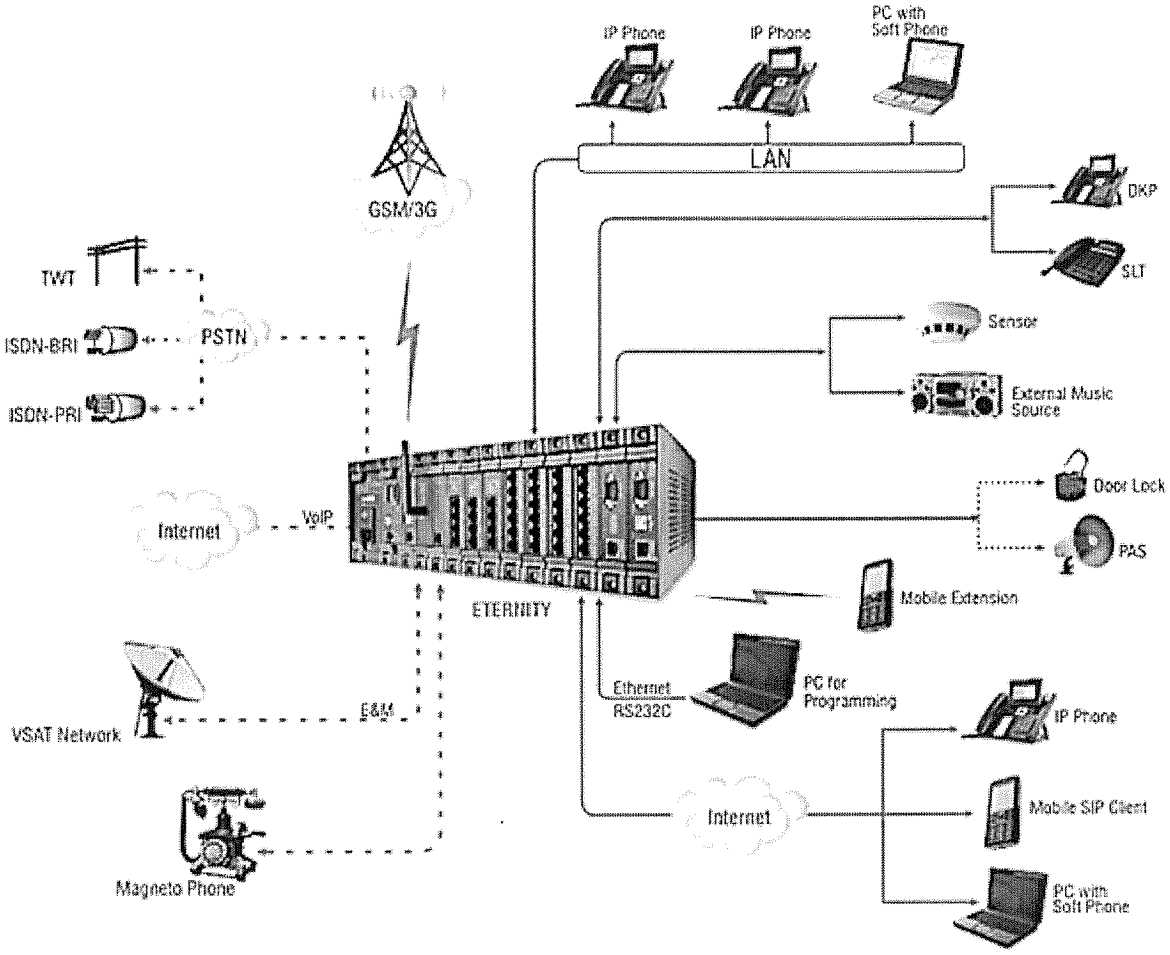
Conference Rooms

- Speakers
- Projectors
- AV Technologies
- Communication Devices
- Smart Technology
- Microphones

Telecommunications Threat Security Issues:

- Interception of calls
- Denial of Service Attacks
- Theft of Service

- Illegal Electronic Eavesdropping
- Exfiltration of data via media session
- Malware embedded in signaling and media session



Analog Systems

- Phones
- Faxes
- Conference Units
- Phone Rooms
- Wiring

Digital Systems

- Phones
- Communication Devices
- Conference Units
- White Boards

VoIP Systems

- Phone Systems
- POI
- Network Wiring
- VoIP Traffic
- VoIP Security

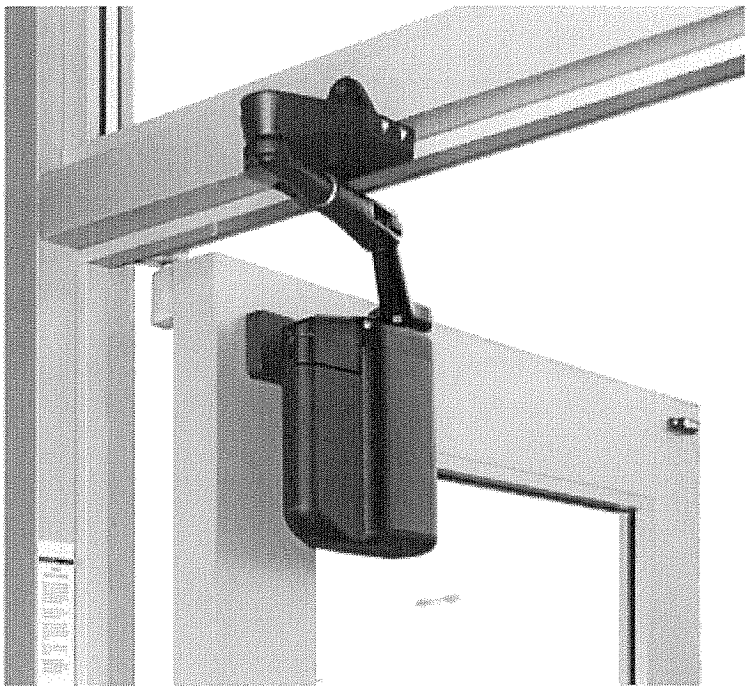
Cyber security focuses on many factors including communications channels such as VoIP, Digital, and Analog Systems.

Types of Attacks on Cyber Technology

- Unused Wiring
- Bypass Switches
- Radio Frequency Bugs
- Carrier Current Transmitters
- Bugs
- Software
- Internal Staff
- Outside Attacks

ASSA ABLOY acquires ADAEZ Pro line of wire-free door openers

Source: ASSA ABLOY Feb 29, 2016



The ADAEZ Pro Line door opener products will become a product series for Norton Door Controls.

Monroe, North Carolina, February 12, 2016 — ASSA ABLOY has successfully completed the acquisition of the ADAEZ Pro line of specialty door operators from EDMIT Industries. The ADAEZ Pro line offers unique benefits for rigorous institutional and commercial applications.

The ADAEZ Pro line comprises two heavy-duty low energy operators, both for high traffic environments. The ADAEZ Pro offers a Regenerative Power System that charges an onboard battery pack, eliminating the need for wired electrical power in high use applications. The Pro ships standard with an integral RF receiver and wireless push buttons that make install a breeze.

The ADAEZ Pro Plus model plugs into any standard outlet. It also ships with integral RF receiver and push buttons, and offers many features available in full size operators such as Push-and-Go and integration with access control systems.

The ADAEZ Pro Line will become a product series for Norton Door Controls, an ASSA ABLOY Group company, and will be manufactured in Monroe, North Carolina.

"The acquisition of the ADAEZ Pro line is a great addition to our current low energy operator offering. These two operators make it very easy to convert any opening to be compliant with the Americans with Disabilities Act (ADA), offering our customers yet another option to meet their facilities' requirements. We look forward to having the team at ADAEZ joining us," stated Eric Sejourne, President, ASSA ABLOY Architectural Accessories and Door Controls Group.

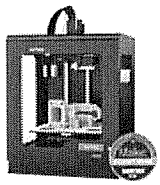
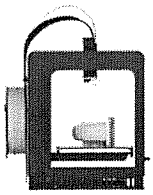
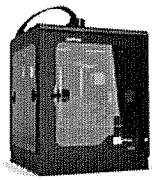
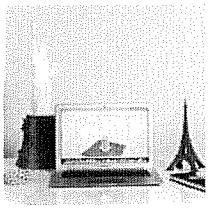
ADAEZ was founded in 2008 and is headquartered in Chateauguay, Québec Canada.

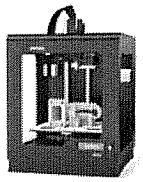
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Zortrax M200 3D Printer

PHOTO VIDEO



(2) Add Review

* Make: Magazine 2016 Best Overall 3D Printer - 2nd Place Award
* Award winning high performance 3D printer for designers and industrial users.

$1,989.99

Qty: 1

Suggested Add-ons

- ☐ Zortax Filament Z-ABS [$21.99]
- ☐ Zortrax Filament Z-ULTRAT [$49.99]
- ☐ Make: Design for 3D Printing [$17.99]

24

☐ Make: 3D Printing Projects [$19.99]

WISHLIST

More Details

Winner of **BEST OVERALL 3D PRINTER** 2nd place award from *Make:*'s 2016 Digital Fabrication Shootout!

An exceptionally reliable 3D Printer, the Zortrax M200 allows you to print extensive jobs with almost no maintenance. The device's affordable price combined with the high 3D print quality it offers make the Zortax M200 3D printer a top choice among both designers and industrial companies.

The Zortrax M200 is part of an integrated system of professional 3D printers, compatible materials, and dedicated software all developed by the company. Because of this, it prints with a dimensional accuracy and repeatability that is unique to 3D printers. A large workspace and a wide selection of professional quality materials with different properties make the Zortrax M200 a very versatile tool.

From the *Make*: 3D Printer Buyer's Guide: *"Print after print after print, the M200 pumped out consistently excellent results. So if you really just want to print and print well and you're willing to pay a bit more for looks, forgive a few small blemishes, and have no interest in upgrades, rebuilds, or tweaks, and are happy to buy the filament from the manufacturer, this is the printer for you..."* Read the full review here.

Key Features

- **High quality 3D prints:** The perfectly matched 3D printer, software, and materials guarantee careful reproduction of the dimensions of every 3D model, which means that you can print detailed elements with the certainty that each copy will be identical.
- **Supports materials with varied properties:** Produce elements of your project using materials with different properties, from standard filament to exotic filaments like glass.
- **Dimensional accuracy:** Elements printed separately fit together perfectly.
- **Intuitive 3D printing software:** Z-SUITE, developed by Zortrax, works with most 3D modeling programs and reads .stl, .obj, and .dxf file formats.
- Extensive library of 3D models contributed by the community
- Great for 3D Hub or 3D printing businesses
- 3D Hubs named the Zortrax M200 *Best Plug & Print 3D printer of 2015*

Key Specifications

- Build volume: 200 x 200 x 180 mm; 7.87 x 7.87 x 7.08 in; 7400 cm^3

29

- Extruder: Single
- Filament size: 1.75mm - Only Zortrax filament can be used
- Heated platform: Yes
- OS: Mac, Windows
- Open Software / Hardware: No

Product Documentation / User Guides

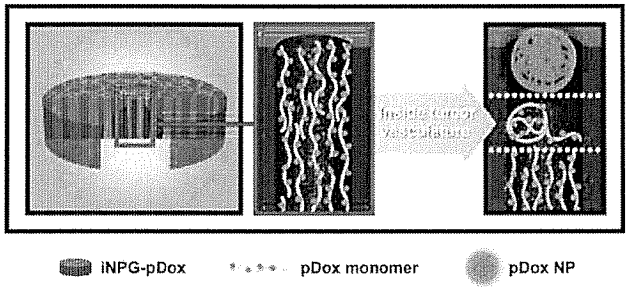
Product Overview & Specifications
Software Download
Note: This item does not qualify for discounts.

Reviews

30

Injectable nanoparticle generator could radically transform metastatic cancer treatment

14 March 2016



The iNPG process. Credit: Houston Methodist Research Institute

A team of investigators from Houston Methodist Research Institute may have transformed the treatment of metastatic triple negative breast cancer by creating the first drug to successfully eliminate lung metastases in mice. This landmark study appears today in *Nature Biotechnology*.

The majority of cancer deaths are due to metastases to the lung and liver, yet there is no cure. Existing cancer drugs provide limited benefit due to their inability to overcome biological barriers in the body and reach the cancer cells in sufficient concentrations. Houston Methodist nanotechnology and cancer researchers have solved this problem by developing a drug that generates nanoparticles inside the lung metastases in mice.

In this study, 50 percent of the mice treated with the drug had no trace of metastatic disease after eight months. That's equivalent to about 24 years of long-term survival following metastatic disease for humans.

Due to the body's own defense mechanisms, most cancer drugs are absorbed into healthy tissue causing negative side effects, and only a fraction of the administered drug actually reaches the tumor, making it less effective, said Mauro Ferrari, Ph.D, president and CEO of the Houston Methodist Research Institute. This new treatment strategy enables sequential passage of the biological barriers to transport the killing agent into the heart of the cancer. The active drug is only released inside the nucleus of the metastatic disease cell, avoiding the multidrug resistance mechanism of the cancer cells. This strategy effectively kills the tumor and provides significant therapeutic benefit in all mice, including long-term survival in half of the animals.

This finding comes 20 years after Ferrari started his work in nanomedicine. Ferrari and Haifa Shen, M.D., Ph.D., are co-senior authors on the paper, which describes the action of the injectable nanoparticle generator (iNPG), and how a complex method of transporting a nano-version of a standard chemotherapy drug led to never before seen results in mice models with triple negative breast cancer that had metastasized to the lungs.

"This may sound like science fiction, like we've penetrated and destroyed the Death Star, but what we discovered is transformational. We invented a method that actually makes the nanoparticles inside the cancer and releases the drug particles at the site of the cellular nucleus. With this injectable nanoparticle generator, we were able to do what standard chemotherapy drugs, vaccines, radiation, and other nanoparticles have all failed to do," said Ferrari.

Houston Methodist has developed good manufacturing practices (GMP) for this drug and plans to fast-track the research to obtain FDA-approval and begin safety and efficacy studies in

humans in 2017.

"I would never want to overpromise to the thousands of cancer patients looking for a cure, but the data is astounding," said Ferrari, senior associate dean and professor of medicine, Weill Cornell Medicine. "We're talking about changing the landscape of curing metastatic disease, so it's no longer a death sentence."

The Houston Methodist team used doxorubicin, a cancer therapeutic that has been used for decades but has adverse side effects to the heart and is not an effective treatment against metastatic disease. In this study, doxorubicin was packaged within the injectable nanoparticle generator that is made up of many components.

Shen, a senior member of the department of nanomedicine at Houston Methodist Research Institute, explains that each component has a specific and essential role in the drug delivery process. The first component is the nanoporous silicon material that naturally degrades in the body. The second component is a polymer made up of multiple strands that contain doxorubicin. Once inside the tumor, the silicon material degrades, releasing the strands. Due to natural thermodynamic forces, these strands curl-up to form nanoparticles that are taken up by the cancer cells. Once inside the cancer cells, the acidic pH close to the nucleus causes the drug to be released from the nanoparticles. Inside the nucleus, the active drug acts to kill the cell.

"If this research bears out in humans and we see even a fraction of this survival time, we are still talking about dramatically extending life for many years. That's essentially providing a cure in a patient population that is now being told there is none," said Ferrari, who holds the Ernest Cockrell Jr. Presidential Distinguished Chair and is considered one of the founders of nanomedicine and oncophysics (physics of mass transport within a cancer lesion).

The Houston Methodist team is hopeful that this new drug could help cancer physicians cure lung metastases from other origins, and possibly primary lung cancers as well.

More information: An injectable nanoparticle generator enhances delivery of cancer therapeutics, *Nature Biotechnology*, DOI: 10.1038/nbt.3506

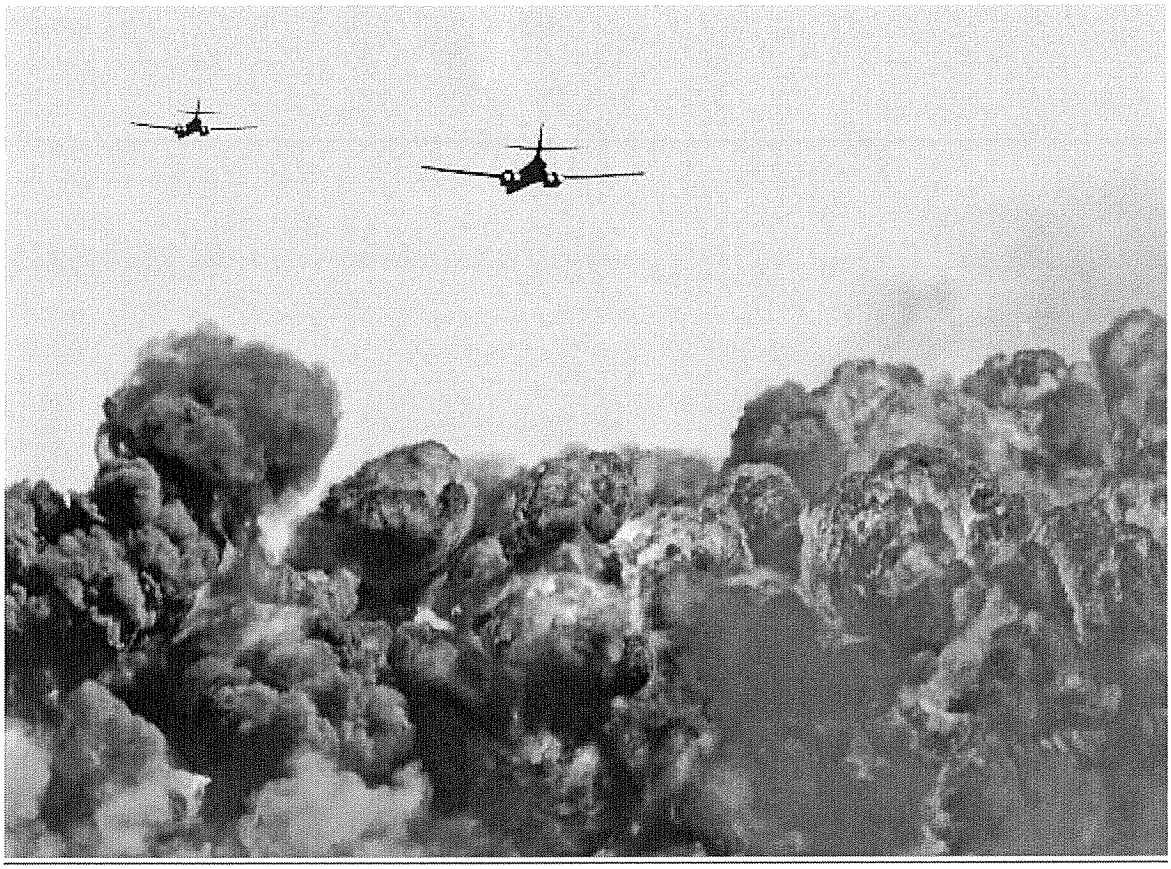
Provided by Houston Methodist

APA citation: Injectable nanoparticle generator could radically transform metastatic cancer treatment (2016, March 14) retrieved 17 March 2016 from http://phys.org/news/2016-03-nanoparticle-radically-metastatic-cancer-treatment.html

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P.W. Singer and August Cole Security Date of Publication: 08.07.15. 08.07.15

How Fiction Can Reveal the Horrors of Future Wars



Click to Open Overlay Gallery Getty Images

The fact that he couldn't feel the drill going into the back of his skull made the noise all the more terrifying.

His eyes darted around the room. He tried to turn his head, but he couldn't move. A computer display in front of him was all that he could see; the screen showed a surgeon drilling into a shaved skull. A puff of bone dust smoked up from the metal boring through the skull on the screen. Then the screen itself was covered with a fine white powder that wafted in from behind him. His vision blurred as some of the powder fell into his eyes. He tried to blink but couldn't. Someone outside his field of view squirted a liquid into his eyes and dabbed the corners as the liquid dripped out.

WIRED Opinion

About

P.W. Singer is Strategist at New America. August Cole is Non Resident Fellow at the Atlantic Council. They are the authors of Ghost Fleet: A Novel of the Next World War.

A second and third time, the drill bored through the skull on the video screen, sending more puffs of bone dust wafting over. He wanted to close his eyes to stop watching, but he couldn't. After the second squirt of liquid into his eyes, he realized it was because his eyelids were no longer there. He couldn't do anything, in fact, but watch as the surgeon began to insert thin fiber-optic wires into the

three holes in the skull. He knew the wires were filled with over five hundred electrodes, each as thin as a human hair, that would link the interrogator's computer with the electromagnetic signals of his brain.

The Power of What Ifs

Our new book *Ghost Fleet: A Novel of the Next World War* explores something quite scary: the risks of war breaking out between the US and Russia and China. The above scene may be the scariest moment in it, because it lays out how a real-world technology originally developed to aid the paralyzed and those suffering from PTSD (the brain-machine interfaces in DARPA's Braingate and SUBNET project, which are now migrating into things like video gaming), will also be used in terrifying new ways.

We both work in the policy world, exploring the technology and trends of the 21st century. Over the years, we have learned from various war games we helped organize for the military that narrative and storytelling can play a powerful role in illuminating real issues. Fiction can aid in truth telling by asking tough questions that might otherwise be too complex, too contrarian, or too uncomfortable to posit directly. Questions such as: Have we spent trillions of dollars on weapons that might let us down? Could ubiquitous sensors and artificial intelligence utterly change the way we think of humanity's role, not just in the economy, but also in war? And, perhaps most uncomfortable of all (because no one wants it but it must be weighed as a real risk) what would the 21st century version of full-out, great power, state-on-state warfare look like?

That's the question we felt compelled to dig into. Do we think such a war is inevitable? No. Let us repeat: No. But it is a risk in years ahead, given the geopolitical landscape (indeed, the Communist Party's official *People's Daily* newspaper has declared "A U.S.-China war is inevitable..." if the US doesn't change its policies in the Pacific, while leaders in both the US and Russia this last month declared the other their No. 1 threat), and therefore it's important to consider why it could happen and how to avoid it.

In exploring such futures, fiction can also flesh out a looming danger not just of a war, but new technologies used within it. One of the best examples of this is the story "Danger!" written by Arthur Conan Doyle just prior to the outbreak of World War I. He warned that the new technology of submarines would rewrite the rules of what was possible in war, turning strengths, like big fleets of battleships, into sunk costs, in both meanings of the term.

What technologies and trends are similarly about to rewrite the rules for the next iteration of warfare? During the next decade, the US will become an energy export powerhouse; the Internet of Things will move from marketing concept to a reality that operates in the background; while China's Navy will outnumber the Pentagon's fleet by over 100 warships.

That's the power of fiction: you can move the dial forward and explore "what ifs" (think HG Wells and how he envisioned the way a new device he called an "Atomic Bomb" might change the world). You can envision future worlds in new kinds of detail, and explore potential pathways in a way that is sometimes difficult in nonfiction and nearly impossible within bureaucratic confines.

Hacking an F-35

Worm banked the F-35B hard to the left immediately after takeoff. The jet shifted smoothly into forward-flight mode, and he tried to gain some kind of situational awareness, just like they'd taught him in flight school.

The AN/AAQ-37 electro-optical distributed aperture system fed his helmet with data from visual and IR sensors located around the plane, allowing him to "see" through the plane below. And what he saw was chaos. He'd once flown through a forest fire during a training mission in California's Sierra Nevada mountains; this was worse. All the smoke and debris in the air had created a swirl of darkness with patches of bright sun. Chinese drones darted in and out of the smoke at low levels, and on the deck, his squadron's fighters lay scattered about like puzzle pieces. He scanned up and around the sky and confirmed what he'd feared: his was the only U.S. jet in the air.

He started to check on the jet's other systems. No sound came over his radios. The fighter's GPS-coupled inertial navigation system was wrong, showing him as flying over Maui when he knew damn well this was Oahu. Electronically generated false targets flickered on the horizontal situation display and then disappeared. The plane, with its novel software systems and millions of lines of code, was designed to be its own copilot, capable of automation and interpretation never before possible in battle. But at this moment, Worm thought, the fifth-generation fighter was having trouble getting out of its own way, electronically speaking.

This section of our book illustrates one of the closest equivalents we may have today to Doyle's warning about submarines. Our ubiquitous digital systems, which have given us amazing new powers, have created unprecedented vulnerabilities. One of us broke the story on the F-35 program being hacked as far back as 2009, while the other has worked with business and government to mitigate the vast campaign of IP theft and espionage that has hit everything from defense contractors to Silicon Valley to most recently the Office of Personnel Management. With that background, the above fictional scene let us explore the ultimate risks of these cybertheft campaigns and connect them to how they would change the tide of an actual battle. Sound far-fetched? Well, last year the Pentagon's weapons tester found every single major weapons program had "significant vulnerabilities" to cyber attack.

And the cross of fiction and nonfiction can also crystalize issues and draw new insights, even on the most controversial debates. For example, an international campaign has called for the preemptive ban of "killer robots" (a narrative inspired in part by science fiction), culminating in a letter last week signed by nearly 2,000 scientists and technology leaders like SpaceX CEO Elon Musk, Apple co-founder Steve Wozniak and physicist Stephen Hawking. And yet, there are as many as 21 different current projects where AI technologies are being designed today to be used in a future war, as we explore in our book. They range from autonomous drones and AI battle management systems to submarine hunting robotics. If the campaign to stop this future is going to succeed, it will have to overcome such use cases being imagined for a future war, which is why these weapons are being worked on in the real world.

Such insights point to the utility of "useful fiction," which culminates in a wider reach. We've been asked to brief our book's findings with groups that range from 4-star generals and members of Congress to 600 Navy officers at the service's annual strategy conference. And the reason isn't just that novels are more fun to read than policy memos. Rather, packaging real world lessons within a fictional format lets people reflect on how many long-held assumptions about our world simply won't be true in the future.

And that may be the broader lesson from the experience. As our main character advises a young officer on how much the world is poised to change, "Just because you see the world one way today does not mean it will be that way tomorrow."

Posted: Feb 03, 2016

Cellulose aerogel made of paper waste is biodegradable, non-toxic, flexible and ultra-strong

(*Nanowerk News*) A research team from the National University of Singapore's (NUS) Faculty of Engineering has achieved a world's first by successfully converting paper waste into green cellulose aerogels that are non-toxic, ultralight, flexible, extremely strong and water repellent. This novel material is ideal for applications such as oil spill cleaning, heat insulation as well as packaging, and it can potentially be used as coating materials for drug delivery and as smart materials for various biomedical applications. This pioneering work was achieved by a team led by Assistant Professor Duong Hai Minh from the Department of Mechanical Engineering.

"Aerogels, which are among the lightest solid materials known to man, are one of the finest insulation materials available. Traditional aerogels are mainly made of silica, which is not environmentally-friendly. In contrast, cellulose is low cost and makes up 75 to 85 per cent of recycled paper. Our team developed a simple, cost-effective and fast method of converting paper waste into aerogels. In addition to low thermal conductivity, these novel aerogels have several unique features, one of which is super high oil absorption capacity - it is up to four times higher than commercial sorbents available in the market. We are very excited about the potential applications of this new material," said Asst Prof Duong.

Reduce environmental problems by recycling paper waste

The global production of paper is expected to increase to 500 million tonnes by 2020. The large amount of paper-related waste generated annually causes destruction of forestation and environmental pollution, and the enormous waste is also difficult to dispose. Recycling or converting paper waste into useful products, therefore, contributes towards environmental conservation.

The NUS team has also developed a more eco-friendly process to convert paper waste into aerogels.

"Our fabrication process uses 70 per cent less energy, produces fewer polluting emissions into the air and water, as well as uses less dioxins in the chlorine bleaching process. It is also faster – the entire process only takes three days," explained Asst Prof Duong.

Four times more effective than commercial oil sorbents

The novel cellulose aerogels developed by the NUS team boast super high oil absorption capacity. Coated with Trimethoxy-methylsilane (MTMS), the aerogels are water repellent and are capable of absorbing oil (excluding water) up to 90 times their dry weight, making them up

to four times more effective than commercial oil sorbents. Furthermore, they can be squeezed to recover over 99 per cent of the crude oil absorbed.

Elaborating on the potential application of the cellulose aerogels, Asst Prof Duong said, "Oil spills are serious disasters that threaten marine ecosystems. Sorption has been considered one of the most effective ways to clean oil spills. Polypropylene (PP)-based absorbents are widely used for oil absorption but they are non-biodegradable, and their absorption capabilities are both low and slow. Our novel cellulose aerogels therefore serve as an attractive alternative to current methods of oil spill cleaning, which has a potential market size of US$143.5 billion."

Super heat insulation materials

Another important application of the novel cellulose aerogels is to serve as insulation materials for buildings.

In Singapore, air-conditioning of buildings take up about two-thirds of the energy consumption in buildings. About 25 to 50 per cent of heat losses are from windows, doors, basement and roof of the buildings. These have resulted in a high market demand for eco-friendly sorbents which have greater absorbency and water repellent properties, as well as effective heat insulation materials that are less costly to install. Thermal insulation of buildings is estimated to have a potential market of US$3.3 billion globally.

"As a heat insulation material, our novel cellulose aerogels offer a few added advantages. Their water repellent property allows them to be adaptable to both dry and rainy weather and their structure remains stable for about six months in tropical climate. Being extremely strong, they increase building strength. In addition, these aerogels are lightweight and slim, resulting in slimmer walls, thus increasing building space," added Asst Prof Duong.

Potential applications aplenty

The novel cellulose aerogels developed by the NUS team could also signal a change in the packing industry. Plastic-based packing materials such as the bubble wrap could be replaced with biodegradable aerogel-based foam or advanced cellulose aerogel nanosheets, which are environmentally-friendly.

With high surface area and high porosity, the biodegradable aerogels could also be used as coating materials in drug delivery or as smart materials.

The NUS team has also discovered a way of expanding the weight capacity of the cellulose aerogels. This is done by infusing the fibres of the cellulose aerogels with a solution of metallic nanoparticles. The cellulose aerogels are then hammered flat to remove most of the air,

resulting in a magnetic thin film that has a weight capacity of over 28 tonnes per square centimetre.

MTMS-uncoated cellulose aerogels are hydrophilic, thus they can also absorb and retain huge volumes of polar fluids such as water and alcohol. Therefore, they can be used in products such as baby diapers and sanitary napkins.

In addition, compressed cellulose aerogels can be used to plug life-threatening wounds such as a gunshot or stabbing lesion by injecting them into the wound cavity. The sponges expand inside the cavity, creating pressure that can block bleeding and life-threatening haemorrhage in 20 seconds or less. This incredible speed is a remarkable boon, which could greatly enhance survival rates.

From idea to market

The team has filed a patent for their invention in USA, China, India and Southeast Asia. The technology has been licensed by the NUS Liaison Office, which is part of NUS Enterprise, to Bronxculture Pte Ltd in November 2015 for commercialisation. Bronxculture intends to manufacture the cellulose aerogels and further expand its applications in three areas, namely, insulating materials for packaging boxes, insulating layer for winter garment and oil absorption materials.

Source: *National University of Singapore*

Read more: Cellulose aerogel made of paper waste is biodegradable, non-toxic, flexible and ultra-strong

OFTALMOLOGIE

Electronics

Electronic Glasses That Treat "Lazy Eye"

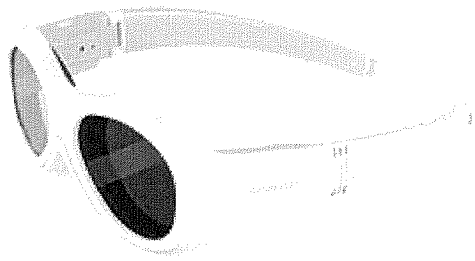
Charles Heschmeyer

19 January 2016

One of the most common vision problems in children is lazy eye, or amblyopia, a condition in which the vision in one eye does not develop normally during early childhood. Common treatments are eyepatches or medicated eye drops. Both treatments can be challenging for ophthalmologists and parents because children tend to show strong resistance to them. Failure to follow these treatments is the number one cause of children going blind in one eye.

Now, the U.S. Food and Drug Administration (FDA) has approved a new type of treatment: electronic glasses that combine both vision correction and occlusion therapy in one device.

Trademarked Amblyz, the glasses are the creation of XMD, a spinoff of the European company XPAND, a leader in active shutter 3D eyewear for movie theaters, gaming and home entertainment. The colorful lightweight plastic frames are designed to appeal to kids and the glasses themselves look like a mix of everyday prescription eyewear and sunglasses.



The electronics glasses have won approval from the U.S. Food and Drug Administration. Image source: xpand.meBecause lazy eye is mostly a condition of de-activated or neglected neural pathways between one eye and the brain, the treatment of lazy eye is based on the occlusion principle: by blocking the vision in the stronger eye, the brain is stimulated to use the weak eye to see, which ultimately improves vision in the weak eye.

How They Work

The Amblyz liquid crystal display, or LCD, lenses are made of shatter-proof laminated glass that features an electronic shutter controlled by a pre-programmed microchip embedded in the frame. Powered by a rechargeable Li-ion battery, the microprocessor controls the shutter, allowing it to turn opaque and intermittently occlude the stronger eye to treat the weaker one.

For XPAND, the biggest engineering challenge wasn't the shutter technology, which has been applied in entertainment markets for more than a decade, but coming up with a kid-friendly product.

"Designing a product that was exclusively targeted at young children in the age range of 3-10 years was new for us," says Karel van Gorp, XMD co-founder and product development director.

Unexpected requirements came up, for example the absence of buttons. Van Gorp says that small children love to push buttons so including them on a device could compromise the treatment. Eventually, however, the main challenge was finding the optimum among robustness, light weight and comfort. "Choosing the right medical grade materials was key," he says

Shutter Technology

Active shutter technology is based on two properties of liquid crystals, or LCs. They align in a specific direction under the application of an electric field, and they influence the polarization of the light passing through them. The LCs are placed between two glass layers covered by a polarizer to form a shutter lens. Without an electric field, the lenses are transparent, but with a slight tint. When the electric field is applied over the LCs they align in such a way that they polarize the light in the direction opposite to the polarizer, thereby blocking all the light from passing through. This results in the eye being occluded behind the lens.

By modulating the electric field, the occlusion can be controlled up to very high frequencies. At XPAND, engineers manipulate the open and closing of the shutters in the realm of 10 microseconds, allowing virtually any desired occlusion frequency and pattern.

Breakthrough Treatment

Creating a viable, FDA-approved alternative to the adhesive eyepatch was itself an advancement in treating amblyopia, says Daniel Neely, MD, Professor of Ophthalmology at the Glick Eye Institute at the Indiana University School of Medicine. "This form of standard therapy has not changed in the last 50 years, so the new treatment with the LCD glasses is definitely a breakthrough."

The eyepatch can be a source of embarrassment, discomfort and even trauma in children, preventing it from being an effective therapy for many patients. "When we talk to adults who were patched as children, they always describe what a horrible experience it was," Neely says. "It is traumatic for children and families."

Not only are the new glasses as effective as the patch for correcting moderate amblyopia (vision of 20/40 to 20/100), but it even may be superior for more severe amblyopia and noncompliant patients. "The reason is that the glasses are more enjoyable and permit normal vision every 30 seconds from the good eye whereas adhesive patches require covering the good eye continuously for two to six hours or more straight," Neely says. Children who cannot see well do not tolerate this very easily, he says. Neely is a specialist in pediatric ophthalmology involved in the Amblyz study presented at a November 2015 meeting of the American Academy of Ophthalmology.

Typically, the treatment course for amblyopia runs six to nine months, but in some cases significant improvement in vision can be noted in as little as three months. "The glasses have been amazingly effective at treating amblyopia," Neely says. "So far we have found them to be 100% equal to the traditional form of treatment."

In fact, the programmable LCD glasses have proven so effective in treating moderate amblyopia that research is underway to apply the technology to treat more severe vision impairments including strabismus (misalignment of the eye, either inward or outward), myopia, hyperopia and astigmatism.

Market

About 4% of all children suffer from lazy eye and another 4% from strabismus. Because of some overlap in the conditions, this means that the conditions are present in around 7% of all births

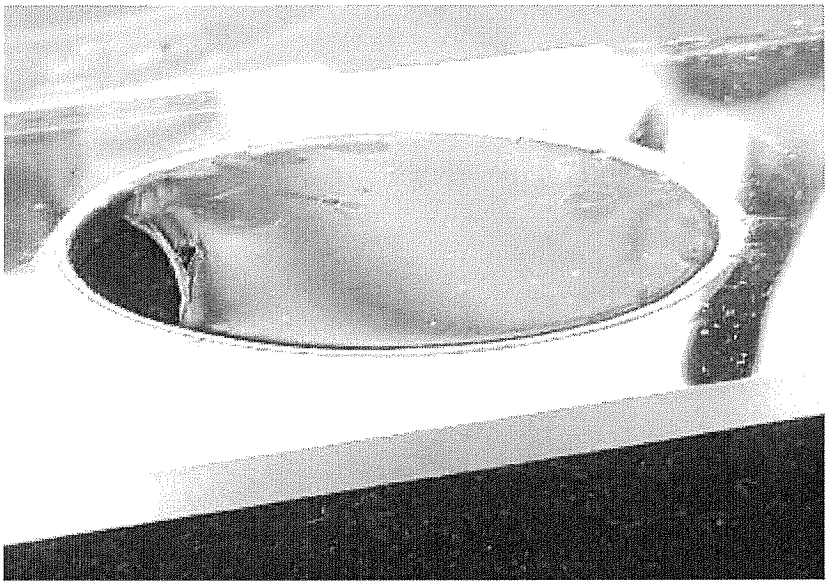
annually, resulting in about 300,000 new patients each year in the U.S. "We're determined to help improve the quality of life and saving the eyesight of as many children as possible," says XMD's van Gorp. "We have an extensive pipeline of new applications of our wearable medical technology lined up, both in vision care and in other fields of neurostimulation."

Posted: Mar 01, 2016

Physicists get a perfect material for air filters

(*Nanowerk News*) A research team from the Institute of Theoretical and Experimental Biophysics of the Russian Academy of Sciences have synthesized the material that is perfect for protection of respiratory organs, analytical research and other practical purposes. An almost weightless fabric made of nylon nanofibers with a diameter less than 15 nm beats any other similar materials in terms of filtering and optical properties.

The scientists whose work is published in *Macromolecular Nanotechnology Journal* ("Filtering and optical properties of free standing electrospun nanomats from nylon-4,6"), characterize their material as lightweight (10-20 mg/m2), almost invisible (95% light transmission: more than that of a window glass), showing low resistance to airflow and efficient interception of <1 micrometer fine particulate matter.



A sample of the new fabric in reflected light. (Image courtesy of the researchers)

The wording "nanofibers" in the researchers' article is more than a fashion statement. Previously, the same team demonstrated that reducing fiber diameter from 200 nanometers down to 20 decreased filter resistance to airflow by two thirds, and this effect could no longer be explained by classical aerodynamics. When an obstacle size is smaller than the free path of gas molecules, the standard methods estimating aerodynamic resistance based on the continuum theory no longer work. In normal conditions, the mean free path of air molecules makes 65 nanometers.

The mean free path is the average distance one molecule manages to cover before colliding with another. Only if all obstacles are much bigger than this value, the free stream coming at them can be rightfully considered a continuous medium.

The scientists used the technique called electrospinning: a jet of a dissolved polymer is ejected through a special nozzle aiming at a target under action of an electric field. From the other side, ethanol is electrosprayed. The polymer jet and the alcohol ions take the opposite electric charges. Colliding in the air, they form ultra-thin fibrous films. Electrospinning technology as a way to produce nonwoven fibrous filters has been developed back in the 50s to purify air in atomic industry. However, the researchers introduced an important improvement: instead of obtaining nanomats on a solid conducting substrate like before, now with the new technology, a free filter is formed covering a 55-mm hole in a non-conductive polycarbonate screen.

The published work completed the cycle of the authors' papers devoted to development of the manufacturing technology and studies of properties of nanofilters manufactured using this new process. It was established that the unique optical and filtering properties originate from a special mechanism of "healing" holes and defects in free standing filters. Such holes literally attract fibers landing onto the filter surface. As a result, a good filter without big holes can be obtained from a minimum amount of nanofibers and, accordingly, with a minimum resistance to airflow. Moreover, active healing of big holes between threads provides the filters with the properties inherent in filters with calibrated pores, so called track-etched membranes (Nuclepores). The scientists have also demonstrated that the "healing" mechanism does not work in the conventional electrospinning technique where nanofibers are deposited onto a conducting substrate completely at random.

The testing of nylon-4,6 electrospun films showed that thess almost weightless and invisible fabrics trap no less than 98% of airborne dust particles. For testing, the scientists used particles from 0.2 to 0.3 micron in diameter. This roughly corresponds to the dust that is not caught by the nasal pharynx, and penetrates the lungs causing a number of dangerous medical conditions. Submicron particles (< 1 micrometer in diameter) are the ones also used to test industrial and medical filters. To assess performance, resistance to airflow is tested as well.

Experiments to measure resistance have been made on singular samples so far. In real filters a multi-layer surface with a complex configuration is normally used. The experiments showed that the nylon-4,6 filtering material had the best properties out of all types of fabric previously described . In terms of interception extent to filter weight ratio and interception-resistance to airflow ratio, the new filtering material beats any existing equivalents by several times.

At first it looks like a ring sitting on a sheet of paper. In reality, it is a sample of the new fabric for filters. The small red spot on top of "I" letter is a spot wherea laser beam penetrates the film. Low intensity of dispersed light demonstrates high transparency of the new material. A transmission index of the new product is higher than that of a good window glass. The picture is courtesy of the researchers.

Speaking about possible applications of this material, the scientists claim it is more than the obvious air and water purification from particulate matter. Since the material surpasses glass in transparency, it can be used in biological research. For example, after pumping air or water through the new filter intercepted microorganisms may be directly observed right on the transparent filter under a microscope. Again, this effect is due to ultra-fine threads. Their thickness is significantly less than even visible light wavelength.

Source: *Moscow Institute of Physics and Technology*

Read more: Physicists get a perfect material for air filters

3r

October 2012

A Guide to the Specification of LED Lighting Products 2012

This Guide has been produced under the umbrella of the Lighting Industry Liaison Group and is endorsed by its member organisations:

HEA
Highway Electrical Association

PLDA
Professional Lighting Designers Association

Society of Light and Lighting

ILP
Institution of Lighting Professionals

Lighting Industry Association

IALD
International Association of Lighting Designers

1.0 Introduction

The rise of LED lighting is driving a significant transformation of the lighting industry. LEDs can provide a palette of millions of colors and dynamic effects that conventional lighting cannot match in terms of design, scene-setting and ambience. Thanks to their miniaturized dimensions and low heat radiation, they can be embedded almost anywhere. And being digital, they are programmable, offering unlimited scope for creative use and effective management. They offer long lifetimes, energy and maintenance savings, making them potentially an efficient solution.

This is the fourth edition of the guidance notes produced under the umbrella of the Lighting Liaison Group, which is an informal group representing the major lighting organisations in the UK who have endorsed and added their names to this Guidelines document. They introduce a universal set of quality criteria from the IEC/PAS documents. As a user of LED luminaires it is important to apply the same set of standardised quality criteria when evaluating manufacturer's claims. Users of LED luminaires should always ask for LED luminaire specifications measured in compliance with the new IEC/PAS documents. This will allow all interested parties to judge comparison claims on an equal, like-for-like basis serving the interests of end-users, specifiers, designers and manufacturers.

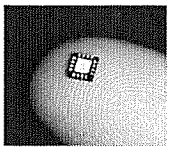
Summary

Typical questions a user should ask are shown below. More detail is given in further sections of this guide.

Question	Answer	Realistic Performance Indications	Evidence required
How is life defined?	By a combination of lumen maintenance and failure fraction.	Life should always be stated as: 1. Light Loss - Usually either L90 or L70 (L50 for decorative luminaires) – no. of hours; and 2. Physical Failures - LED Life F10 – no. of hours E.G. If the rated life of a product is 50,000 hours, this means light loss of L70 and physical failures of Fx (where x is the percentage no. of failures) at the rated life of 50,000 hours. (Note: it should be assumed that the manufacturer has tested to a maximum of 6000 hrs and extrapolated beyond that – unless they explicitly state differently)	See section 2.0
What is the lumen depreciation?	Rate and percentage of light loss	Light output > 90% of initial Code 9 Light output > 80% of initial Code 8 Light output > 70% of initial Code 7	See section 3h
What is the colour rendering index?	The rated CRI should include any shift over life.	Initial CRI and CRI change.	See section 3f
How stable is the Colour temperature?	Defined by the initial colour variation & colour variation through life	Within a 1-step ellipse Within a 3-step ellipse Within a 5-step ellipse Within a 7-step ellipse Greater than a 7-step ellipse	See section 3g
What ambient temperature is the luminaire performance based on?	For indoor 25°C for outdoor 15°		
What is the photometric distribution?	Measurement of the light intensities at various angles in absolute units	Candelas (cd) and degrees	See section 3n
Driver current	The current at which the LED's are driven	Measured in mA	
Power Factor	The power factor for the whole circuit	0.85 or better.	

The following terms are used in the guidance document:

LED Die -
The LED die (or chip) is the funamental light source.



LED Package -
The LED die is contained in a suitable package allowing simplified electrical connection or assembly.



LED Module -
This is the LED together with mechanical and optical components making a replaceable item for use in a luminaire.



LED Luminaire -
This is the complete system consisting of all elements described in Section 1.



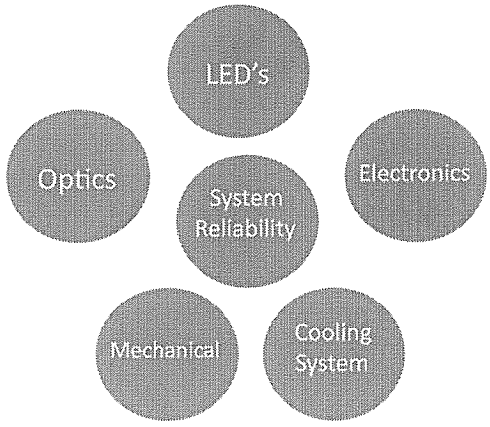
2.0 System Reliability

Most quality criteria are linked to the initial performance requirements of LED modules and LED luminaires. For maintained values 25% of rated life time up to a maximum of 6.000 hours is used. There is no measurement of lifetime above 6.000 hours. Accelerated test methods providing more advanced insight in lumen depreciation over LED module and/ or LED luminaire life are under consideration. However it is important to keep in mind that lifetime claims based on lumen maintenance and luminaire life are two very different things. The lifetime claims based on lumen maintenance refers to the lumen maintenance projections of the LED light sources integrated into that luminaire. Lifetime claims based on luminaire life relate to physical failures.

Currently many LED luminaire manufacturers use test results provided by LM-80 (IES LM-80-08. Approved Method: Measuring Lumen Maintenance of LED-Light Sources – Illuminating Engineering Society of North America, 2008. It consists of a real measurement over the first 6000 hours combined (with an extrapolation out to end of life) as the L90, L70 and L50 lumen maintenance thresholds of LED luminaires. But there is a disconnection between the LM-80 test results made by the LED die manufacturer and the results from the LED luminaire where, for example, issues such as thermal management can change the actual performance. LM-80 requires testing of LED light sources for 6.,000 hours, and recommends testing for 10.,000 hours. It calls for testing at three surface temperatures (55° C, 85° C, and a third temperature to be determined by the manufacturer) so that users can see the effects of temperature on light output, and it specifies additional test conditions to ensure consistent and comparable results. In practice, leading LED light source manufacturers test their products to the LM-80 minima of 6.000 or 10.000 hours, and then apply extrapolation methodologies as described in TM-21 (IES TM-21-11. Projecting Long Term Lumen Maintenance of LED Packages – Illuminating Engineering Society of North America, 2011) to arrive at L90, L70 and L50 figures. Luminaire manufacturers translate these curves into LED luminaire specific curves.

There are two constraints in translating these test results into LED luminaire performance. First catastrophic failures of individual LEDs and other failure modes of light output depreciation are not taken into consideration. Second there is no validated way to translate the lumen maintenance curve of an individual LED-light source into a curve for the LED-luminaire.

Luminaire life, on the other hand, has to do with the reliability of the components of a LED luminaire as a system.



Factors affecting the system performance are:

LEDs -
While LEDs do not radiate heat, with current products half or more of the input energy may be converted to heat that must be conducted away from the diodes.

Optical -
LEDs are directional light sources, giving the lamp or luminaire designer new challenges when compared to existing lamp technology. The use of reflectors, lenses and diffusers allows a designer to direct light in many different ways. The efficiency and depreciation of the optical system must be considered and factored into the overall efficiency of the luminaire.

Mechanical -
The mechanical integrity of a luminaire is important in several different areas including: IP rating to suit the application, heat-sinking that will not become compromised with time, lack of maintenance, vibration resistance so the heat-sink does not become detached from the PCB, bonding mechanisms that are suitable for the life of the luminaire. Many LEDs and specifically phosphor can react to different chemicals. Some gaskets can out-gas chemicals which can affect the performance of some LEDs. A luminaire manufacturer should work with the LED supplier and qualify any new gasket materials.

Cooling system -
The performance of a LED is dependent on its temperature during operation. The design of the luminaire will influence its operating temperature and hence published characteristics. The paint finish/ colour may affect the heat dissipation from the luminaire. A PCB is the interface between a LED and the heat-sink and has a thermal resistance value. The higher the resistance the less efficient the system is at conducting away heat from the LED. This may well impact on the LED lumen output performance and ultimately its life.

Electronics -
Electrical overstress is a cause of catastrophic failure of LEDs. Some LEDs contain an on board Transient Voltage Suppression chip (TVS), which provides some level of protection. A well designed lamp or luminaire will feature the necessary design or protection in order to minimise damage at installation or power-up. Failure rate of the external control gear shall be included in the overall assessment of total life/failure rate.

The entire system lasts only as long as the critical component with the shortest life, whether that critical component is a weather seal, an optical element, a LED, an electronic control gear circuit or something else. LED light sources are simply one critical component among many, although they are often the most reliable component in the whole lighting system.

Because the reliability of LED luminaires is in most cases much longer than the practical test times, verification of manufacturer's life time claims need to be made in a sufficiently confident way. For that reason the acceptance or rejection of a manufacturer's life time claim, past 25 % of rated life (with a maximum of 6.000 hours), is out of the scope of both the IEC/PAS documents. In order to validate a life time claim, an extrapolation of test data is needed. There is no validated way to translate the lumen maintenance curve of an individual LED Light source into a curve for the LED Module or LED luminaire.

Life testing of the LED light source is carried out according to LM-80 up to 6000h or 10,000h. Beyond these values statistical predictions are made (see. Fig 1). If LED Light source data from tests carried out to 6000h is available, LED Modules and LED Luminaires may have life testing carried out to 2000h. Accelerated test methods for projecting measurement data beyond limited test time is currently under consideration.

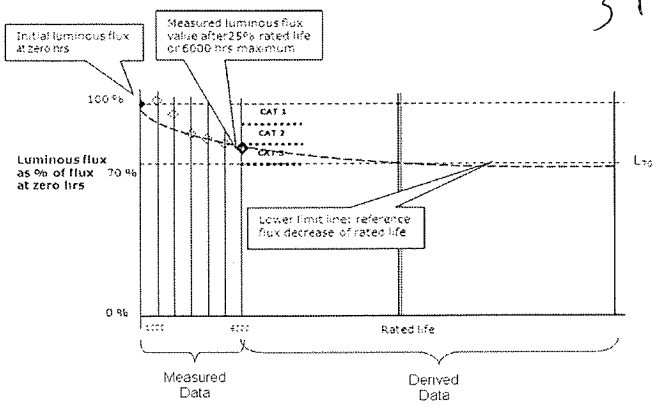


Fig1

3.0 Quality Criteria

The IEC published two Public Available Specification (PAS) performance requirement documents dealing with LED products.

- IEC/PAS 62717 Performance requirements – LED modules for general lighting
- IEC/PAS 62722 Performance requirements – LED luminaires for general lighting

These were developed together to provide:
- the definition of a set of quality criteria related to the initial specifications of a product;
- a standardised description on how to measure these quality criteria.

To ensure consistency in quality criteria, definitions and measuring methods, most of these are defined in IEC/PAS 62717. The luminaire standard IEC/PAS 62722 under certain conditions allows the use of compliant modules to reduce the number of tests for LED luminaires. This makes manufacturers claims of initial specifications of LED- modules and luminaires comparable.

The following list of quality criteria should be considered when evaluating manufacturer's claims:

a) *Rated input power* -
The rated input power shows the amount of energy consumed by a luminaire, including its power supply. It is expressed in watts.

b) *Rated luminous flux* -
This is the light emitted by the luminaire which is expressed in lumens. For traditional (non LED) luminaires it is usual that *Relative* values are measured and multiplied by the lamp flux. For 'LED' luminaires it is recommended that *Absolute* photometric values are used. Absolute photometry results in a LOR=1.

c) *LED luminaire efficacy* -
The measured initial luminous flux divided by the measured initial input power of the same individual LED luminaire. It is expressed in lumens per watt.

d) *Luminous intensity distribution* -
The spatial distribution of the luminous flux graphically depicted in a luminous intensity distribution curve, which is usually expressed in a polar diagram representing the light intensity as a function of angle about a light source. It is expressed in cd.

e) *Correlated Colour Temperature (CCT)* -
Although white light is a mixture of colours, not all whites are the same since they depend on their constituent colours. So a white with a higher proportion of red will appear warmer and a white with a higher proportion of blue will appear cooler. In order to classify the different types of white light, the concept of colour temperature is applied which is described as the colour impression of a perfect black-body radiator at certain temperatures. This concept can be best explained with the help of familiar thermal radiators like the filament of an incandescent lamp or an iron bar. When these materials are heated to a temperature of 1000 K their colour appearance will be red, at 2000-3000 K they will look yellow white, at 4000 K neutral white, and at 5000-7000 K cool white. The higher the colour temperature, the cooler the perception of the white light becomes. It is expressed in Kelvin. The initial CCT value classification for the photometric code can be obtained by taking the initial CCT value divided by 100.

f) *Rated Colour Rendering Index (CRI)* -
Although light sources may have the same colour appearance, this doesn't necessarily mean that coloured surfaces will look the same under them. Two lights that seem to have the same white colour appearance may be the result of different blends of wavelengths. As a result a given material may appear differently since the surface may not reflect the constituent wavelengths by the same extent. Its colour appearance will change when it is exposed to one or other light. So, colour rendering is an important criterion when selecting light sources for lighting application solutions. However with new LED technology coming in, with a narrow spectrum, the CRI index is not in all circumstances giving a fair representation of the colour appearance. New definitions and methods for measuring are currently under development in CIE. The initial CRI value classification for the photometric code can be obtained by using the following intervals:

Code	CRI Range	Colour rendering properties
6	57-66	Poor
7	67-76	Moderate
8	77-86	Good
9	87-100	Excellent

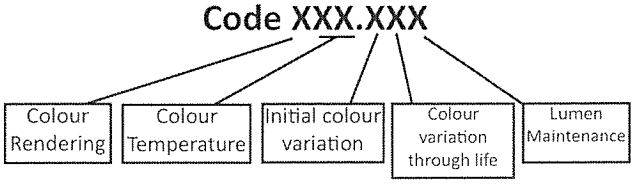
g) *Rated chromaticity co-ordinate values both initial and maintained* -
MacAdam ellipses refer to the region on a chromaticity diagram which contains all colours which are indistinguishable to the average human eye, from the colour at the centre of the ellipse. The contour of the ellipse therefore represents the just noticeable differences of chromaticity. MacAdam ellipses are often scaled up to a larger size of 3x, 5x or 7x the original. This is indicated as a 3-step, 5-step or 7-step MacAdam ellipse. Initial variations in colour, or colour shift with time can be shown by the size of ellipse needed to contain these positions. The initial and maintained chromaticity co-ordinates are measured for the maintained value at 25% of rated life up to a maximum of 6.000 hours. The classification for the photometric code can be obtained by using the following intervals.

Size of MacAdam ellipse, centered on the rated colour target	Colour variation category	
	initial	maintained
3-step	3	3
5-step	5	5
7-step	7	7
>7-step ellipse	7+	7+

h) *Lumen maintenance code* -
As the typical life of a LED luminaire is (very) long, it is time-consuming to measure the actual lumen reduction over life. Also the actual LED behavior with regard to lumen-maintenance may differ considerably by type and manufacturer. It is not possible to express the lumen-maintenance of all LEDs in simple mathematical relations. A fast initial decrease in lumen output does not automatically imply that a particular LED will not make its rated life. In order to validate a life time claim, an extrapolation of test data is needed. In the IEC a general method of projecting measurement data beyond limited test time is under consideration. In the US an extrapolation based on LM-80 test data will be described in IES TM-21. Instead of life time validation, the IEC/PAS has opted for lumen maintenance codes at a defined finite test time. Therefore, the code number does not imply a prediction of achievable life time. The maintained luminous flux is measured at 25% of rated life time up to a maximum of 6.000 hours and expressed as a percentage of the initial value. The maintained value determines the lumen maintenance code.

Lumen maintenance (%)	Code
>90	9
>80	8
>70	7

i) *Photometric code* -
A six digit photometric code that displays the important 'quality of light' parameters: CRI, CCT, chromaticity co-ordinates and luminous flux. The six digit photometric code displays the important 'quality of light' parameters.



Example:
Initial CRI value of 84 – code 8
Initial CCT value of 3000K – code 30
Initial spread of chromaticity co-ordinates within a 3-step MacAdam ellipse – code 3
Maintained spread of chromaticity co-ordinates within a 5-step MacAdam ellipse – code 5
Maintained luminous flux of 91% – code 9
Photometric Code = 830/359

j) *Rated life (in h) of the LED module and the associated rated lumen maintenance (Lx)* -
The length of time expressed in hours, during which a population of LED modules provides more than the claimed percentage (x) of the initial luminous flux always published in combination with the failure fraction. The recommended series of values for (x) is 70, 80, 90.

k) *Failure fraction (Fy), corresponding to the rated life of the LED module in the luminaire* -
The percentage (y) of a number of LED modules of the same type at their rated life that have failed. This failure fraction expresses the combined effect of all components of a module including mechanical, as far as the light output is concerned. The recommended series of values for (y) is 10, 50.

l) *Ambient temperature (ta) for a luminaire* -
The ambient temperature around the luminaire related to the specified performance. For a given performance claim the ambient temperature (ta) is a fixed value. It is possible to specify performance claims at different ambient temperatures. If the LED luminaire is to be used at an ambient temperature different to that at which it was tested, correction factors will need to be applied to the performance criteria. It is expressed in degrees Celsius.

m) *Power Factor* -
The power factor should be clearly stated in all cases. Although product standards may not require this below 26W, it should be noted that some clients, and in particular contractors and local authorities working with un-metered supplies (the majority of public lighting in the UK), will require power factor correction of 0.85 or better.

n) *Intensity Distribution** -
Photometric data is available in two formats. Absolute Photometry does not require the use of a separate lumen output for the light source. Relative Photometry requires the LED package flux to be quoted. Both methods produce the same result. For LED luminaires Absolute photometry shall be used.

Absolute photometry of LED luminaires should be conducted according to IES LM-79-08 Photometric Measurements of Solid-State Lighting Products. Relative photometry should be conducted according to EN13032-1 (2004) Light and lighting - Measurement and presentation of photometric data of lamps and luminaires - Part 1: Measurement and file format.

These standards contain advice on measurement uncertainty. Photometric results that are calculated by deviation from the tested sample by the use, for example of higher or lower drive currents or dies from bins other than the bin used for the tested device are to be clearly identified as such. Correction factors used are to be provided with the results.

**Applicable for luminaires which modify the distribution of the light source.*

o) *Drive Current* -
For proper operation, the power supply and electronics must provide a well-controlled DC drive current. Drive current affects LED operating temperature and thus life and output. Normally around 350mA is quoted but this can be higher. The higher the LED is driven the brighter it will be but it may have a shorter operation lifetime and be less efficient. Some of the new multi die LEDs are designed to operate and perform at higher drive currents. Declaration of the drive current is important when remote drivers are used.

p) *Optical Risk* -
The Control of Artificial Optical Radiation at Work Regulations 2010 apply to light emitted from all artificial light sources including LEDs. These regulations require employers to protect the eyes and skin of workers from exposure to hazardous sources of artificial optical radiation. Exposure limits defined in the standard EN-62471 are in European regulation (directive 2006/25/CE) These are a combination of source power and exposure time.

Risk Group 0	Exempt
Risk Group 1	Low
Risk Group 2	Moderate
Risk Group 3	High

When light sources are placed in a luminaire, the Risk Group classification can change due to the optics used in the luminaire.

4.0 Luminaire manufacturers design data

When evaluating LED luminaire performance claims it is important to compare a standardised set of quality criteria measured in compliance with the appropriate standard. These quality criteria are designed to ensure that performance claims can be matched against traceable data.

This data is summarised below:

1) Rated input power (in W)
2) Rated luminous flux (in lm)
3) LED luminaire efficacy (in lm/W)
4) Luminous intensity distribution
5) Photometric code
   5a) Correlated Colour Temperature (CCT in K)
   5b) Rated Colour Rendering Index (CRI)
   5c) Rated chromaticity co-ordinate values (initial and maintained)
   5d) Maintained luminous flux
6) Rated life (in h) of the LED module and the associated rated lumen maintenance (Lx)
7) Failure fraction (Fy), corresponding to the rated life of the LED module in the luminaire
8) Ambient temperature (ta) for a luminaire
9) Power Factor
10) Intensity Distribution
11) Drive Current
12) Optical Risk

Product Type	Safety Standard	Performance Standard
Self-ballasted LED-lamps for general lighting services >50V	IEC 62560 Edition 1Publication expected 2010	IEC 62612/PAS Publicly Available Specification
Control gear for LED modules	IEC 61347-2-13 Published 2006	IEC 62384 Published 2006
LED modules for general lighting	IEC 62031 Edition 1 Publication 2008	IEC/PAS 62717 Published 2011
LED luminaires	IEC 60598-1	IEC/PAS 62722-2-1 Ed. 1: Luminaire performance - Part 2-1: Particular requirements for LED
LEDs and LED modules	IEC TS 62504 Terms and Definitions for LEDs and LED modules in general lighting	
CIE Technical Committees	TC2-46 CIE/ISO standards on LED intensity measurements	
	TC2-50 Measurement of the optical properties of LED clusters and arrays	
	TC2-58 Measurement of LED radiance and luminance	
	TC2-63 Optical measurement of High-Power LEDs	
	TC2-64 High speed testing methods for LEDs	

3 r

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West Sussex
BN12 6PG

Highway Electrical Association

Institution of Lighting Professionals
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Regent Place
Rugby
CV21 2PN

Institution of Lighting Professionals

PLDA
Office Administration
Haller Str, 209
33334 Gütersloh

PLDA
Professional Lighting Designers Association

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3 Albert Embankment
London
SE1 7SL

Lighting Industry Association

Society of Light and Lighting
222 Balham High Road
London
SW12 9BS

Society of Light and Lighting

The International Association of Lighting Designers
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Chicago, IL 60654
USA

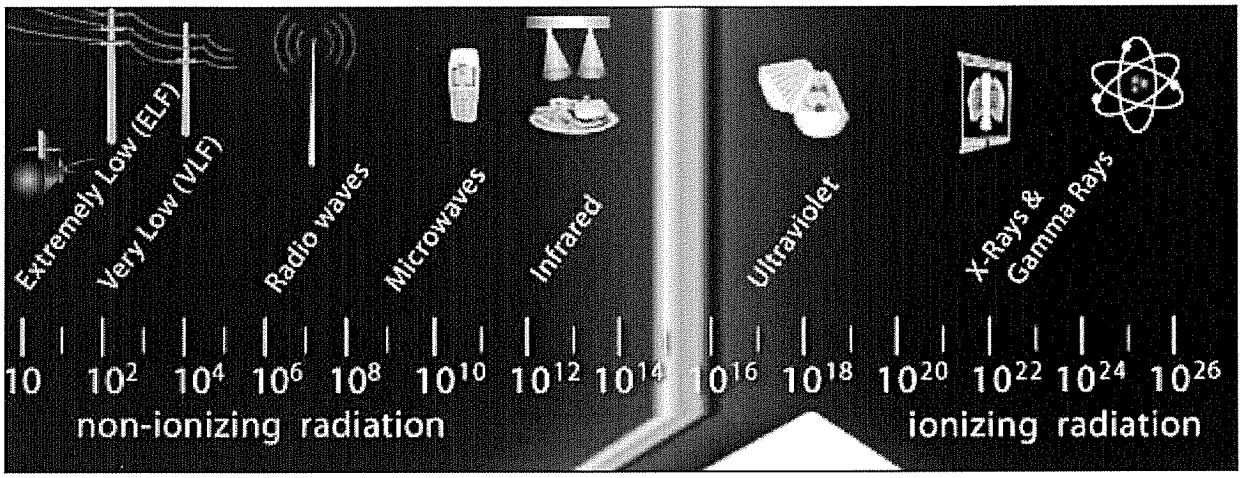
IALD
International Association of Lighting Designers

What Are The Uses For UV LED Light?

Posted on Jul 28, 2014 in Commercial, Industrial | Comments Off on What Are The Uses For UV LED Light?

Until relatively recently there was no such thing as a commercially available ultraviolet (UV) LED light. But as LED technology continues to develop and power densities increase, UV LED lights are expanding into the market and replacing more traditional alternatives.

Ultraviolet (UV) light is an invisible form of electromagnetic energy (light energy) that travels at a higher frequency and carries more energy than visible light. UV lightwaves were originally called "chemical rays" when first discovered in the 19th century because of their ability to cause certain substances to change at the molecular level.



Here are a few examples of the many applications for UV LED lighting:

Industrial and Cosmetic Curing

UV curing is a process that uses UV light to instantly cure (or "dry") inks, coating and adhesives through cross-polymerization of photosensitive materials. UV LED technology is emerging as an ozone gas- and mercury-free option for chemical curing with both industrial and cosmetic applications.

Nail polish cures have traditionally been done using unregulated UV lamps, but controversy arose earlier this year over a study published in the Journal of the American Academy of Dermatology which reported a potential danger of skin cancer. The study found that LED lamps were much safer for this application, due to the lower frequency of UV light they emit.

Analytic Tools

Due to UV lighting's ability to make certain materials visible to the human eye, it has been used for quite some time as an analytic tool. One common use for ultraviolet light sources is checking UV watermarks to validate currency, or identifying bodily fluids in forensic crime scenes.

Scientific and Biological

A 2012 study published in Applied Entomology and Zoology showed that UV LED lights were an effective method for dealing with the West Indian sweet potato weevil. This disagreeable insect is

known for decimating sweet potato crops, and detection is difficult due to the fact that most adult activity happens during the night.

The study used a diffused UV LED light trap and a sacrificial sweet potato. This easily detected the pests, allowing farmers to take appropriate actions in response.

Sterilization and Disinfection

UV lighting is an excellent tool for air and water purification. In fact, in addition to avoiding the energy hungry dryer, another reason for hanging clothes outside to dry is that the sun's natural UV light kills potentially harmful bacteria on clothes.

According to a 2007 study published in Medical & Biological Engineering & Computing, UV LED light sources were able to deactivate bacteria in water. Due to the safety advantages and compact size of LED lights, the study reported that UV LED devices have great potential as water sterilization solutions.

Indoor Gardening

UV LED lights are playing an increasing role in the trend toward indoor urban gardening. Using UV LED lights for your indoor harvest can increase production of polyphenols, which are believed to have antioxidant and anti-aging qualities. In addition to edible gardening, UV lights supposedly have beneficial applications for resin-producing plants such as medical marijuana by increasing potency of its medicinal properties.

Health Properties

Faroese physician Niels Finsen, the father of modern phototherapy, developed the first artificial UV light source to treat smallpox lesions. Although later eradication of smallpox rendered his technology irrelevant, UV phototherapy is used today to treat certain skin conditions including psoriasis and vitiligo as well as inhibit the growth of a certain type of skin cancer. According to the American Cancer Society, researchers found that when used alongside other treatments, UV lights resulted in long-term remission among many patients in early stages of the disease.

For psoriasis, an inflammatory skin condition caused by immune system malfunction, UV light works to suppress the immune system and reduce the inflammatory response.

Dangers of UV light

Exposure to UV radiation can damage skin and eyes if used without protection. Safety precautions should be used with UV LED lighting, with skin and eye protection used whenever possible.

Contact Flexfire LEDs to learn more

Are you interested in purchasing a UV LED light, or do you have any unanswered questions? Contact us or give us a call at (925)273-9080 and let one of our lighting specialists help you realize your LED project today.

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(https://www.goldengadgets.com/catalog/product/view/id/1077/s/uv-b19-3-watt-ultra-violet-uv-flashlight/category/57/)



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The custom UV-566 LED flashlight is a 1-watt UV 365 nm LED Flashlight powered by AA alkaline batteries. The UV-566 true black light 365 nm UV LED black light flashlight is the perfect inspection tool. The flashlight runs on 1 x AA battery for compact portability or extends to 2 x AA battery for longer use. The flashlight body is crafted out of aircraft grade aluminum and O-ring sealed for water and shock resistance. Perfect for Leak Detection and inspection of rodents, urine, and other fluids.

$69.99

Availability: In stock

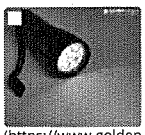
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Description | Additional | Tags | Reviews | Light Bulb Color

Features:

- True 365 nm Black light from a 1-Watt LED
- Compact size for ultimate portability
- Run on 1 x AA Alkaline battery or extend to 2 x AA Alkaline batteries
- Super durable aluminum body with hard anodizing for shock and corrosion resistance
- O-ring sealed for water resistance
- LED Lifetime of 25,000 hrs
- Glow-in-the-dark recessed on/off button switch

Used for:

- counterfeit detection (check the security strip on currencies)
- inspect rodent contamination, hotel inspection, kitchen inspection, leak detection, scorpion hunting, Non destructive testing, invisible inks, dye tracing, forensics, UV-Curing
- Essential tool for law enforcement, postal inspections, customs, medical forensics, HVAC repair

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Specifications:

- Size: 3.75" x 0.75" (1 x AA), 5.80" x 0.75" (2 x AA)
- Weight without batteries: 1.7 ounces (1 x AA) , 2.3 ounces (2 x AA)
- Bulb: 1-Watt 365 nm UV LED bulb - rated for 25,000 hrs
- Power: 1 x AA or 2 x AA Batteries. Alkaline Batteries or NiMH rechargeable batteries recommended.

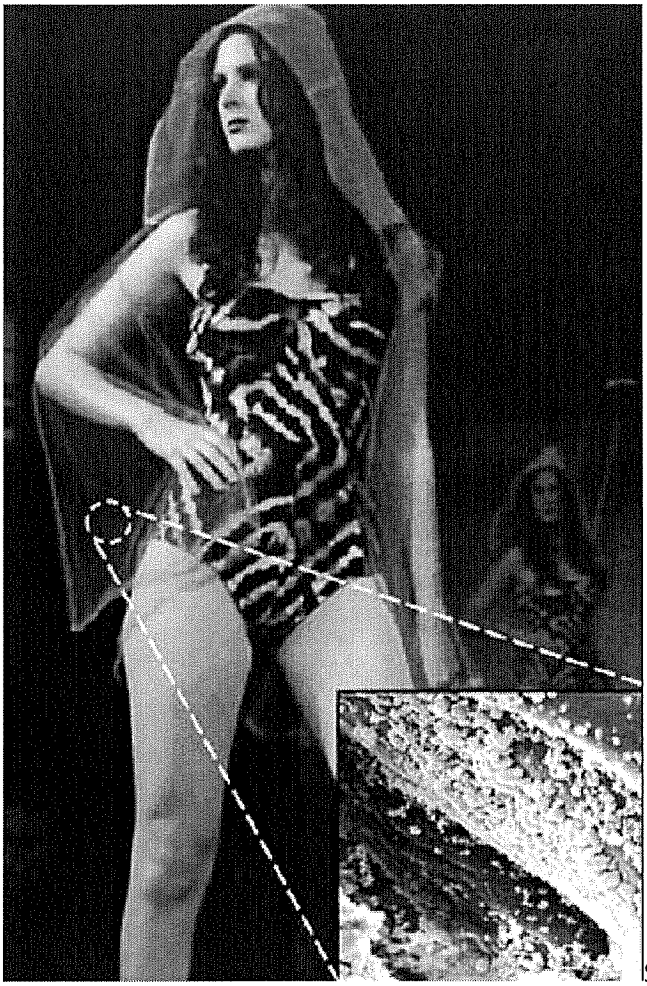
Posted: Feb 29, 2016

Nanotechnology in textiles - the new black

(*Nanowerk Spotlight*) Nanoengineered functional textiles are going to revolutionize the clothing that you'll wear. The potential of nanotechnology in the development of new materials in the textile industry is considerable. On the one hand, existing functionality can be improved using nanotechnology and on the other, it could make possible the manufacture of textiles with entirely new properties or the combination of different functions in one textile material (read our previous *Nanowerk Spotlight* on this topic: "Nanotechnology textiles").



Applications of nanotechnology in textiles. (Reprinted with permission by American Chemical Society) A first generation of nano-enhanced textiles benefitted from *nano finishing*: Coating the surface of textiles and clothing with nanoparticles is an approach to the production of highly active surfaces to have UV-blocking, antimicrobial, antistatic, flame retardant, water and oil repellent, wrinkle resistant, and self-cleaning properties. One stubborn hurdle that prevents nanomaterial-enhanced textiles from becoming more of a commercial reality is the insufficient durability of nanocoatings on textile fibers or the stability of various properties endowed by nanoparticles. Quite simply put, the 'smart' comes off during washing. While antimicrobial properties are exerted by nano-silver, UV blocking, self-cleaning and flame-retardant properties are imparted by nano-metal oxide coatings. Zinc oxide nanoparticles embedded in polymer matrices like soluble starch are a good example of functional nanostructures with potential for applications such as UV-protection ability in textiles and sunscreens, and antibacterial finishes in medical textiles and inner wears (read more about nanofinishing in textile



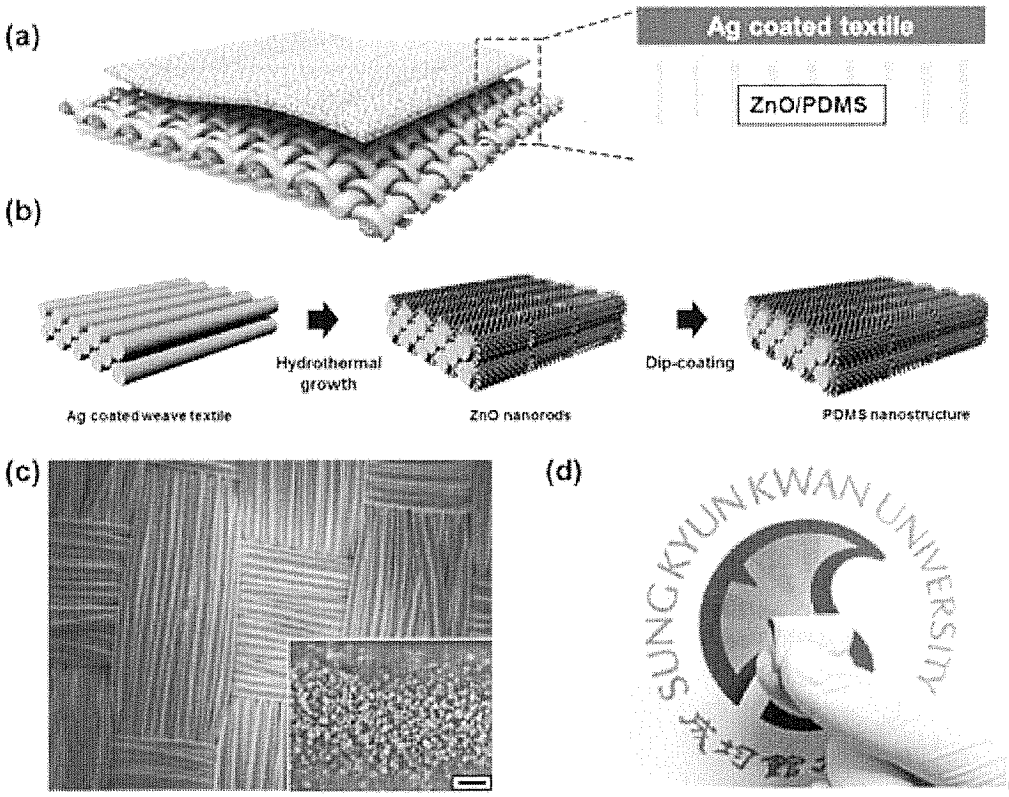
technology). Sandy Mattei models a design by Matilda Ceesay with a Permethrin-releasing textile net. (Image: Cornell University) A just published review paper in the February 26, 2016 online edition of *ACS Nano* ("Nanotechnology in Textiles") discusses electronic and photonic nanotechnologies that are integrated with textiles and shows their applications in displays, sensing, and drug release within the context of performance, durability, and connectivity. In these *smart clothes* the textile structures themselves perform electronic or electric functions. Ideally, the nanoelectronic components will be completely fused with the textile material, resulting in that textile and non-textile components cannot be differentiated and 'foreign particles' can no longer be seen or felt.

Electronics in textiles

We have written extensively about smart textiles, for instance

- energy-scavenging fabrics that lead to wearable 'smart' clothes that can power integrated electronics and sensors through ordinary body movements;
- Interwoven solar cells that turn T-shirts into power textiles;
- a wearable textile battery that can be recharged by sunlight;
- nanoelectronics at the tip of a gloved finger;
- graphene yarns that facilitate energy storage textiles;
- graphene-coated 'e-textile' that detect noxious gases.In their review, the authors discuss the electrical conductivity of conducting polymers and graphene, both of which are attractive for

creating textiles that enable the incorporation of sensors and actuators. Another section of the review is dedicated to power sources suitable for e-textiles. This covers lightweight fabric carbon nanotube supercapacitor electrodes; stretchable graphene and PPy-based supercapacitors; triboelectric nanogenerators; flexible fiber and stripe batteries; and stretchable PPy-based supercapacitors for energy transfer.



(a) Schematic illustration of a wearable triboelectric nanogenerator. (b) Fabrication process of the nanopatterned PDMS structure. (c) FE-SEM images of the bottom textile with nanopatterned PDMS. Inset is a high-resolution image clearly showing the ZnO NR-templated PDMS nanopatterns. (d) Photographic image of the flexible, foldable WTNG. (Reproduced with permission by American Chemical Society) (click on image to enlarge) Adding digital components to these e-textiles would open up an entirely new area of functional clothing. OLEDs in fiber form could lead to revolutionary applications by integrating optical and optoelectronic devices into textile. Combined with nanoelectronic devices, we might one day see flexible optical sensors and display screens woven into shirts and other garments. You could literally wear your next-generation smart phone or iPad on your sleeves; including the solar panels to power them (read more: "Light-emitting nanofibers shine the way for optoelectronic textiles").

Photonic technologies for textiles

Want your clothes to change color at the push of a button, in response to ambient heat or illumination, warning you about airborne pollutants or pollen, or glow in the dark? The integration of optical technologies into garments will make this possible. As the authors write, "photonic materials and devices including films, nanoadditives, or optical fibers have been adopted in the fabrication of textiles and garments to not only enhance the aesthetic performance but also endow the garments with additional functionalities. The most distinctive and basic application of optical technologies on fabrics or garments is perhaps tuning their appearance by controlling the intensity, color, and pattern of light. "For example, optical films made of periodical dielectric multilayers could be directly coated on fabrics, thus offering a highly reflective colorful appearance and enabling different color

perceptions depending on the angle of observation. Holographic films may also achieve similar functions and even provide a more complex 3D visual effect."

Sensing and drug release in textiles

Lab-on-fiber technology will allow the implementation of sophisticated, autonomous multifunction sensing and actuating systems – all integrated in individual optical fibers. Such multifunctional labs integrated into a single optical fiber, exchanging information and combining sensorial data, could provide effective auto-diagnostic features as well as new photonic and electro-optic functionalities (read more: "Move over chips – here come multifunctional labs on a single fiber"). The general sensing principle of a plasmonic fiber sensor is described in detail in the review paper: "In a plasmonic fiber sensor, a lossy surface plasmon mode propagating along a metal/dielectric interface can be excited at its resonance by an optical fiber core-guided mode via evanescent wave coupling when the phase-matching condition between the two modes is satisfied at a certain frequency. The presence of such a plasmonic mode manifests itself as a spectral dip in the fiber transmission spectrum, with its spectral location corresponding to the phase-matching frequency. Variations in the refractive index of an analyte adjacent to the metal layer could significantly modify the phase-matching condition, thus displacing the spectral dip in the optical fiber transmission spectrum." Already, temperature, humidity, and pressure sensors have been incorporated in textiles. In future, microfluidics can be incorporated in thread-based channels for application in point-of-care diagnostics. Combined with LEDs, these textiles can give visual sensing information. Combined with drug-loaded nanoparticles, textile fibers could provide programmable release of therapeutic drugs. For example, the designer Matilda Ceesay created a hooded body suit embedded at the molecular level with insecticides to ward off mosquitoes infected with malaria. The cotton mesh used for this anti-malaria garment was coated with a material where an insect repellent and fabric are bound at the nano level using metal organic framework molecules (MOFs). Concluding their review, after an extensive discussion of fabrication methods and functionalities, the authors also address the issues of toxicity of nanomaterials in textiles as well as commercial trends in the global nanotechnology-enhanced textile market. *By Michael Berger. Copyright © Nanowerk*

Read more: Nanotechnology in textiles - the new black

Self-directed robot can identify objects

23 February 2016, by Rich Barlow



"That is a ball." "I do believe that is a cone." "Seems like a wonderful book." The voice is mechanical and flat, and anyone offering such banal commentary and sounding so bored would surely bomb in a job interview. But in this case, the observations are impressive. They're made by what looks like a two-foot-tall stack of hors d'oeuvre trays on wheels, careening around the floor and proclaiming its discoveries as its "eye," an attached camera, falls on them.

This robot has learned to recognize these specific objects—and to steer around obstacles, albeit clumsily—without human guidance. Its camera sends information about what it sees to a laptop sitting atop the robot; the laptop in turn communicates with a laboratory desktop, whose monitor flashes whatever the robot's camera catches.

"It's almost self-thinking" in its ability to get around roadblocks, says Emily Fitzgerald (ENG'16), who bestowed the 'bot with a brain as her summer 2015 project with Boston University's Undergraduate Research Opportunities Program (UROP), which provides funding for faculty-mentored research by undergrad students. More important than the robot's autonomous navigation, she says, is its ability to recognize specific objects.

Such self-guiding, object-spotting robots are a Holy Grail for scientists, with potential applications that include exploring distant planets' landscapes. In Fitzgerald's case, she used a deep neural network, a form of artificial intelligence that simulates brain neurons. Deep neural networks process huge amounts of data to solve problems, like recognizing a ball or cone.

"There's an algorithm that will take a ton of pictures of one object and will put it in and compile it all," says Fitzgerald. "Then we basically assign a number to it." The robot "will come upon an object and it will say, 'Oh, there's an object in front of me, let me think about it.' It will...find a picture that corresponds with the object, pick that number, and then it will be able to use that as a reference, so it can exclaim, 'Oh, it's a ball,' 'It's a cone,' or whatever object I had decided to teach it."

Massimiliano Versace (GRS'07), a BU College of Arts & Sciences research assistant professor and director of BU's Neuromorphics Lab, oversaw Fitzgerald's UROP project, and she had help from Lucas Neves (ENG'16), a volunteer in Versace's lab, and Matthew Luciw, a visiting researcher at BU's Center for Computational Neuroscience & Neural Technology.

Asked how hard it was to train their metallic pupil in object recognition, the team members laugh. "There were quite a few times where we did despair a little bit that, you know, this wasn't going to work," says Fitzgerald, who first had to master an unfamiliar programming language. Then the team needed to make sure that the array of different software in the project would work together "without crashing the system," she says.

Often, the software wasn't compatible, resulting in a somewhat ditsy robot. "Most of the time, it just didn't start," Neves says, ruefully recalling those tough moments. It also could get lost: sensors in its wheels tell the robot how far it's traveled. But "the

wheels weren't moving at a constant rate, so whenever the robot would shoot off, it would think it had gone farther than it had because the wheels spun faster," says Fitzgerald.

So the Terminator it isn't. Whether Fitzgerald's project will yield a commercial application someday remains an open question, says Versace, but he has no doubt about the viability of this type of work. Versace heads Neurala, a BU spin-off company, and members of his lab met recently with NASA to discuss related research.

As for Fitzgerald, who was turned on to engineering after excelling at physics and math in high school, she says the project persuaded her to pursue a career in bioimaging. Someday, she says, robotic surgical devices running off neural networks will detect objects in human patients.

"I've actually taken this project and I've said, OK, what else can I do with it in the biomedical setting as well?" she says. "It's really shaped how I've thought about my future going forward."

Provided by Boston University

APA citation: Self-directed robot can identify objects (2016, February 23) retrieved 25 February 2016 from http://phys.org/news/2016-02-self-directed-robot.html

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Football Helmet Absorbs Impact

PRETURI TARI

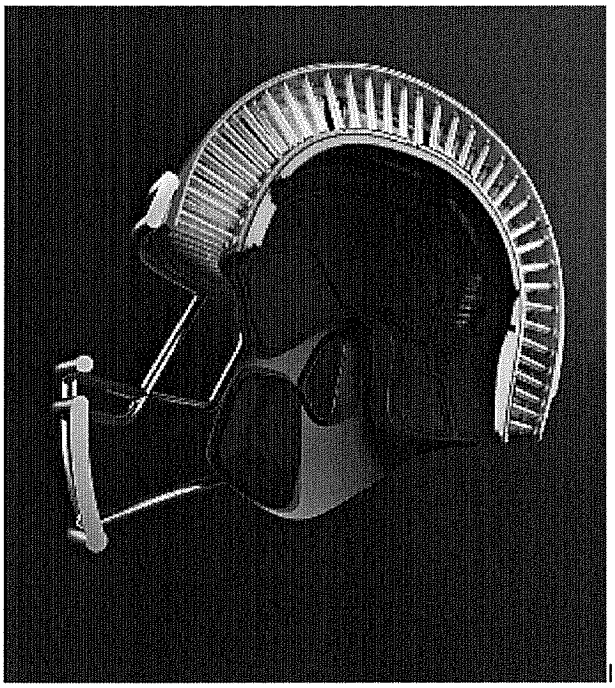
By Engineering360 News Desk

28 January 2016

At about $1,500 each, the Vicis helmet may not be for backyard play just yet. But for professional and college athletes, investing in the helmet could mean an investment in their health along with the longevity of their sports careers.

Launched by a neurosurgeon with the Sports Concussion Program at Children's Hospital in Seattle, and the chair of the University of Washington's mechanical engineering department, the company is working to reinvent the traditional sports helmet.

(Read "Yellow Line, Green Turf: The Innovations That Drove Sport Action Tracking.")



Internal structure of the Vicis helmet. The company started with the idea of an outer shell of plates that shift when hit and so disperse the energy of impact. Two years of work and the "tectonic" plates evolved into a helmet with a softer outer shell and a more rigid inner shell. The "crushable" outer shell mimics the automotive industry's collapsible materials that absorb and disperse energy as they are hit. The stiff inner core may even prevent skull fractures.

Awareness of the effects of head impact in contact sports like American football has never been greater. The Vicis (from the Latin word for change) helmet has five main engineering points: the lode shell is an outer core that absorbs impact by deforming; the core layer has vertical struts that bend and buckle to slow impact forces; the foam liner helps with fit; and the arch shell is a hard plastic layer to protect the skull. The chin strap is the last point, with half of its snaps fastening to the core to keep energy from flowing through the jaw.

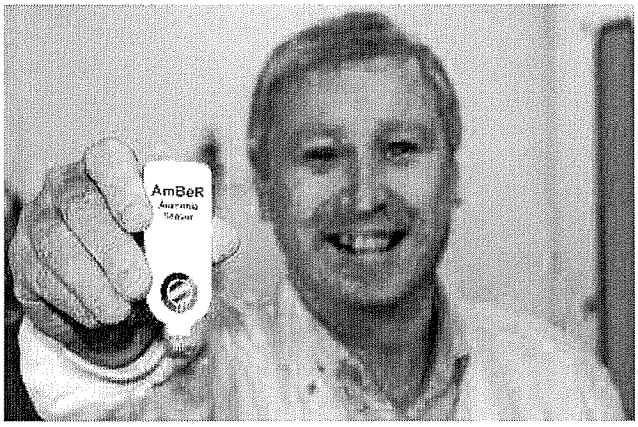
The company recently received $500,000 from the National Football League to develop the technology. Company officials hope to reduce the incidence of concussion by 50% as they roll out their helmets for the 2016-2017 season. With 25% of American parents polled in 2015 saying they won't allow their children to play contact sports because of injuries, change could be just what's needed.

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New device could end blood test agony for thousands

23 February 2016



Patients could be spared the unpleasant ordeal of having blood taken in future thanks to the work of a University of the West of England (UWE Bristol) academic who has devised a new breath testing device.

Professor Tony Killard has created a mass producible sensor which can detect ammonia levels in breath – a breakthrough which could eliminate the use of needles among thousands of patients.

Named AmBeR, the device could help patients with a number of chronic diseases and conditions who regularly need to check their ammonia levels through blood testing.

The technology will allow patients to test their ammonia levels painlessly with greater accuracy, on a more frequent basis and even while at home when a self-testing version of the device is developed.

Professor Killard, head of biomedical sciences at UWE Bristol, said: "Ammonia blood testing is inaccurate and ineffective. There are problems doing this with some conditions, especially where it involves children who have learning difficulties. With those types of patient, it is a major challenge.

"This will give clinicians a tool they don't currently have and it changes where and how often they can do the testing. You can do a test every day if necessary or you could do a test at home – it's quite transformative.

"No one has been able to do ammonia breath testing in a way which is accurate without using a large piece of equipment. There are instruments in existence which can do it but they are not economically viable. The AmBeR device will be more like glucose testing strips where you use the sensor test strip once and throw it away when finished. We are trying to make this a game-changer commercially."

Professor Killard, who has formed a company called BreathDX to market his innovation, has secured funding to explore the application of AmBeR in specific conditions. The device, which is smaller than a shoe box, is now in production and will go into clinical studies in May.

Professor Killard said he was 'humbled' when he realised the impact his work could have.

He said: "We went to some conferences and really saw the daily challenges people and their families with these conditions have. I was humbled by it. We had spent the whole time thinking about the scientific objective but then the human focus comes into sight and you start to think differently - about the value to other people.

"With the feedback we had, we realised how important it could be to them – that places a responsibility on you to deliver something for them."

Professor Killard came up with the idea for the

device while investigating new sensor materials based on novel nanomaterials technology. He developed a new ammonia sensing material using polyaniline, a polymer which can conduct electricity. By forming it into nanoparticles, he discovered it was extremely sensitive and be could deposited in very thin layers only thousandths of a millimetre thick using low-cost printing technology.

Of his discovery, he said: "That was kind of the eureka moment. What we had was a cluster of new characteristics which allowed us to do new things we couldn't do before. Before, this material (polyaniline) was just a laboratory curiosity to scientists and you would play around with this stuff.

"Now we are looking at commercialising it, which has always been key to our activities - having a societal and economic impact."

Professor Killard said the technology could eventually be used to measure other trace breath gases for the non-invasive monitoring of further diseases, including potentially diabetes.

Provided by University of the West of England

APA citation: New device could end blood test agony for thousands (2016, February 23) retrieved 25 February 2016 from http://phys.org/news/2016-02-device-blood-agony-thousands.html

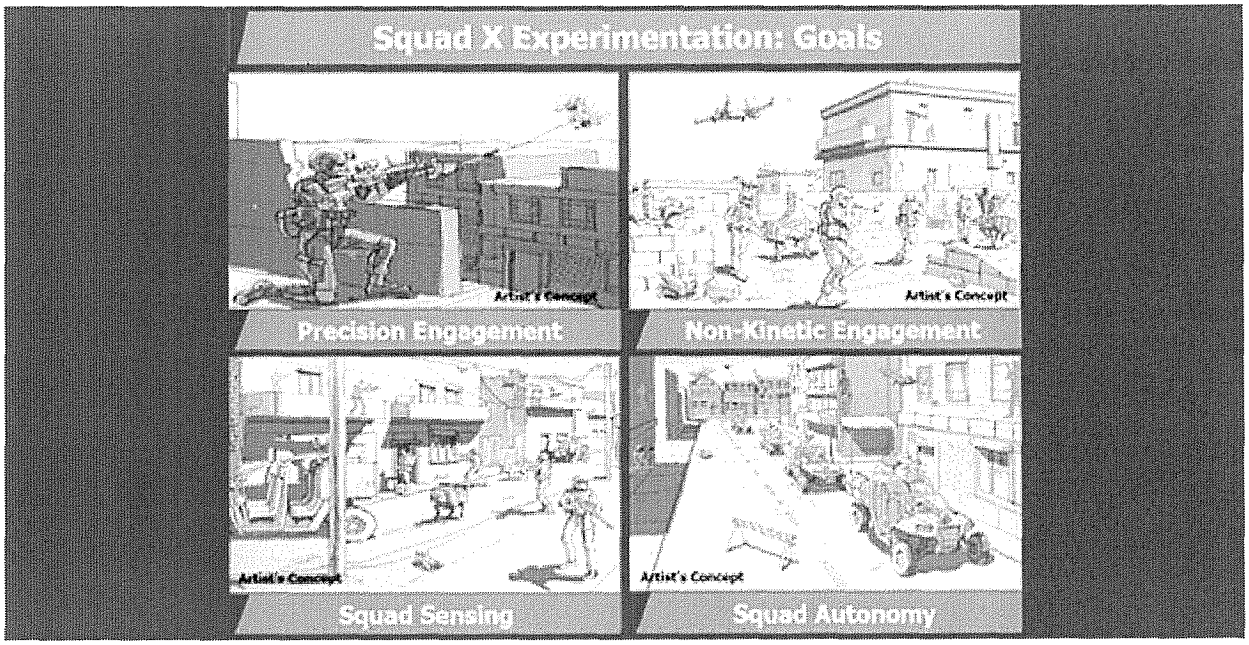
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Squad X Program Envisions Dismounted Infantry Squads of the Future

Program seeks to develop portable, integrated systems that would provide vastly improved capabilities in the physical, electromagnetic and cyber domains

outreach@darpa.mil

3/15/2016



Modern military engagements increasingly take place in complex and uncertain battlefield conditions where attacks can come from multiple directions at once, and in the electromagnetic spectrum and cyber domains as well. U.S. Army and U.S. Marine Corps dismounted infantry squads, however, have been unable to take full advantage of some highly effective multi-domain defensive and offensive capabilities that vehicle-assigned forces currently enjoy—in large part because many of the relevant technologies are too heavy and cumbersome for individual Soldiers and Marines to carry or too difficult to use under demanding field conditions.

To help overcome these challenges and help ensure U.S. squad dominance over adversaries in the decades to come, DARPA has launched the Squad X Experimentation (Squad X) program. Squad X seeks to design, develop and validate system prototypes for combined-arms squads. The program intends to lay the foundation for breakthrough technologies and capabilities that would:

- Improve shared situational understanding of the multi-domain operational environment: physical, electromagnetic and cyber
- Increase the time and space in which squads can maneuver through optimized use of physical, cognitive and material resources
- Shape and dominate the battlespace through synchronization of fire and maneuvering in all three domains

"Through Squad X, we want to vastly improve dismounted squad effectiveness in all domains by integrating new and existing technologies into systems that squads can bring with them," said Maj. Christopher Orlowski, DARPA program manager. "The squad is the formation with the greatest potential for impact and innovation, while having the lowest barrier to entry for experimentation

and system development. The lessons we learn and the technology we create could not only transform dismounted squads' capabilities, but also eventually help all warfighters more intuitively understand and control their complex mission environments."

Squad X intends to combine off-the-shelf technologies and new capabilities under development through DARPA's Squad X Core Technologies (SXCT) program, which was launched specifically to develop novel technologies that Squad X could integrate into user-friendly systems. SXCT shares Squad X's overarching goal of ensuring that Soldiers and Marines maintain uncontested tactical superiority over potential adversaries by exploring capabilities in four areas: precision engagement, non-kinetic engagement, squad sensing and squad autonomy. In an important step toward that goal, SXCT recently awarded Phase 1 contracts to nine organizations.

The U.S. Army, U.S. Navy and U.S. Marine Corps have expressed interest in future Squad X capabilities and plan to support the experimentation efforts with testing in simulated operational environments as the program progresses.

To familiarize potential participants with the technical objectives of Squad X, DARPA has scheduled Squad X Information Days and a Proposers Day in advance of a planned Broad Agency Announcement (BAA). The Information Days will be held on Tuesday and Wednesday, March 29 and 30, 2016, and the Proposers Day will be held on Friday, April 22, 2016. All events will take place at the DARPA Conference Center in Arlington, Va., from 9:00 AM to 4:00 PM Eastern.

The Special Notice announcing the events is available at http://go.usa.gov/cGfrm. Advance registration is required for all events through the registration website: http://ow.ly/ZduQo. Registration opens on Tuesday, March 15, 2016, at 11:00 AM Eastern and closes Thursday, March 24, 2016, at 3:00 PM Eastern or when capacity is reached, whichever comes first. There is no fee for registration. Due to space limitations of the conference facility, attendance will be limited to the first 150 registrants for each event, and no more than two representatives per organization (parent company).

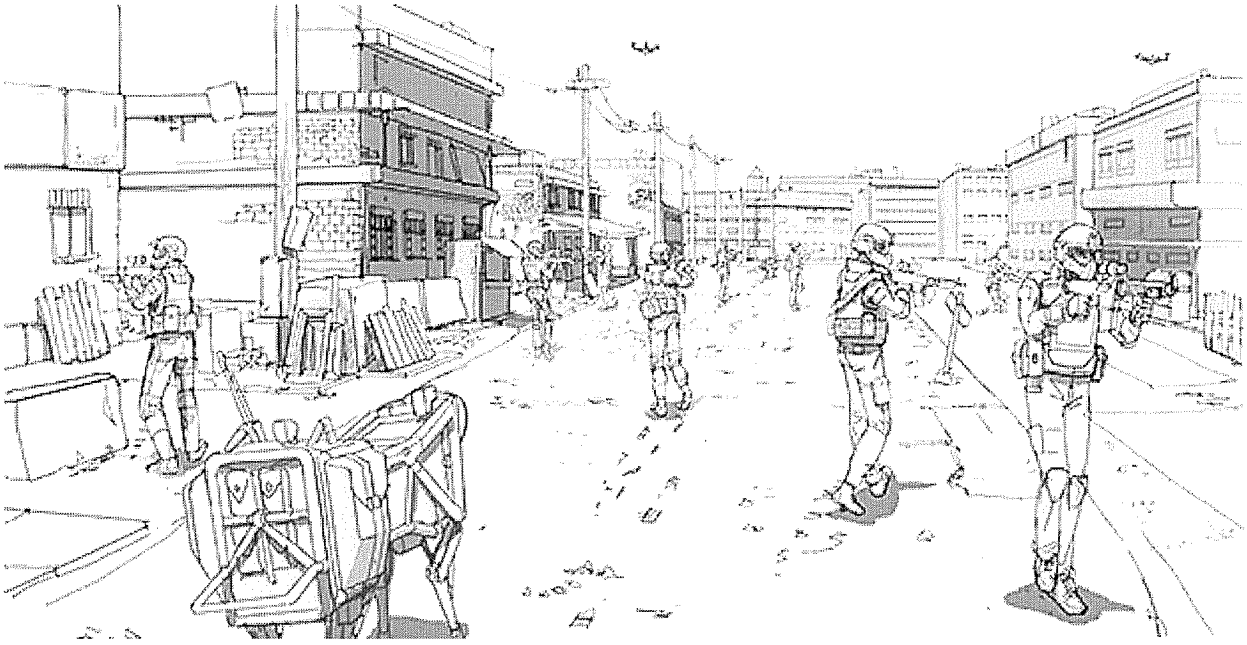
To maximize the pool of innovative proposal concepts, DARPA strongly encourages participation in these events by and subsequent submissions from non-traditional performers, including small businesses, academic and research institutions and first-time government contractors.

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Squad X Core Technologies (SXCT)

MAJ Christopher Orlowski, USA, Ph.D.



To succeed in their missions, military units must have a robust, multi-faceted picture of their operational environments, including the location, nature and activity of both threats and allied forces around them. Technology is making this kind of rich, real-time situational awareness increasingly available to airborne and other vehicle-assigned forces, along with a capacity to deploy precision armaments more safely, quickly and effectively. Dismounted infantry squads, however, have so far been unable to take full advantage of some of these highly effective capabilities because many of the technologies underlying them are too heavy and cumbersome for individual Soldiers and Marines to carry or too difficult to use under demanding field conditions.

DARPA's Squad X Core Technologies (SXCT) program aims to develop novel technologies that could be integrated into user-friendly systems that would extend squad awareness and engagement capabilities without imposing physical and cognitive burdens. The goal is to speed the development of new, lightweight, integrated systems that provide infantry squads unprecedented awareness, adaptability and flexibility in complex environments, and enable dismounted Soldiers and Marines to more intuitively understand and control their complex mission environments.

SXCT plans to explore four key technical areas:

- Precision Engagement: Precisely engage threats out to 0.6 mile (1,000 meters), while maintaining compatibility with infantry weapon systems and without imposing weight or operational burdens that would negatively affect mission effectiveness. Capabilities of interest include distributed, non-line-of-sight targeting and guided munitions.
- Non-Kinetic Engagement: Disrupt enemy command and control, communications and use of unmanned assets at a squad-relevant operational pace (walking with occasional bursts of speed). Capabilities of interest include disaggregated electronic surveillance and coordinated effects from distributed platforms.

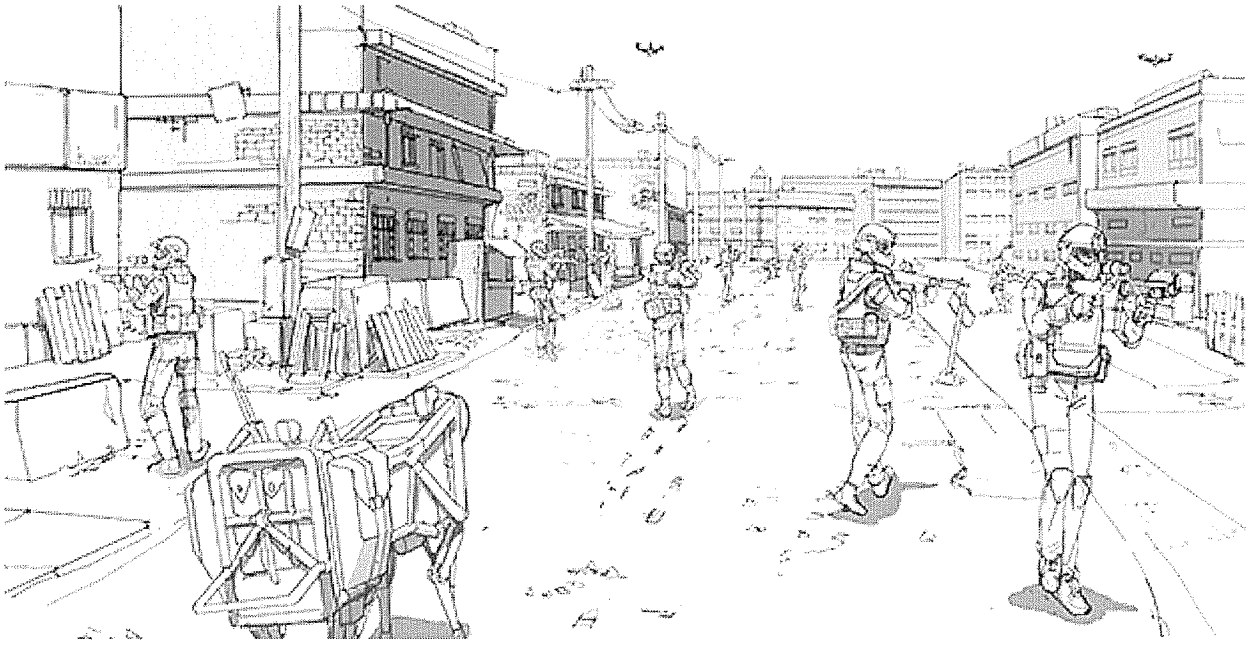
- **Squad Sensing: Detect potential threats out to 0.6 mile (1,000 meters) at a squad-relevant operational pace. Capabilities of interest include multi-source data fusion and autonomous threat detection.**
- **Squad Autonomy: Increase squad members' real-time knowledge of their own and teammates' locations to less than 20 feet (6 meters) in GPS-denied environments through collaboration with embedded unmanned air and ground systems. Capabilities of interest include robust collaboration between humans and unmanned systems.**

Squad X Core Technologies Takes First Steps toward Improving Capabilities for Dismounted Soldiers and Marines

DARPA selects nine organizations to start developing novel technologies that could enhance squads' ability to collaborate, understand their surroundings and act effectively

outreach@darpa.mil

12/10/2015



To succeed in their missions, military units must have a robust, multi-faceted picture of their operational environments, including the location, nature and activity of both threats and allied forces around them. Technology is making this kind of rich, real-time situational awareness increasingly available to airborne and other vehicle-assigned forces, along with a capacity to deploy precision armaments more safely, quickly and effectively. Dismounted infantry squads, however, have so far been unable to take full advantage of some of these highly effective capabilities because many of the technologies underlying them are too heavy and cumbersome for individual Soldiers and Marines to carry or too difficult to use under demanding field conditions.

To address this application lag, DARPA's Squad X Core Technologies (SXCT) program aims to develop novel technologies that could be integrated into user-friendly systems that would extend squad awareness and engagement capabilities without imposing physical and cognitive burdens. The

program, whose overarching goal is to ensure that Soldiers and Marines maintain uncontested tactical superiority over potential adversaries, recently awarded Phase 1 contracts to nine organizations.

"Our goal is to develop technologies that support a three-dimensional common operating picture leveraging input from integrated mobile sensors, as well as the ability to organically locate and identify friendly forces and threat locations in near real time," said Maj. Christopher Orlowski, DARPA program manager. "The Phase 1 performers for SXCT have proposed a variety of technologies that, in the future, could provide unprecedented awareness, adaptability and flexibility to dismounted Soldiers and Marines and enable squad members to more intuitively understand and control their complex mission environments."

DARPA has awarded Phase 1 contracts for SXCT to the following organizations:

- Helios Remote Sensing Systems (Utica, N.Y.)
- Kitware (Clifton Park, N.Y.)
- Leidos (Huntsville, Ala., and San Diego, Calif.)
- Lockheed Martin Corporation (Cherry Hill, N.J., and Grand Prairie, Tex.)
- Raytheon Company (Tucson, Ariz.)
- Scientific Systems Company, Inc. (Woburn, Mass.)
- Six3 Systems, Inc. (Mclean, Va.)
- SoarTech (Ann Arbor, Mich.)
- SRI International (Menlo Park, Calif.)

SXCT is pursuing research in the following four technical areas:

- Precision Engagement: Precisely engage threats out to 0.6 mile (1,000 meters), while maintaining compatibility with infantry weapon systems and without imposing weight or operational burdens that would negatively affect mission effectiveness. Capabilities of interest include distributed, non-line-of-sight targeting and guided munitions.
- Non-Kinetic Engagement: Disrupt enemy command and control, communications and use of unmanned assets at a squad-relevant operational pace (walking with occasional bursts of speed). Capabilities of interest include disaggregated electronic surveillance and coordinated effects from distributed platforms.
- Squad Sensing: Detect potential threats out to 0.6 mile (1,000 meters) at a squad-relevant operational pace. Capabilities of interest include multi-source data fusion and autonomous threat detection.
- Squad Autonomy: Increase squad members' real-time knowledge of their own and teammates' locations to less than 20 feet (6 meters) in GPS-denied environments through collaboration with embedded unmanned air and ground systems. Capabilities of interest include robust collaboration between humans and unmanned systems.

The U.S. Army, U.S. Navy and U.S. Marine Corps have expressed interest in future SXCT capabilities.

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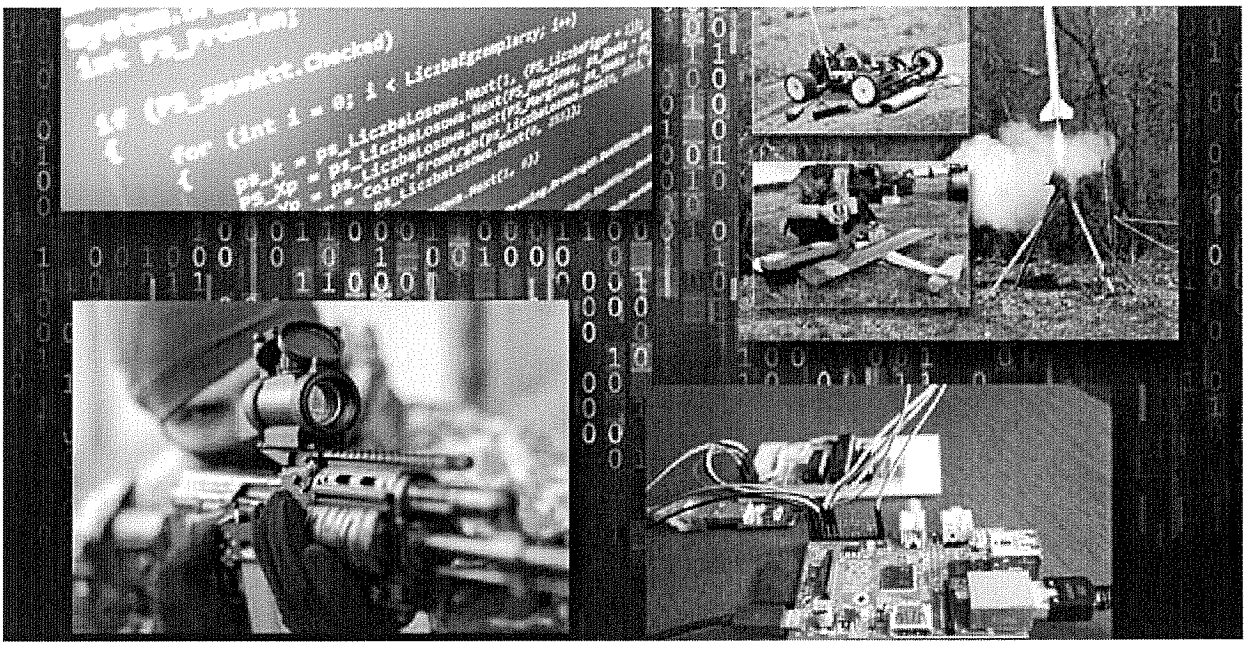
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Mining Everyday Technologies to Anticipate Possibilities

DARPA's "Improv" effort asks the innovation community to identify commercial products and processes that could yield unanticipated threats

outreach@darpa.mil

3/11/2016



For decades, U.S. national security was ensured in large part by a simple advantage: a near-monopoly on access to the most advanced technologies. Increasingly, however, off-the-shelf equipment developed for the transportation, construction, agricultural and other commercial sectors features highly sophisticated components, which resourceful adversaries can modify or combine to create novel and unanticipated security threats. To assess this growing security challenge and identify specific potential risks, a new DARPA effort will ask experts across multiple disciplines to look at today's bustling tech marketplace with an inventor's eye and imagine how easily purchased, relatively benign technologies might be converted into serious security threats. The endeavor is dubbed "Improv", an abbreviated reference to the potential for improvising with widely available technology to create new and unanticipated risks.

"DARPA's mission is to create strategic surprise, and the agency primarily does so by pursuing radically innovative and even seemingly impossible technologies," said program manager John Main, who will oversee the new effort. "Improv is being launched in recognition that strategic surprise can also come from more familiar technologies, adapted and applied in novel ways."

Improv will explore ways to combine or convert commercially available products such as off-the-shelf electronics, components created through rapid prototyping, and open-source code to cost-effectively create sophisticated military technologies and capabilities. To bring a broad range of perspectives to bear, DARPA is inviting engineers, biologists, information technologists and others from the full spectrum of technical disciplines—including credentialed professionals and skilled hobbyists—to show how easily-accessed hardware, software, processes and methods might be used to create products or systems that could pose a future threat. DARPA will assess candidate ideas and offer varying levels of support to develop and test selected proposals. The emphasis will be on speed

and economy, with the goal of propelling winning submissions from concept to simple working prototypes within about 90 days.

"DARPA often looks at the world from the point of view of our potential adversaries to predict what they might do with available technology," Main said. "Historically we did this by pulling together a small group of technical experts, but the easy availability in today's world of an enormous range of powerful technologies means that any group of experts only covers a small slice of the available possibilities. In Improv we are reaching out to the full range of technical experts to involve them in a critical national security issue."

DARPA intends to fund selected Improv proposals through a short feasibility-study phase, during which performers will refine their ideas and compete for the opportunity to build prototypes. DARPA will evaluate the results of that work, and a subset of the prototypes will proceed to a detailed evaluation regimen. If performance warrants, DARPA may advance the relevant capabilities in separate follow-on efforts.

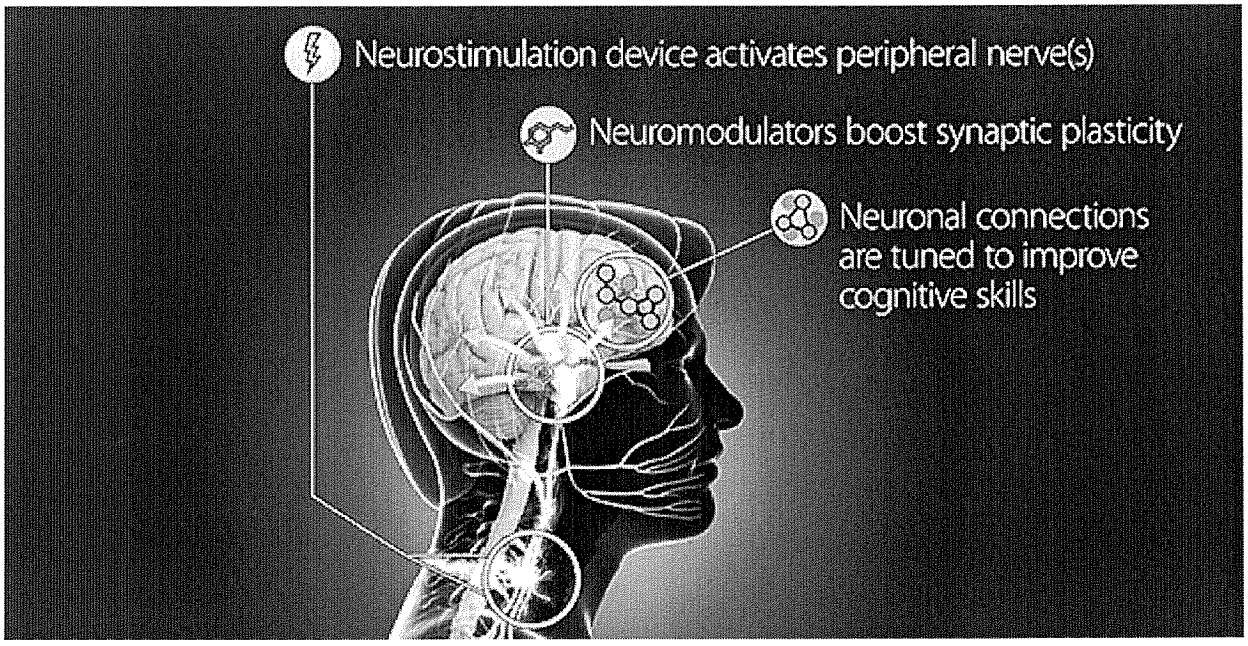
A Proposers Day webinar is scheduled for March 29. Details are available here: http://go.usa.gov/cfzx3. A Broad Agency Announcement describing Improv's goals and methods is posted here: http://go.usa.gov/cfzpw.

Boosting Synaptic Plasticity to Accelerate Learning

A new DARPA program will explore using peripheral nerve stimulation to enhance learning processes in the brain

outreach@darpa.mil

3/16/2016



The body's branching network of peripheral nerves connects neurons in the brain and spinal cord to organs, skin, and muscles, regulating a host of biological functions from digestion to sensation to locomotion. But the peripheral nervous system can do even more than that, which is why DARPA already has research programs underway to harness it for a number of functions—as a substitute for drugs to treat diseases and accelerate healing, for example, as well as to control advanced prosthetic limbs and restore tactile sensation to their users.

Now, pushing those limits further, DARPA aims to enlist the body's peripheral nerves to achieve something that has long been considered the brain's domain alone: facilitating learning. The effort will turn on its head the usual notion that the brain tells the peripheral nervous system what to do.

The new program, Targeted Neuroplasticity Training (TNT), seeks to advance the pace and effectiveness of a specific kind of learning—cognitive skills training—through the precise activation of peripheral nerves that can in turn promote and strengthen neuronal connections in the brain. TNT will pursue development of a platform technology to enhance learning of a wide range of cognitive skills, with a goal of reducing the cost and duration of the Defense Department's extensive training regimen, while improving outcomes. If successful, TNT could accelerate learning and reduce the time needed to train foreign language specialists, intelligence analysts, cryptographers, and others.

The program is also notable because, unlike many of DARPA's previous neuroscience and neurotechnology endeavors, it will aim not just to restore lost function but to advance capabilities beyond normal levels.

"Recent research has shown that stimulation of certain peripheral nerves, easily and painlessly achieved through the skin, can activate regions of the brain involved with learning," said TNT

Program Manager Doug Weber, adding that the signals can potentially trigger the release of neurochemicals in the brain that reorganize neural connections in response to specific experiences. "This natural process of synaptic plasticity is pivotal for learning, but much is unknown about the physiological mechanisms that link peripheral nerve stimulation to improved plasticity and learning," Weber said. "You can think of peripheral nerve stimulation as a way to reopen the so-called 'Critical Period' when the brain is more facile and adaptive. TNT technology will be designed to safely and precisely modulate peripheral nerves to control plasticity at optimal points in the learning process."

DARPA intends to take a layered approach to exploring this new terrain. Fundamental research will focus on gaining a clearer and more complete understanding of how nerve stimulation influences synaptic plasticity, how cognitive skill learning processes are regulated in the brain, and how to boost these processes to safely accelerate skill acquisition while avoiding potential side effects. The engineering side of the program will target development of a non-invasive device that delivers peripheral nerve stimulation to enhance plasticity in brain regions responsible for cognitive functions. The goal is to optimize training protocols that expedite the pace of learning and maximize long-term retention of even the most complicated cognitive skills. To meet these diverse objectives, TNT expects to attract multidisciplinary teams spanning backgrounds such as cognitive neuroscience, neural plasticity, electrophysiology, systems neurophysiology, biomedical engineering, human performance, and computational modeling.

To familiarize potential participants with the technical objectives of TNT, DARPA will host a Proposers Day on Friday, April 8, 2016, at the Westin Arlington Gateway in Arlington, Va. The DARPA Special Notice announcing the Proposers Day and describing the specific capabilities sought is available at https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-SN-16-20/listing.html. A Broad Agency Announcement with full technical details on TNT will be forthcoming. For more information, please email DARPA-SN-16-20@darpa.mil.

Image caption: *TNT technology will be designed to safely and precisely modulate peripheral nerves to control synaptic plasticity during cognitive skill training.*

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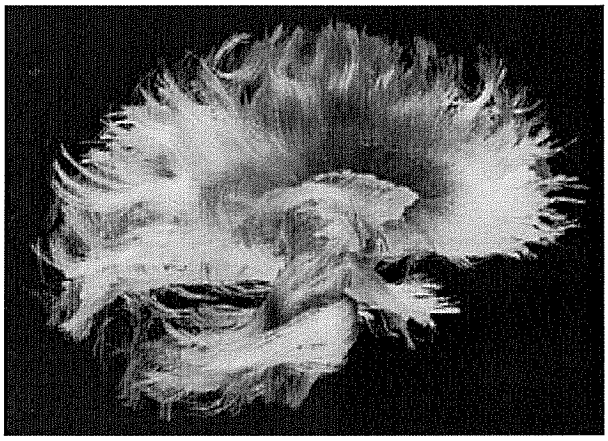
US Bets $100 Million on Machines That Think More Like Humans

- By Shelly Fan ON Mar 13, 2016

"One small step for man, one giant leap for mankind."

When Neil Armstrong stepped onto the dusty surface of the moon on July 20, 1969, it was a victory for NASA and a victory for science.

Backed by billions and led by NASA, the Apollo project is hardly the only government-organized science initiative to change the world. Two decades earlier, the Manhattan Project produced the first atomic bomb and restructured modern warfare; three decades later, the Human Genome Project published the blueprint to our DNA, heralding the dawn of population genomics and personalized medicine.



A macro-level map of the brain's white matter. Image credit: The Human Connectome Project

In recent years, big science has become increasingly focused on the brain. And now the government is pushing forward what is perhaps the most high-risk, high-reward project of our time: brain-like artificial intelligence.

And they're betting $100 million that they'll succeed in next decade.

Led by IARPA and a part of the larger BRAIN Initiative, the MICrONS (Machine Intelligence from Cortical Networks) project seeks to revolutionize machine learning by reverse engineering algorithms of the mammalian cortex.

It's a hefty goal, but one that may sound familiar. The controversial European Union-led Human Brain Project (HBP), a nearly $2 billion investment, also sits at the crossroads between brain mapping, computational neuroscience and machine learning.

But MICrONS is fundamentally different, both technically and logistically.

Rather than building a simulation of the human brain, which the HBP set out to do, MICrONS is working in reverse. By mapping out the intricate connections that neurons form during visual learning and observing how they change with time, the project hopes to distill sensory computation into mathematical "neural codes" that can be fed into machines, giving them the power to identify, discriminate, and generalize visual stimulation.

The end goal: smarter machines that can process images and video at human-level proficiency. The bonus: better understanding of the human brain and new technological tools to take us further.

It's a solid strategy. And the project's got an all-star team to see it through. Here's what to expect from this "Apollo Project of the Brain."

The Billion-Dollar Problem

Much of today's AI is inspired by the human brain.

Take deep reinforcement learning, a strategy based on artificial neural networks that's transformed AI in the last few years. This class of algorithm powers much of today's technology: self-driving cars, Go-playing computers, automated voice and facial recognition — just to name a few.

Nature has also inspired new computing hardware, such as IBM's neuromorphic SyNAPSE chip, which mimics the brain's computing architecture and promises lightning-fast computing with minimal energy consumption.

As sophisticated as these technologies are, however, today's algorithms are embarrassingly brittle and fail at generalization.

When trained on the features of a person's face, for example, machines often fail to recognize that face if it's partially obscured, shown at a different angle or under different lighting conditions.

In stark contrast, humans have a knack for identifying faces. What's more, we subconsciously and rapidly build a model of what constitutes a human face, and can easily tell whether a new face is human or not — unlike some photo-tagging systems.

Even a rough idea of how the brain works has given us powerful AI systems. MICrONS takes the logical next step: instead of guessing, let's figure out how the brain actually works, find out what AI's currently missing, and add it in.

See the World in a Grain of Sand

To understand how a computer works, you first need to take it apart, see the components, trace the wiring.

Then you power it up, and watch how those components functionally interact.

The same logic holds for a chunk of brain tissue.

MICrONS plans to dissect one cubic millimeter of mouse cortex at nanoscale resolution. And it's recruited Drs. David Cox and Jeff Lichtman, both neurobiologists from Harvard University to head the task.

Last July, Lichtman published the first three-dimensional complete reconstruction of a crumb-sized cube of mouse cortex. The effort covered just 1,500 cubic microns, roughly 600,000 times smaller than MICrONS' goal.

It's an incredibly difficult multi-step procedure. First, the team uses a diamond blade to slice the cortex into thousands of pieces. Then the pieces are rolled onto a strip of special plastic tape at a rate of 1,000 sections a day. These ultrathin sections are then imaged with a scanning electron microscope, which can capture synapses in such fine detail that tiny vesicles containing neurotransmitters in the synapses are visible.

Mapping the tissue to this level of detail is like "creating a road map of the U.S. by measuring every inch," says MICrON's project manager Jacob Volgestein to *Scientific American*.

Lichtman's original reconstruction took over six long years.

That said, the team is optimistic. According to Dr. Christof Koch, president of the Allen Institute for Brain Science, various technologies involved in the process will speed up tremendously, thanks to new tools developed under the BRAIN Initiative.

Lichtman and Cox hopes to make tremendous headway in the next five years.

Function Follows Form

Simply mapping the brain's static roadmap isn't enough.

Not all neurons and their connections are required to learn a new skill or piece of information. What's more, the learning process physically changes how neurons are wired to each other. It's a dynamic system, one in constant flux.

To really understand how neurons are functionally connected, we need to see them in action.

We're hoping to observe the activity of 100,000 neurons simultaneously while a mouse is learning a new visual task, explained Cox. It's like wire tapping the brain: the scientists will watch neural computations happen in real time as the animal learns.

To achieve the formidable task, Cox plans on using two-photon microscopy, which relies on fluorescent proteins that only glow in the presence of calcium. When a neuron fires, calcium rushes into the cell and activates those proteins, and their light can be observed with a laser-scanning microscope. This gives scientists a direct visual of neural network activation.

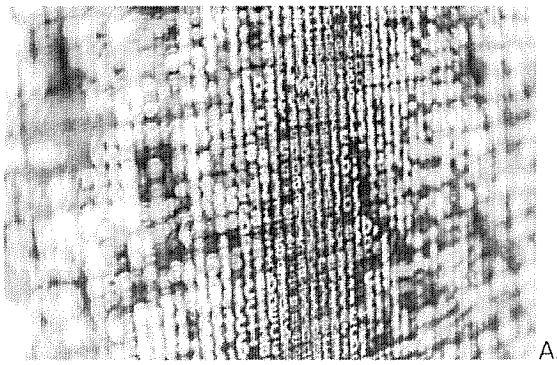
The technique's been around for a while. But so far, it's only been used to visualize tiny portions of neural networks. If Cox successfully adapts it for wide-scale imaging, it may well be revolutionary for functional brain mapping and connectomics.

From Brain to Machine

Meanwhile, MICrONS project head Dr. Tai Sing Lee at Carnegie Mellon University is taking a faster — if untraveled — route to map the mouse connectome.

According to *Scientific American*, Lee plans to tag synapses with unique barcodes — a short chain of random nucleotides, the molecules that make up our DNA. By chemically linking these barcodes together across synapses, he hopes to quickly reconstruct neural circuits.

If it works, the process will be much faster than nanoscale microscopy and may give us a rough draft of the cortex (one cubic millimeter of it) within the decade.



As a computer scientist and machine learning expert, Lee's formidable skills will likely come into play during the next phase of the project: making sense of all the data and extracting information useful for developing new algorithms for AI.

Going from neurobiological data to theories to computational models will be the really tough part. But according to Cox, there is one guiding principle that's a good place to start: Bayesian inference.

During learning, the cortex actively integrates past experiences with present learning, building a constantly shifting representation of the world that allows us to predict incoming data and possible outcomes.

It's likely that whatever algorithms the teams distill are Bayesian in nature. If they succeed, the next step is to thoroughly test their reverse-engineered models.

Vogelstein acknowledges that many current algorithms already rely on Bayesian principles. The crucial difference between what we have now and what we may get from mapping the brain is implementation.

There are millions of choices that a programmer makes to translate Bayesian theory into executable code, says Vogelstein. Some will be good, others not so much. Instead of guessing those parameters and features in software as we have been doing, it makes sense to extract those settings from the brain and narrow down optimal implementations to a smaller set that we can test.

Using this data-based ground-up approach to brain simulation, MICrONS hopes to succeed where HBP stumbled.

"We think it's a critical challenge," says Vogelstein. If MICrONS succeeds, it may "achieve a quantum leap in machine learning."

For example, we may finally understand how the brain learns and generalizes with only one example. Cracking one-shot learning would circumvent the need for massive training data sets. This sets up the algorithms for functioning in real-world scenarios, which often can't produce sufficient training data or give the AI enough time to learn.

Finally achieving human-like vision would also allow machines to parse complex sceneries, such as those captured by surveillance cameras.

Think of the implications for terrorism and cybersecurity. AI systems powered by brain-like algorithms will likely have "transformative impact for the intelligence community as well as the world more broadly," says Volgeinstein.

Lichtmas is even more optimistic.

"What comes out of it — no matter what — it's not a failure," he says, "The brain [is] ... really complicated, and no one's ever really seen it before, so let's take a look. What's the risk in that?"

Unlocking the secrets of the brain's intelligence to develop smarter technologies

11 March 2016, by Graciela Gutierrez

Of all the fast and powerful computers in the world, our brain remains by far the most impressive. Now an interdisciplinary team of scientists, led by Baylor College of Medicine, aims to reveal the computational building blocks of our brain and use them to create smarter learning machines.

To enable this ambitious project, the U.S. government's Intelligence Advanced Research Projects Activity(IARPA) has awarded a $21 million contract to an interdisciplinary team of neuroscientists, computer scientists, physicists and mathematicians, led by principal investigator Dr. Andreas Tolias, associate professor of neuroscience at Baylor. The research team includes scientists from Baylor, the California Institute of Technology, Columbia University, Cornell University, Rice University, the University of Toronto and the University of Tuebingen.

The program supporting this research is known as Machine Intelligence from Cortical Networks (MICrONS) and was envisioned and organized by Jacob Vogelstein, a neuromorphic engineer and program manager with IARPA. It is part of the broader BRAIN Initiative, launched in 2013 by President Obama with the goal of understanding devastating brain diseases and developing new technology, treatments and cures.

"Our goal is to discover the algorithms and learning rules that the brain implements and use these discoveries to create fundamentally smarter artificial neural networks" said Tolias.

Artificial Intelligence

Artificial Intelligence (AI) has been a dream for a long time, but an elusive one. People have consistently underestimated how hard it is to construct intelligent systems, Tolias said. Famously, in 1955, cognitive scientists proposed to solve AI as a summer project for several Dartmouth undergraduates. It didn't turn out to be that easy.

But in the past few years, AI has been booming, and applications have blossomed everywhere. Handheld devices now use machine learning algorithms to recognize faces and speech, the first self-driving cars already are on the roads, and computer systems regularly wade through Big Data to find new medicines and anticipate geopolitical and financial trends.

Despite their new successes, "these artificial neural networks are still incredibly primitive compared to biological neural networks, and don't learn the way real brains do," said Dr. Xaq Pitkow, co-principal investigator of the MICrONS project, and an assistant professor of neuroscience and McNair Scholar at Baylor as well as an assistant professor of electrical and computer engineering at Rice University. "By modeling the brain's computations and extracting their key features, we think we can give computers the ability to do much better."

Bigger Data

Researchers have been trying to develop brain-like intelligence for years, so what has changed that makes this more achievable today? Tolias's answer: bigger and better data.

Jacob Reimer, assistant professor of neuroscience at Baylor and one of the lead scientists and project manager of the team, agrees.

"Technologies in both physics and molecular biology have advanced so much that we can now record from many hundreds of neurons at a time, with even more extensive recordings on the horizon," he said. "This lets us analyze neural circuits in ways that we couldn't dream of just a few years ago."

In order to accomplish their ambitious goals, the team musters an impressive range of experts, each

directing a research group in different aspects of the project. Chris Xu, a physicist at Cornell University, has pioneered 3-photon imaging, a novel method to monitor neural activity non-invasively and more deeply in the brain than ever before. Thanos Siapas of Caltech will focus his team's efforts on unraveling the learning rules in the brain. On the theoretical and mathematical modeling side, Mathias Bethge of the University of Tuebingen and Liam Paninski of Columbia, will develop mathematical models and statistical methods to help interpret the complex data collected by the team's experimentalists.

Even with the massive trove of data they will collect by recording neural activity, it can be hard to tell which neurons are connected to each other, directly exchanging information. That type of wiring information is critical to understanding the brain's algorithms that are embodied in its biological wetware.

Accordingly, the Baylor-led team also is partnering with two other groups to reconstruct the complete wiring diagram for a cube of brain whose activity they measure.

Clay Reid and Nuno da Costa from the Allen Institute for Brain Science will use electron microscopy to image biological structures down to scales reaching just billionths of a meter. They will then hand off about 1,000 large hard disks full of these massive images to Sebastian Seung from Princeton University, who will extract the three-dimensional structure of the neurons, including their shapes and connections. All together, the team will create one of the most exhaustive neuroscience data set in history.

Creating Networks

The ultimate key to succeeding in the goals of the MICrONS project is to implement neuroscience principles in computer algorithms. Working closely with the neuroscientists, team members Ankit Patel, assistant professor of neuroscience at Baylor College of Medicine and Rice University, Richard Baraniuk from Rice University, and Raquel Urtasun and Richard Zemel from the University of Toronto, are machine learning experts, tasked with integrating the computational building blocks the neuroscientists discover into new kinds of artificial neural networks.

This endeavor represents a monumental challenge and opportunity for both neuroscience and computer science. There is no better test of neuroscience principles than to see whether machines built from those principles actually solve real-world problems, Tolias said.

"The project demonstrates what is possible when we bring together world-class interdisciplinary researchers to solve fundamental problems. This bold endeavor could provide enormous benefits to society, including new computer technologies, new understanding of the brain, and new medical breakthroughs," said Dr. Paul Klotman, Baylor College of Medicine president, CEO and executive dean.

The team's grand aims are to understand one cubic millimeter of a mouse brain, and if they are successful their new algorithms will revolutionize machine learning. But it will still be the product of human ingenuity and creativity, and it will take more understanding than we can squeeze from a tiny cube of mouse brain to match that feat.

Provided by Baylor University

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