



# S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

[Advanced manufacturing \(1\)](#)

[Advanced materials \(5\)](#)

[Autonomous systems & robotics \(7\)](#)

[Biotechnology \(1\)](#)

[Communications technology \(2\)](#)

[Cyber security \(1\)](#)

[Energy \(4\)](#)

[Imaging technology \(1\)](#)

[Materials science \(1\)](#)

[Microelectronics \(1\)](#)

[Neuroscience \(1\)](#)

[Photonics \(1\)](#)

[Quantum science \(2\)](#)

[S&T policy \(1\)](#)

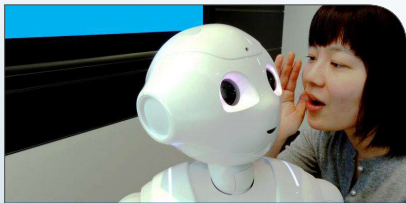
[Science without borders \(1\)](#)

[Sensors \(1\)](#)

## FEATURE ARTICLES

### [How to make an AI forget](#)

[Physorg.com, 17AUG2017](#)



*If you tell a robot secrets, you might want to make sure it can forget them too. Credit: ibmphoto24/Flickr, CC BY-NC-ND*

Researchers are exploring the idea of robot memory in many ways. This raises not only technical issues, but concerns related to privacy, law and ethics. AI that often uses neural

networks modelled on the structure of the brain faces several problems related to “forgetting”, over-fitting (inability to generalize and predict future events), and “catastrophic forgetting” among others. Researchers are trying to build artificial neural networks that can appropriately adjust to new information without abruptly forgetting what they learned before. Just like people, AI should remember important and useful information, while forgetting low value, irrelevant knowledge. However, determining what is relevant and valuable may include factors besides the task at hand, such as questions of ethics, law and privacy.

*Tags: Neuroscience, Artificial intelligence, Featured Article*

### [Reactions in nanocontainers - towards the world's smallest coaxial cable](#)

[Nanowerk, 15AUG2017](#)

Coaxial cables, typically made up of an inner conductor (usually copper) surrounded by an insulating plastic jacket, are reaching the limit of miniaturization. An international team of researchers (UK, Hungary) has developed miniscule wire – comprising a carbon nanotube located inside a boron nitride nanotube. They are strong, lightweight, highly electrically conducting, typically 1-5 nanometres in diameter, but up to centimetres in length, and are ideal for the core of an insulated nanoscale cable. Boron nitride nanotubes are electrically insulating. They developed a technique to arrange these two nanoscale materials one inside the other in the required co-axial

geometry using C60 fullerenes. The technique could lead to the production of novel materials, with potentially broad ranging applications, from nanoscale electronics to catalytic materials and in sensing devices.

**TECHNICAL ARTICLE**

*Tags: Advanced materials, Featured Article*

## S&T NEWS ARTICLES

### ADVANCED MANUFACTURING

#### [Print no evil: Three-layer technique helps secure additive manufacturing](#)

[Science Daily, 16AUG2017](#)

3-D printed components will be going into people, aircraft and critical infrastructure systems. Malicious software installed in the printer or computer could compromise the production process. A team of researchers in the US (Georgia Institute of Technology, Rutgers University) has developed a three-layer system to verify that components produced have not been compromised. Their system uses acoustic and other physical techniques to confirm that the printer is operating as expected, and nondestructive inspection techniques to verify the correct location of tiny gold nanorods buried in the parts. The validation technique is independent of printer firmware and software in the controlling computer. [OPEN ACCESS](#)

**TECHNICAL ARTICLE**

*Tags: Advanced manufacturing, Cyber security*

### ADVANCED MATERIALS

#### [Energized fabrics could keep soldiers warm and battle-ready in frigid climates](#)

[EurekaAlert, 20AUG2017](#)

A team of researchers at the U.S. Army Natick Soldier Research, Development & Engineering Center are working to extend the Stanford University idea of embedding silver nanowire in fabrics suitable for military uniforms, such as polyester and cotton/nylon blend. They found that applying a mere 3 volts to 1-inch by 1-inch

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[BACK TO TOP](#)

test swatches of these fabrics raises the temperature by 100 degrees Fahrenheit in just one minute. If these experimental fabrics can be used in uniforms, soldiers could dial up or down the voltage to vary the amount of heat their uniforms produce to match weather conditions and uniforms could be thinner and lighter. The paper will be presented at the upcoming ACS meeting.

*Tags: Advanced materials, Military technology*

### **The power of perovskite**

[Science Daily, 18AUG2017](#)

Perovskite solar cells have reached power conversion efficiencies of over 22%, and perovskite light-emitting diodes have recently achieved over 11% external quantum efficiency. To date, most research on perovskite light-emitting diodes has focused on solution-processed films. Researchers in Japan investigated an all-vapor perovskite growth process by chemical vapor deposition and demonstrated luminance up to 560 cd/m<sup>2</sup>. There are many advantages of a vapor-based growth process to prepare perovskites, including ease of patterning, ability to batch process and material compatibility. [TECHNICAL ARTICLE](#)

*Tags: Advanced materials, Foreign S&T, S&T Japan*

### **Graphene-like materials printed with inkjet printer**

[Science Daily, 17AUG2017](#)

An international team of researchers (UK, China, Finland) has shown that a black phosphorus ink that can reliably inkjet print enables scalable development of optoelectronic and photonic devices. They optimized the chemical composition to achieve a stable ink through the balance of complex and competing fluidic effects. This enabled the production of new functional photonic and optoelectronic devices by inkjet printing with excellent print quality and uniformity. They demonstrated printed black phosphorus as a passive switch for ultrafast lasers, stable against intense irradiation, and as a visible to near-infrared photodetector with high responsivities. The new ink is compatible with conventional inkjet printing techniques.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Advanced materials*

### **Researchers develop model for lighter armor**

[Physorg.com, 17AUG2017](#)

The Mohr-Coulomb model approximates the material's resistance to shear strength as a linear function of applied pressure. The shear strength does not increase linearly with pressure and will saturate at high pressures. A team of researchers in the US (University of Florida, Army Research Laboratory, MD) developed a new model that identifies the important material parameters for penetration performance of a ceramic target. This will guide how the failure processes in ceramic can be controlled through improved material design or through a

multi-materials systems approach. [TECHNICAL ARTICLE](#)  
*Tags: Advanced materials, Military technology*

## AUTONOMOUS SYSTEMS & ROBOTICS

### **Helping robots correct errors on-the-fly and learn from each other**

[Science Daily, 21AUG2017](#)

Researchers in the UK have developed mathematical foundations for new algorithms which could allow for Artificial Intelligence to collect error reports and correct them immediately without affecting existing skills -- at the same time accumulating corrections which could be used for future versions or updates. The algorithms are combined into a system, an AI corrector, capable of improving performance of legacy AIs on-the-fly. The researchers have discovered and proved stochastic separation theorems which provide tools for correction of the large intelligent data analytic systems. With this approach, instantaneous learning in Artificial Intelligence could be possible, providing AI with the ability to re-learn following a mistake after an error has occurred. [TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, Artificial intelligence, S&T UK*

### **DARPA Squad-x program for integration of robots, drones and sensors with infantry**

[Next Big Future, 18AUG2017](#)

DARPA wants to design, develop, and validate system prototypes for a combined arms squad, to over-match adversaries through the synchronization of fire and maneuver in the physical, electromagnetic spectrum, and cyberspace domains. DARPA's goal is to have real-time coordination of a squad with its flying and ground based drones and to have all relevant sensor data being presented in a useful way to cut through the fog of war to be able to move quickly and effectively eliminate threats within 1000 meters.

*Tags: Autonomous systems & robotics, Military technology*

### **AI Is Taking Over the Cloud**

[MIT Technology Review, 17AUG2017](#)

A cloud storage company in the US announced today that it is adding computer-vision technology from Google to its platform. Users will be able to search through photos, images, and other documents using their visual components, instead of by file name or tag. They are looking to add audio, video and text for which an algorithm could add semantic analysis, making it possible to search by the meaning of a document rather than specific keywords.

*Tags: Autonomous systems & robotics, Artificial intelligence*

### **Microsoft researchers test AI-controlled soaring machine (w/video)**

[Physorg.com, 17AUG2017](#)

Microsoft researchers have created a system that uses artificial intelligence to keep a 16 ½-foot, 12 ½-pound sailplane aloft by autonomously finding and catching rides

*continued...*

“That which can be asserted without evidence, can be dismissed without evidence.”

CHRISTOPHER HITCHENS

on naturally occurring thermals, similar to how many birds stay aloft. It is not only making predictions but also taking action based on those predictions. According to the researchers, the infinite soaring machine could eventually be used for monitoring crops in rural areas and providing mobile Internet service in places where there's no easy way to get needed connectivity. Theoretically it can stay aloft indefinitely by harnessing solar or wind power. It is a test-bed for technologies at the core of anything that will be considered intelligent in the next 10 years.

*Tags: Autonomous systems & robotics*

### **Reliable Perching Makes Fixed-Wing UAVs Much More Useful**

**IEEE Spectrum, 17AUG2017**

Perching with a quadrotor is significantly easier than perching with a fixed-wing aircraft, as they have many more degrees of control. Researchers in Canada have developed Multimodal Autonomous Drone (S-MAD) which uses a thrust-assisted landing technique to reliably perch on walls, and then take off again without involving stall to achieve vertical and ultra-low speed approach. In indoor testing, S-MAD went 20 for 20 in successful perching experiments. Future work will include adding some sensors to help with the final phase of wall contact and working on thrust-assisted wall climbing, managing aborted approaches, and recovering from perch attempts where the microspines don't grab onto the wall properly. [TECHNICAL ARTICLE](#)

*Tags: Autonomous systems & robotics, S&T Canada*

### **DARPA /Assured Autonomy Seeks to Guarantee Safety of Learning-enabled Autonomous Systems**

**DARPA News, 16AUG2017**

The goal of DARPA's [Assured Autonomy](#) program is to create technology for continual assurance of Learning-Enabled, Cyber Physical Systems (LE-CPSs). Continual assurance is defined as an assurance of the safety and functional correctness of the system provided provisionally at design time, and continually monitored, updated, and evaluated at operation-time as the system and its environment evolves. An LE-CPS is defined as a system composed of one or more Learning-enabled Components (LECs). A LEC's behavior is driven by "background knowledge" acquired and updated through a "learning process," while operating in a dynamic and unstructured environment.

*Tags: Autonomous systems & robotics, Artificial intelligence, DARPA*

### **New drone can both swim and fly for future Navy ops**

**Defense Systems, 11AUG2008**

Researchers at Rutgers University have developed a drone called Naviator designed to plunge almost ten meters into the water and surface and fly from that depth, if necessary. The current model can carry a 360 degree waterproof camera. In tests, it successfully conducted underwater bridge inspection. According to the researchers, the next generation Naviator will be designed to carry 30-pound mine countermeasure technology payload, dive up to 30 meters and perform search and rescue missions. Research was sponsored by ONR.

*Tags: Autonomous systems & robotics, Military technology*

## BIOTECHNOLOGY

### **A symbiotic-like biologically-driven regenerating fabric**

**Nature Scientific Reports, 17AUG2017**

Living organisms constantly maintain their structural and biochemical integrity by the critical means of response, healing, and regeneration. An international team of researchers (Israel, USA - Harvard University) present a feasible strategy for driving regeneration in fabric by means of integration with a bacterial biofilm to obtain a symbiotic-like hybrid - the fabric provides structural framework to the biofilm and supports its growth, whereas the biofilm responds to mechanical tear by synthesizing a silk protein engineered to self-assemble upon secretion from the cells. The strategy could be implemented in other systems and drive sensing of integrity and response by regeneration in other materials as well.

*Tags: Biotechnology, Biomimetics*

## COMMUNICATIONS TECHNOLOGY

### **5G Bytes: Small Cells Explained**

**IEEE Spectrum, 19AUG2017**

5G is still in the planning stages. It is not yet clear which technologies will do the most for 5G in the long run, but a few early favorites have emerged. The front-runners include millimeter waves, small cells, massive MIMO, full duplex, and beamforming. Small cells are portable miniature base stations that require minimal power to operate and can be placed every 250 meters or so throughout cities. To prevent signals from being dropped, carriers could blanket a city with thousands of these stations. Antennas on small cells can be much smaller than traditional antennas and the network structure should

provide more targeted and efficient use of the spectrum. Frequencies used by one station in its small broadcast area can be reused by another station in a different area to serve another customer. However, the sheer number of small cells required to build a 5G network may make it impractical to set up in rural areas.

*Tags: Communications technology*

### [Japan launches satellite for better GPS system](#)

[Physorg.com, 19AUG2017](#)

Japan relies on US-operated GPS. They launched the third satellite in its effort to build a homegrown geolocation system aimed at improving the accuracy of car navigation systems and smartphone maps to mere centimetres. The first satellite was put into orbit in 2010 and the second was launched in June 2017 and the fourth is to be launched by March 2018 to start up the service. They plan to boost the number of its satellites in orbit to seven by around 2023.

*Tags: Communications technology, S&T Japan, Satellite technology*

## FEATURED RESOURCE

### [Materials Project](#)

Harnessing the power of supercomputing and state-of-the-art electronic structure methods, the Materials Project provides open web-based access to computed information on known and predicted materials as well as powerful analysis tools to inspire and design novel materials.

## CYBER SECURITY

### [Computer scientists use music to covertly track body movements, activity](#)

[EurekaAlert, 16AUG2017](#)

CovertBand utilizes the principles of active sonar to gather this information. When sound waves bounce off objects in their path, the deflected waves can be picked up by a receiver to determine the object's position, distance and shape. Researchers at the University of Washington have shown that CovertBand can use smart device's built-in microphones as a receiver to pick up reflected sound waves. Repeating pulses can track a person's position, body movements, and activities both in the vicinity of the device as well as through walls.

*Tags: Cyber security*

## ENERGY

### [Stretchable biofuel cells extract energy from sweat to power wearable devices](#)

[Science Daily, 22AUG2017](#)

Researchers at UC San Diego have developed a soft, stretchable electronic-skin-based biofuel cell using a unique combination of lithographically-patterned stretchable electronic framework together with screen-printed, densely-packed three-dimensional carbon-nanotube-based bioanode and cathode array arranged in a stretchable "island-bridge" configuration. It exhibits an open circuit voltage of 0.5 V and a power density of nearly 1.2 mW cm<sup>-2</sup> at 0.2 V and can power conventional electronic devices, such as a light emitting diode and Bluetooth Low Energy radio. It maintains its performance even under repeated strains of 50%, and is stable for two days. The invention is a step forward in the field of soft, stretchable, wearable energy harvesting devices.

#### [TECHNICAL ARTICLE](#)

*Tags: Energy, Flexible electronics*

### [China pips US in race to start the world's first meltdown-proof nuclear power plant](#)

[South China Morning Post, 17AUG2017](#)

China has 20 nuclear power plants under construction, more than any other country on earth. Over the next two weeks, the power plant will start loading more than 100 fuel assemblies into the honeycomb core of its AP1000 reactor with a pair of robotic arms. Compared with current technology, the AP1000 reactor is theoretically 100 times safer, requires 80 per cent less piping, 85 per cent fewer control cables, and needs a third fewer pumps. [RELATED ARTICLE](#)

*Tags: Energy, Foreign S&T, Nuclear energy, S&T China*

### [Fullerene Device Acts as Both Solar Cell and a Current Inverter](#)

[IEEE Spectrum, 17AUG2017](#)

An international team of researchers (China, Spain, Germany) has developed a photovoltaic cell based on a combination of magnetic electrodes and C60 fullerenes that increases the photovoltaic efficiency of the device by 14 percent over photovoltaics using ordinary materials and architecture. The C60 is both a photovoltaic material and one that can sustain the spin polarization of the electronic carriers. The result offers a new way for solar cells to convert light into electricity. To address the low current output mainly due to C60, they are working on building a similar device using better performing materials. [TECHNICAL ARTICLE](#)

*Tags: Energy, Advanced materials, Solar energy*

## **Candy cane supercapacitor could enable fast charging of mobile phones**

Science Daily, 16AUG2017

In polymer supercapacitors, the ions necessary for chemical reactions can only access the top few nanometers below the material surface. An international team of researchers (UK, Bulgaria) used semi-interpenetrating networks (sIPNs) of a pseudocapacitive polymer in an ionically conductive polymer matrix to decrease ion diffusion length scales and make virtually all active material accessible for charge storage. The technique improves specific capacitance, cycling stability and flexibility. The sIPN fabrication process presents a framework to develop a range of polymer-based interpenetrated materials for high-performance energy storage technologies. [TECHNICAL ARTICLE](#)

*Tags: Energy, Advanced materials*

## IMAGING TECHNOLOGY

### **Lockheed Martin Closes In On Shrinking the Telescope, Reveals First Images from Instrument as Thick as a Pen Cap**

Lockheed Martin Corporation, 03AUG2017

Researchers in the US have revealed the first images from an experimental, ultra-thin optical instrument, showing it is possible to shrink space telescopes to a sliver of the size of today's systems while maintaining equivalent resolution. Weighing 90 percent less than a typical telescope, the Segmented Planar Imaging Detector for Electro-Optical Reconnaissance (SPIDER) opens a path for extremely lightweight optical instruments, allowing for more hosted payloads or smaller spacecraft. The sensor technology has applications for aircraft and other vehicles. The SPIDER project has roots in research funded by DARPA.

*Tags: Imaging technology, Sensors*

## MATERIALS SCIENCE

### **Electrons flowing like liquid in graphene start a new wave of physics**

Nanowerk, 21AUG2017

The maximum possible conductance for any normal metal is defined by the Landauer-Buttiker formalism. An international team of researchers (UK, Italy, the Netherlands, USA - MIT, Israel, Russia, Japan) has shown that Landauer's fundamental limit can be breached in graphene. Studying electron transport through graphene constrictions they found that their conductance below 150 K increases with increasing temperature, in stark contrast to the metallic character of doped graphene. This anomalous behaviour is attributed to collective movement of interacting electrons, which 'shields' individual carriers from momentum loss at sample boundaries. Besides fundamental interest, their work shows that viscous effects can facilitate high-mobility transport at elevated temperatures, a potentially

useful behaviour for designing graphene-based devices.

[TECHNICAL ARTICLE](#)

*Tags: Materials science, Advanced materials*

## MICROELECTRONICS

### **AI implications: Engineer's model lays groundwork for machine-learning device**

Physorg.com, 18AUG2017

A team of researchers in the US (Washington University, Argonne National Laboratory) developed a model based on the theory that every nanoparticle in a network is a node that is connected to every other node, not only its immediate neighbors. The current flowing through the nodes doesn't necessarily occupy the spaces between the nodes, it needs only to pass through the nodes themselves. This behavior, which is predicted by the model, produces experimentally observable current hotspots at the nanoscale. They also looked at neural network. Based on those theories, they propose to design a simple chip to study the output for specific inputs. [TECHNICAL ARTICLE](#)

*Tags: Microelectronics, Artificial intelligence, Microelectronics*

## PHOTONICS

### **Light is seen to scatter off light**

Physics World, 18AUG2017

Light-by-light scattering is a quantum-mechanical process that is forbidden in the classical theory of electrodynamics. An international team of researchers, including the US, reports that out of a total of four billion events they identified just 13 that could have been due to light-by-light scattering. These were events comprising a single flash of light at two diametrically opposed points in the ATLAS calorimeter at CERN, but with no sign of any other particle emission – and in particular no curved tracks from charged particles travelling through the detector's magnetic field.

[OPEN ACCESS TECHNICAL ARTICLE](#)

*Tags: Photonics, Science without borders*

## QUANTUM SCIENCE

### **Electric fields control nuclear spin qubits in silicon**

Nanotechweb, 21AUG2017

A team of researchers in the US (Princeton University, Lawrence Berkeley National Laboratory) has developed a technique for controlling nuclear spins in silicon by purely electrical means. The new technique could be used to develop quantum computers that use nuclear spins to encode quantum information. In future quantum processors, they envision arrays of donor nuclear spin qubits that are separated by just tens of nanometres. In the processors, cross-talk will be a problem if we use RF magnetic fields as they are difficult to confine on the nanoscale. Electric fields are easier to confine, so as devices

are scaled down, they may have to use an electrical method of controlling nuclear spins. Additionally, this approach makes it possible to drive nuclear spin qubits either at their resonance frequency or at its first subharmonic, thus reducing device bandwidth requirements.

#### TECHNICAL ARTICLE

*Tags: Quantum science*

### Tiny traps bring quantum magnetic memory under control

[Nanotechweb](#), 18AUG2017

Fluxons, quantum tubes of magnetic field that thread through a superconductor, could act as tiny, efficient memory elements in devices that use superconducting materials as substrates if their arrangement can be controlled. Researchers in Austria have developed nanostructured superconductors that can trap and arrange fluxons in non-uniform patterns. The patterns could provide the basis of information storage in superconductor-based computers. TECHNICAL ARTICLE

*Tags: Quantum science, Foreign S&T*

## S&T POLICY

### How Materials Science Will Determine the Future of Human Civilization

[MIT Technology Review](#), 16AUG2017

If Moore's law continues, electronic devices will consume more than half the world's energy budget within 20 years. According to researchers in Switzerland, the solution will be in the form of a fundamental breakthrough that changes the way we think about information technology and the way we use it. One or two potential avenues for this breakthrough are multiferroics and strong correlations between electrons in solids. True breakthroughs that will change the course of history will come from off-beat individuals or small teams of fundamental researchers pushing the boundaries of knowledge in directions for which there is not yet an application. [OPEN ACCESS](#)

#### TECHNICAL ARTICLE

*Tags: S&T policy*

## SCIENCE WITHOUT BORDERS

### Tech leaders warn against 'Pandora's box' of robotic weapons

[Physorg.com](#), 21AUG2017

At the International Joint Conference on Artificial Intelligence in Australia, more than 100 robotics and artificial intelligence entrepreneurs signed a letter to the United Nations calling for action to prevent the development of autonomous weapons. According to the signators, lethal autonomous weapons threaten to become the third revolution in warfare. Once developed, they will permit armed conflict to be fought at a scale greater than ever, and at timescales faster than humans can comprehend. The innovators also highlighted the danger that the technology could fall into the wrong hands.

*Tags: Science without borders, Artificial intelligence, Autonomous systems & robotics*

## SENSORS

### Lockheed next generation active electronically scanned array radar

[Next Big Future](#), 19AUG2017

Lockheed Martin's active electronically scanned array (AESA) technology incorporates gallium nitride (GaN) transmitter technology and advanced signal processing techniques including recently developed and proven 360-degree sensor/fire control algorithms based on advanced threat sets. These technologies and concepts have been fully integrated into both demonstration and production systems resulting in the industry's first fielded ground based radars with GaN technology.

*Tags: Sensors, Military technology* ■

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