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S&T NEWS BULLETIN

THE LATEST IN SCIENCE AND TECHNOLOGY RESEARCH NEWS

Feature Articles

These Robots Can Merge and Split Their Brains to Form New Modular Bots

IEEE Spectrum, 18SEP2017

Researchers are developing splittable, mergeable nervous systems for truly modular robots. Credit: Image: Marco Dorigo and Nithin Mathews/Nature Communications

An international team of researchers (Belgium, Portugal, Switzerland) has developed robots whose bodies and control systems can merge to form entirely new robots that retain full sensorimotor control. With one module acting as the brain, the rest of the robot modules (whatever their configuration) form the rest of the nervous system. Modules farther from the brain collect sensor data, passing it to their parent modules, which synthesize and pass refined data up the chain. For its part, the brain module makes all high-level decisions, which are passed back down to individual actuator modules. The robot can split into separate autonomous robots each with an independent brain unit, absorb robotic units with different capabilities into its body, and self-heal by removing or replacing malfunctioning body parts—including a malfunctioning brain unit. Open Source TECHNICAL ARTICLE

Tags: Autonomous systems & robotics, Featured Article

World first: 'Storing lightning inside thunder'

Science Daily, 18SEP2017

Researchers in Australia have fabricated a chip in which information in acoustic form travels at a velocity five orders of magnitude slower than in the optical domain. The delay allows for the data to be briefly stored and managed inside the chip for processing, retrieval and further transmission as light waves. Building an acoustic buffer inside a chip improves our ability to control information by several orders of magnitude. The system is not limited to a narrow bandwidth which makes it possible to store and retrieve information at multiple wavelengths simultaneously, vastly increasing the efficiency of the device. Such a hybrid chip could have a huge impact in cloud computing and telecommunication centers. Open Source TECHNICAL ARTICLE

Tags: Microelectronics, S&T Australia, Featured Article

S&T News Articles

ADVANCED MANUFACTURING

Engineers explore origami to create folding spacecraft

Physorg.com, 25SEP2017

Researchers at JPL are working on Starshade, an immense, folding iris that has been proposed as a way to block light from distant stars. It would unfurl to a diameter of about 85 feet in space. Dampening the brightness of a star's light would extend the capability of a space telescope to detect orbiting exoplanets. Starshade and the Transformers project are still in their early stages. CubeSats are limited in what they can do without folding structures, origami can pack antennas and other equipment into them. In July, NASA placed an open call for origami designs to be used in radiation shielding.

Tags: Advanced manufacturing, Space technology

ADVANCED MATERIALS

Bringing signals into phase

Physorg.com, 26SEP2017

In an electric circuit, a capacitor and an inductor can change phase, but only by exactly 90°. An international team of researchers (Saudi Arabia, Arab Emirates) has created a fractional-order capacitor using vinylidene fluoride by depositing a thin film on a layer of gold on a silicon substrate. The electrical properties of the polymer were controlled using a simple solution-mixing approach to add different amounts of trifluoroethylene and/or

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cholorfluroethylene. They could tune the constant phase angle (CPA) of their devices between 66 and 88 degrees depending on the blend composition. The devices acted over a wide range of frequencies from 0.1 to 10 megahertz. TECHNICAL ARTICLE

Tags: Advanced materials, Integrated circuits

AUTONOMOUS SYSTEMS & ROBOTICS

New study measures human-robot relations

Physorg.com, 18SEP2017

A team of researchers in Australia is designing a psychometric scale to enhance the understanding of human-robot interactions and find out if people feel comfortable and ready to bond with a social robot. It could have wide individual and industry application, such as finding out how people react to an interaction with a health, tutor or worker robot in their environment or workplace. The research may lead to a new way to rate and classify human-robot connections, particularly as robots begin to integrate into the public in the near future.

Tags: Autonomous systems & robotics, S&T Australia

BIOTECHNOLOGY

A DNA-based rewritable memory device

Nanowerk, 18SEP2017

A team of researchers at SUNY Albany used shape-changing DNA nanostructures for short term storage of data, where the information is "written" in different conformations of the nanostructures. The stored data can be easily read-out using gel electrophoresis, eliminating any multi-step or costly methods, information can be erased and rewritten. A write-protection function is provided to prevent erasing of specific bits. They have demonstrated that the device is stable and functional even after drying and can thus be potentially used for labeling with 5-bit codes, or expanded to 8-bits or more by placement of more address sites. The system has applications in data encryption, and biosensing. Open Source TECHNICAL ARTICLE

Tags: Biotechnology, Information technology

Cells programmed like computers to fight disease

Science Daily, 18SEP2017

An international team of researchers (France, UK, Spain) has proved that RNA can be genetically engineered and organised into tailor-made sequences of commands—similar to codes for computer software—which feed specific instructions into cells, programming them to do what we want. As well as fighting disease and injury in humans, scientists could harness this technique to control plant cells and reverse environmental and agricultural issues, making plants more resilient to disease and pests. Open Source TECHNICAL ARTICLE

Tags: Biotechnology, Synthetic biology

COMMUNICATIONS TECHNOLOGY

Wireless high-speed data and power transfer integrated

Science Daily, 18SEP2017

To minimize the power loss in generating magnetic fields, narrow bandwidth antennas are used in wireless power transfer technologies. As narrow bandwidth antenna limits data transfer, separate radios for data transmission are incorporated. Researchers at North Carolina State University have shown that a wide-bandwidth system with narrow-bandwidth components can be configured adapting data-rate enhancement techniques, such as channel equalization, to further improve data rate and data signal quality. TECHNICAL ARTICLE

Tags: Communications technology

COUNTER WMD

How Sandia is Trying to Stop Anthrax in its Tracks

R&D Magazine, 18SEP2017

A team of researchers from Sandia and other national laboratories, local, state and federal agencies is working on the DHS-sponsored Underground Transport Restoration project to clean up chemical and biological warfare agents after an attack. They have developed scientific sampling methods to determine the extent and nature of the contamination, improved processing samples, updated subway system models that can be used to assess the spread of a potential release and tested decon agents and decon methods.

Tags: Counter WMD, Government S&T

ENERGY

Breaking Coulomb's law: Scientists find a way around the rule that 'opposites attract'

Science Daily, 21SEP2017

An international team of researchers (Japan, USA - Drexel University, UK, Australia, France) has shown that Coulombic ordering starts to break down when ions are confined in minuscule carbon pores, when the pores can accommodate only a single layer of ions. However, equally charged ion pairs are formed due to the induction of an electric potential of opposite sign in the carbon pore walls. This non-Coulombic ordering is further enhanced in the presence of an applied external electric potential. This finding opens the door for the design of better materials for electrochemical applications, and a step towards creating the next generation of batteries, as well as more effective water treatment and better alternative energy. TECHNICAL ARTICLE

Tags: Energy, Advanced materials

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"If we all did the things we are capable of, we would astound ourselves."

THOMAS A. EDISON

A sustainable future powered by sea

Okinawa Institute of Science and Technology, 20SEP2017

According to researchers in Japan, using just 1% of the seashore of mainland Japan can generate about 10 gigawatts of energy which is equivalent to 10 nuclear power plants. They demonstrated that submerged turbines anchored to the sea floor through mooring cables can convert the kinetic energy of sustained natural currents into usable electricity, which is then delivered by cables to the land. The Wave Energy Converter project involves placing turbines at key locations near the shoreline exposing them to ideal wave conditions to generate clean and renewable energy and protect the coasts along with using tetrapods. The turbines are built to withstand the forces thrust upon them during extreme weather. The blades rotate at a carefully calculated speed that allows creatures caught among them to escape.

Tags: Energy, S&T Japan

Researchers' work pushes battery technology forward

Nanowerk, 19SEP2017

An international team of researchers (USA - University of Central Florida, Rice University, China) has designed a new type of electrode that displays excellent conductivity, is stable at high temperatures, is cheap to manufacture and can be recharged thousands of times without degrading. They developed a battery cathode created from a thin-film alloy of nickel sulfide and iron sulfide and etched it to create a porous surface of microscopic nanostructures. TECHNICAL ARTICLE 1, 2

Tags: Energy, Battery

Self-healing catalysts make it easier to store solar energy with water

Physorg.com, 19SEP2017

One of the problems with using water to store solar energy is that the catalysts corrode in water with a neutral pH. An international team of researchers (France, USA - Harvard University) has designed self-healing catalysts that can regenerate themselves in the presence of other elements, such as negatively charged phosphate or borate ions. The self-healing process requires less energy than that needed for normal catalyst operation, can be controlled by adjusting the pH of the solution and can occur over a wide range of pH values. The critical pH "zone of self-healing" depends on the geometry of the water-splitting cell and the phosphate or borate buffer concentration. The rule set they developed provides a roadmap for the design of any self-healing catalyst. TECHNICAL ARTICLE

Tags: Energy, Materials science, Solar energy

FORECASTING

Technique spots warning signs of extreme events

MIT News, 22SEP2017

Dynamical equations used for predicting extreme events in complex systems are based on a system's underlying physics. But the physics governing many complex systems are often not well-understood and they contain important model errors. Researchers at MIT developed a general framework, in the form of a computer algorithm, that combines both equations and available data to identify the precursors of extreme events that are most likely to occur in the real world. They look at the equations for possible states that have very high growth rates and become extreme events, but they are also consistent with data, indicating if this state has any likelihood of occurring. They tested their approach on a model of turbulent fluid flow. The method may help predict hotspots of instability affecting climate, aircraft performance, and ocean circulation. OPEN SOURCE TECHNICAL ARTICLE

Tags: Forecasting, Climatology

INFORMATION TECHNOLOGY

New type of supercomputer could be based on 'magic dust' combination of light and matter

Physorg.com, 25SEP2017

An international team of researchers (Russia, UK) created 'magic dust' polaritons by shining a laser at stacked layers of selected atoms such as gallium, arsenic, indium, and aluminium. They have used polaritons to act as a type of 'beacon' showing the way to the simplest solution to complex problems. They have shown that they can create polaritons at vertices of an arbitrary graph: as polaritons condense, the quantum phases of polaritons arrange themselves in a configuration that corresponds to the absolute minimum of the objective function. They are currently scaling up the device to hundreds of nodes, while testing its fundamental computational power. The goal is a microchip quantum simulator operating at ambient conditions. TECHNICAL ARTICLE

Tags: Information technology

A new way to enhance the capacity of memory devices

Nanowerk, 22SEP2017

An international team of researchers (USA - New Mexico State University, Los Alamos National Laboratory, Argonne National Laboratory, Russia, China, Germany) has shown that an external electric field can displace the core of the

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topological vortex inside barium titanate nanoparticles, and when the field is removed it returns to its original position. The unusual self-organization of atoms and the ability to control it by electric field can be used to generate capacious non-volatile random access memory, quantum computers and other next generation electronics. Open Source TECHNICAL ARTICLE

Tags: Information Technology, Materials science

Featured Resource

IEEE Spectrum magazine

This flagship publication of the IEEE is a monthly magazine for technology innovators, business leaders, and the intellectually curious. Spectrum explores future technology trends and the impact of those trends on society and business. RSS

MATERIALS SCIENCE

Application of air-sensitive semiconductors in nanoelectronics

Physorg.com, 22SEP2017

Upon light irradiation, gallium selenide can generate electron fluxes which is required for optical applications in nanoelectronics. However, the stability of GaSe in real devices is unclear. An international team of researchers (Germany, Russia, Venezuela) has shown that GaSe oxidizes in air and loses its electrical conductivity. According to the researchers, by placing GaSe in a vacuum, an inert environment or covering it with a protective layer, it can be used to produce next-generation optoelectronics, detectors, light sources and solar batteries. TECHNICAL ARTICLE *Tags: Materials science*

Physicists "learn the rules" of magnetic states in newly published research

Physorg.com, 18SEP2017

A team of researchers in the US (Iowa State University, industry) found that in the case of $LaCrGe_3$, for certain pressures and fields, the ferromagnetism is suppressed and new antiferromagnetic states emerge. The new insight into the "rules" of how magnetic states emerge and are suppressed can guide the discovery of other materials with superconducting capabilities. Open Source TECHNICAL ARTICLE

Tags: Materials science, Advanced materials

Physicists guide electromagnetic waves along an infinitesimal line

Physorg.com, 18SEP2017

Researchers at UC San Diego have demonstrated a new mode of electromagnetic wave called a "line wave," which travels along an infinitely thin line along the interface between two adjacent surfaces with different electromagnetic properties, one is inductive and the other capacitive. The different boundaries prevent backscattering, which prevents scattering of defects in the line waves back toward the source and unwanted reflections. According to the researchers, the operating range could be increased by using other materials. Line waves can be used for integrated optical waveguides, optical isolators or circulators. If made using materials such as graphene, line wave guides could be electrically reconfigurable, leading to field-programmable optical circuits. TECHNICAL ARTICLE

Tags: Materials science

MICROELECTRONICS

Researchers produce first 2-D field-effect transistor made of a single material

Physorg.com, 19SEP2017

The current 3-D FETs are reaching their efficiency limit. To address the issue of large contact resistance at the interface between the 2-D semiconductor and any bulk metal, researchers in South Korea developed a new technique to produce 2-D metal transistors with semiconduction made of the polymorphic molybdenum telluride. The contact resistance at the interface between the semiconductor and metallic $MoTe_2$ is low and the barrier height was lowered by a factor of 7, from 150 meV to 22 meV. According to the researchers, in the future it would be possible to realize an even smaller contact resistance, reaching the theoretical quantum limit. TECHNICAL ARTICLE

Tags: Microelectronics, Materials science

Optical, electrical bistability study sheds light on next-gen high speed data transfer

Science Daily, 18SEP2017

Optical bistable devices are fundamental to digital photonics as building blocks of switches, logic gates, and memories in future computer systems. Researchers at the University of Illinois Urbana-Champaign have demonstrated both optical and electrical bistability and capability for switching in a single transistor operated at room temperature. The electro-optical hysteresis is explained by the interaction of electron-hole generation and recombination dynamics with the cavity photon modulation in different switching paths. Open Access TECHNICAL ARTICLE

Tags: Microelectronics, Information technology

NEUROSCIENCE

Designing next-generation neural interfaces with graphene

Nanowerk, 22SEP2017

All currently used neural interface devices are designed to perform a single function: either record activity or electrically stimulate tissue. An international team of researchers (UK, Spain) provides an overview of how graphene-based versatile platforms could help address many of the current

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challenges in neural interface design. They illustrate how graphene and other 2D materials possess an array of properties that can enhance functional capabilities for neural interfaces. TECHNICAL ARTICLE

Tags: Neuroscience, Advanced materials, Biotechnology

Biomedical engineers connecting a human brain to the internet in real time

Medical Express, 14SEP2017

Brainternet is a new frontier in brain-computer interface systems which works by converting EEG signals in an open source brain live stream. Researchers in South Africa have developed a system where a person wears a powered, mobile, internet accessible EEG device that transmits the EEG signals to a tiny computer. The computer live streams the signals to an application programming interface and displays data on a website that acts as a portal. The public can observe the individual's brain activity on the open website. According to the researchers, it enables interactivity between the users and their brain so that the user can provide a stimulus and see the response; there could be information transferred in both directions—inputs and outputs to the brain.

Tags: Neuroscience

Scientists grow human 'mini brains'

Medical Express, 14SEP2017

Researchers in the UK working under a European Commission initiative called the MESO-BRAIN are using human skin cells to turn them into stem cells and then brain cells. They are trying to help neurons to connect and to grow together so that, ultimately, they can build 3-D models of the brain. They are also trying to find the right materials and shapes with which they can create 3-D scaffolds to help create the ideal conditions for neurons to grow in.

Tags: Neuroscience, S&T UK

PHOTONICS

A new approach to ultrafast light pulses

MIT News, 18SEP2017

Two-dimensional molecular aggregates are very effective light emitters that work on a different principle than typical OLEDs or quantum dots. But their potential as components for new kinds of optoelectronic devices has been limited by their relatively slow response time. A team of researchers in the US (MIT, UC Berkeley, Northeastern University, Lawrence Berkeley National Laboratory) found a dominant fluorescent decay channel in a 2D molecular aggregate as a result of the strong and coherent dipole–dipole interaction mediated by a metallic substrate. This unique mechanism leads to an ultrafast fluorescent decay and 10-times greater energy dissipation rate than expected. The finding opens a unique way to manipulate energy transfer and to develop light-energy devices on the molecular level. TECHNICAL ARTICLE

Tags: Photonics

Researchers are turning optical data into readable soundwaves

Nanowerk, 18SEP2017

Researchers in Australia have experimentally demonstrated a coherent buffer in an integrated planar optical waveguide by coherently transferring optical information to an acoustic hypersound wave. Optical information is extracted using the reverse process. The hypersound phonons have similar wavelengths as the optical photons but travel at five orders of magnitude lower velocity. They demonstrated the storage of phase and amplitude of optical information with gigahertz bandwidth and showed operation at separate wavelengths with negligible cross-talk. OPEN SOURCE TECHNICAL ARTICLE

Tags: Photonics, Information technology

Scientists demonstrated 1.3 μm submilliamp threshold quantum dot micro-lasers on Si

EurekAlert, 18SEP2017

An international team of researchers (USA - UC Santa Barbara, industry, Harvard University, Hong Kong) demonstrated record-small electrically pumped micro-lasers epitaxially grown on industry standard (001) silicon substrates. Continuous-wave lasing up to 100°C was demonstrated at a 1.3 μm communication wavelength. A submilliamp threshold of 0.6 mA was achieved for a micro-laser with a radius of 5 μm. OPEN SOURCE TECHNICAL ARTICLE

Tags: Photonics, Microelectronics

QUANTUM SCIENCE

Long-Lasting Qubits Share Vibrations to Stay Cool

IEEE Spectrum, 25SEP2017

Currently, the coherence time of a single qubit is limited to less than 1 min. An international team of researchers (China, USA - University of Michigan) reports the observation of a coherence time of over 10 min for a single qubit consisting of a magnetically trapped, positively charged ytterbium-171 ion. In order to keep their qubits relatively cool, they placed a positively charged barium-138 ion in the same magnetic trap with each ytterbium-171 ion. The long-time quantum memory of the single trapped ion qubit would be an essential component of scalable quantum computers, quantum networks and quantum money. TECHNICAL ARTICLE

Tags: Quantum science

A way to measure and control phonons

Physorg.com, 22SEP2017

Phonons may provide a bridge between the classical world and the quantum world. An international team of researchers (Austria, the Netherlands) has developed a way not only to measure phonons as they propagate, but show that it is possible to control them. They used the state

of the photons to determine the non-classical state of the phonons in the device. The team showed that individual phonons moving in a crystal follow the laws of quantum mechanics as opposed to classical physics. According to the team, because of its quantum properties and the use of light, the technique offers a possible path toward using phonons as a means for storing quantum information of the type that could be needed in a quantum computer. TECHNICAL ARTICLE

Tags: Quantum science, Information technology

Quantum data takes a ride on sound waves

Physorg.com, 22SEP2017

Researchers at Yale University have created a device featuring a qubit made from superconducting aluminum and a mechanical resonator made with a sapphire wafer which has two polished surfaces acting as mirrors for sound waves. It allows a superconducting qubit to exchange energy and quantum information with a high frequency bulk acoustic wave resonator (HBAR). They found that a phonon can live for a very long time when it bounces back and forth between these mirrors, and it can be coupled to a superconducting qubit made on the surface of the sapphire using a disk of aluminum nitride, which converts acoustic energy into electromagnetic energy and vice versa. The combination of these properties enables transferring quantum states back and forth between the qubit and the mechanical resonator. TECHNICAL ARTICLE

Tags: Quantum science

SENSORS

Artificial intelligence for obtaining chemical fingerprints

Physorg.com, 26SEP2017

An international team of researchers (Austria, Germany) has developed a molecular dipole moment model based on environment dependent neural network charges. They demonstrated the power of their approach by applying it to model the infrared spectra of a methanol molecule, n-alkanes containing up to 200 atoms and the protonated alanine tripeptide. In all of these cases, they found excellent agreement between the infrared spectra predicted via machine learning models and the respective theoretical and experimental spectra. TECHNICAL ARTICLE

Tags: Sensors, Pattern recognition

Invisibility cloak closer to becoming a reality

Physorg.com, 18SEP2017

Researchers working on FLATLIGHT, an EU sponsored project, have developed a concept of Conformal Boundary Transformation which is described as an analytical method which allows engineering transmission and reflection of light for any interface geometry and any given incident wave. According to the researchers, the concept provides a wide range of new design opportunities to hide objects behind an 'optical curtain' to create optical illusions by reflecting virtual images, or to suppress the diffraction generally occurring during light scattering at corrugated interfaces.

Tags: Sensors, S&T EU ■

About This Publication

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