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In This Issue.....

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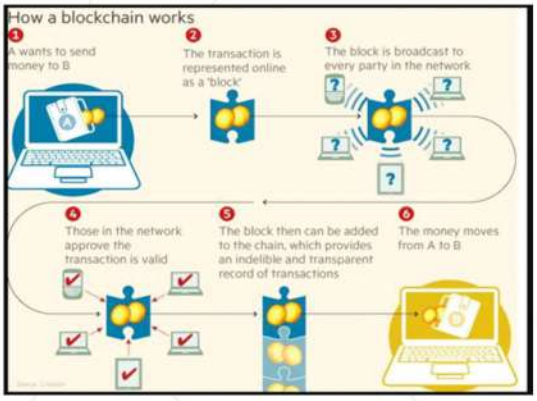
Forget Bitcoin: Blockchain is the Future

Cryptocurrencies of all types make use of distributed ledger technology known as blockchain Blockchains act as decentralized systems for recording and documenting transactions that take place involving a particular digital currency. Put simply, blockchain is a transaction ledger that maintains identical copies across each member computer within a network. The fact that the ledger is distributed across each part of the network helps to facilitate the security of the blockchain.

While Bitcoin and other cryptocurrencies grew intensely popular among the general financial and investment worlds in late 2017 and early 2018, they have since become more of a niche area for cryptocurrency enthusiasts. However, blockchain technology remains a quickly-growing area of growth for companies across a host of industries. It is possible that blockchain technology will ultimately be seen as the most important innovation to come out of the cryptocurrency boom.

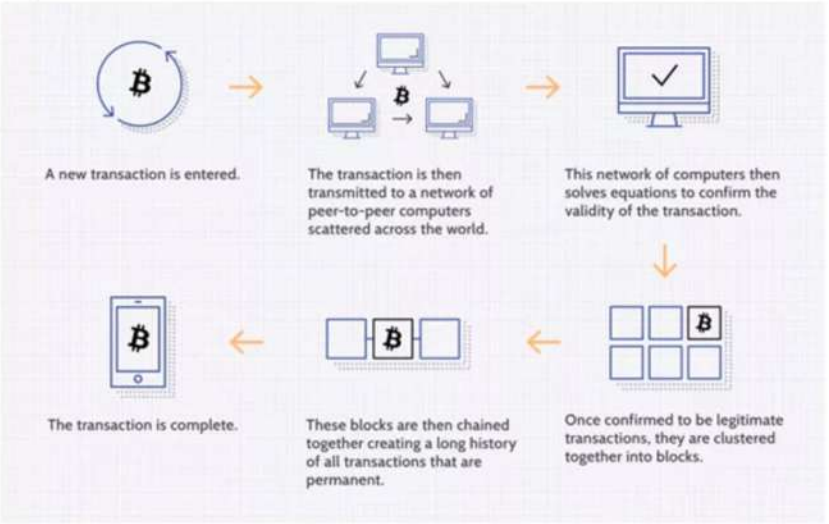


Basics of Blockchain

A blockchain is a distributed database that is shared among the nodes of a computer network. As a database, a blockchain stores information electronically in digital format. Blockchains are best known for their crucial role in cryptocurrency systems, such as Bitcoin, for maintaining a secure and decentralized record of transactions. The innovation with a blockchain is that it guarantees the fidelity and security of a record of data and generates trust without the need for a trusted third party.

One key difference between a typical database and a blockchain is how the data is structured. A blockchain collects information together in groups, known as blocks, that hold sets of information. Blocks have certain storage capacities and, when filled, are closed and linked to the previously filled block, forming a chain of data known as the blockchain. All new information that follows that freshly added block is compiled into a newly formed block that will then also be added to the chain once filled.

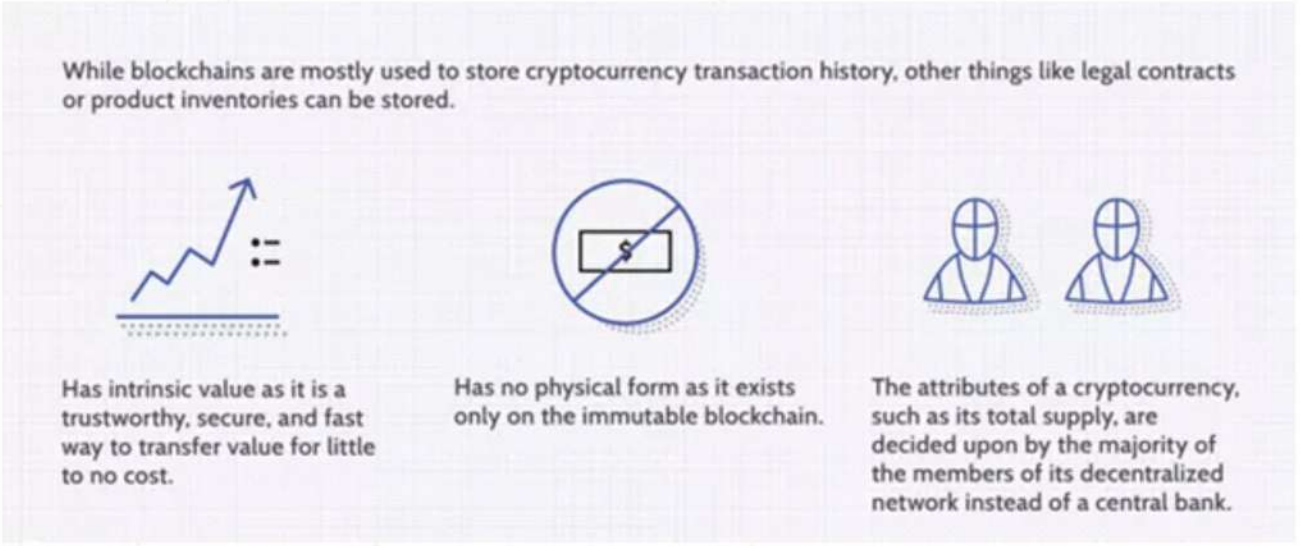
While blockchain is most famous for its role in facilitating the rise of digital currencies over the past several years, there are also many other non-cryptocurrency uses for this technology. Indeed, some blockchain proponents believe that the technology could far outpace cryptocurrencies themselves in terms of its overall impact, and that the real potential of blockchain is only just now being discovered. As such, it's likely that financial advisors and many others in the investing world will encounter blockchain technology much more in the years to come, whether it is linked with a specific cryptocurrency or if it's being utilized in any number of other applications.



Bitcoin vs. Blockchain

Blockchain technology was first outlined in 1991 by Stuart Haber and W. Scott Stornetta, two researchers who wanted to implement a system where document time stamps could not be tampered with. But it wasn't until almost two decades later, with the launch of Bitcoin in January 2009, that blockchain had its first real-world application

The Bitcoin protocol is built on a blockchain. In a research paper introducing the digital currency, Bitcoin's pseudonymous creator, Santoshi Nakamoto referred to it as "a new electronic cash system that's fully peer-to-peer, with no trusted third party." The key thing to understand here is that Bitcoin merely uses blockchain as a means to transparently record a ledger of payments, but blockchain can, in theory, be used to immutably record any number of data points. As discussed above, this could be in the form of transactions, votes in an election, product inventories, state identifications, deeds to homes, and much more.



How Many Blockchains Are There?

The number of live blockchains is growing every day at an ever-increasing pace. As of 2022, there are more than 10,000 active cryptocurrencies based on blockchain, with several hundred more non-cryptocurrency blockchains.

Below I am mentioning some books to learn about blockchain –

1. Cryptoassets by Chris Burniske and Jack Tatar
2. The Book of Satoshi by Phil Champagne
3. The Blockchain Developer by Elad Elrom
4. Blockchain Revolution by Don and Alex Tapscott
5. The Basics of Bitcoins and Blockchains by Antony Lewis

ate identifications, deeds to homes, and much more.

A breakthrough algorithm developed in the US can predict crimes a week ahead

Social scientists at the University of Chicago have developed an algorithm that can forecast crime in urban areas up to a week in advance, Bloomberg reported on Thursday(31st June 2022). Over the past few years, there has been a steep rise in the use of algorithms around us. From predicting weather to driving cars, making shopping recommendations, and finding cures for diseases, algorithms are at work everywhere. It would hardly be a surprise if they were not used to fighting crimes.

Prior to the Olympics, Tokyo Police were looking to implement artificial intelligence (A.I.) based technology to predict crimes before they could take place. If it sounds like we are living in a *Minority Report-like* future already, the fact is that we already are and have been for almost a decade now.

Chicago's Crime and Victimization Risk Model

According to the Bloomberg report, the Chicago Police Department implemented the Crime and Victimization Risk Model way back in 2012 with the help of some academic researchers. The model used factors like age and arrest history to prepare a list of potential attackers and their victims and even assigned a score to listed individuals to help law enforcement agencies confer urgency to tracking the predicted perpetrator as well as their victim.

The concept might sound interesting, but the actual application was dodgy. As investigations later showed, almost half of the alleged perpetrators on the list had never been charged for illegal possession of arms, while others had not been charged with serious offenses before. A Technology Review report in 2019 detailed how risk assessment algorithms that determined whether an individual should be sent to jail or not were trained on historically biased data. So, when researchers at the University of Chicago, led by assistant professor Ishanu Chattopadhyay, tried to build their algorithm, they wanted to avoid past mistakes.

How does the new algorithm work?

The algorithm divides a city into 1,000 square feet tiles and uses the historical data on violent and property crimes to predict future events. The researchers told Bloomberg that their model is different from other such algorithmic predictions since the other look at crime as emerging from hotspots and spreading to other areas.

However, such approaches, the researchers argue, miss the complex social environment of cities and are also biased by the surveillance used by the state for law enforcement. Instead, the algorithm used analyses previous crime reports taking into account many other factors, and then forecasted crime likelihood in Chicago with 90 percent accuracy. The model was also used to predict crimes in eight different cities in the U.S., which included big names like Los Angeles, Atlanta, and Philadelphia, and worked well in those scenarios as well, Bloomberg said in its report.

Abstract

Policing efforts to thwart crime typically rely on criminal infraction reports, which implicitly manifest a complex relationship between crime, policing and society. As a result, crime prediction and predictive policing have stirred controversy, with the latest artificial intelligence-based algorithms producing limited insight into the social system of crime. Here we show that, while predictive models may enhance state power through criminal surveillance, they also enable surveillance of the state by tracing systemic biases in crime enforcement. We introduce a stochastic inference algorithm that forecasts crime by learning spatio-temporal dependencies from event reports, with a mean area under the receiver operating characteristic curve of ~90% in Chicago for crimes predicted per week within ~1,000 ft. Such predictions enable us to study perturbations of crime patterns that suggest that the response to increased crime is biased by neighbourhood socio-economic status, draining policy resources from socio-economically disadvantaged areas, as demonstrated in eight major US cities.

Engineers designed motorless sailplanes that could soon help explore Mars

We have all heard of Mars' Perseverance, the robotic explorer currently roaming on the Red Planet. It's one of eight active spacecraft, including three operated by NASA, that currently orbit Mars, gathering imagery and other data related to the planet.

But what lies in the hundreds of kilometers between the rovers and the orbiters remains a mystery to space explorers as there are no aircraft available to study these areas as of yet.

An out-of-reach critical piece in Mars' planetary boundary layer

"You have this really important, critical piece in this planetary boundary layer, like in the first few kilometers above the ground," said Alexandre Kling, a research scientist in NASA's Mars Climate Modeling Center. "This is where all the exchanges between the surface and atmosphere happen. This is where the dust is picked up and sent into the atmosphere, where trace gases are mixed, and where the modulation of large-scale winds by mountain-valley flows happens. And we just don't have very much data about it."

To tackle this obstacle, Kling has joined forces with a team of University of Arizona engineers to develop a motorless sailplane that can soar over the Martian surface for days at a time, using only wind energy for propulsion. The vehicle will be equipped with flight, temperature and gas sensors as well as cameras. Despite this, it will weigh only 11 pounds making it easy to navigate in the Martian atmosphere.

"These other technologies have all been very limited by energy," said the paper's first author, Adrien Bouskela, an aerospace engineering doctoral student in University of Arizona professor Sergey Shkarayev's Micro Air Vehicles Laboratory. "What we're proposing is just using the energy in situ. It's kind of a leap forward in those methods of extending missions. Because the main question is: How can you fly for free? How can you use the wind that's there, the thermal dynamics that are there, to avoid using solar panels and relying on batteries that need to be recharged?"

Capturing images of new areas

Current vehicles roaming on Mars have mostly captured images of Mars' flat plains because that is the only area where the rovers can safely land. But the new and improved sailplanes would be able to explore new areas by taking advantage of how wind patterns shift around geologic formations such as canyons and volcanoes.

"With this platform, you could just fly around and access those really interesting, really cool places," Kling said.

But what would happen once the planes landed on Mars and could not take off again? The mission would go on with the planes now serving as weather stations, continuing to relay information about the atmosphere back to the spacecraft.

Now, Kling hopes that the low-cost nature of his new planes will allow them to become operational on the Red Planet perhaps in years rather than the decades needed for a full-scale mission.

The world's first operational 'sand battery' can store energy for months

A team of researchers from Finland has set up the world's first commercial scale 'sand battery' that be used to store power generated from renewable sources for months at a time to solve the problem of year-round supply, *BBC* reported.

The push for renewable power has meant that researchers are looking for new ways to store energy over the long term. While batteries made using lithium and other earth minerals can be purposed to work as energy farms, the solution becomes unsustainable if the whole world shift to renewables.

Recently, we reported how Switzerland spent 14 years repurposing its natural reservoirs as giant water batteries. While this uses the centuries-old concept to tap into the potential energy of water stored at a higher level, the construction of such facilities can cost millions of dollars. The Finnish solution could be a much cheaper alternative.

How does the sand battery work?

Just like conventional energy storage systems, when excess power is generated through renewable sources than is required, it is directed towards the sand battery. Instead of trying to move electrons from one electrode to the other or power pumps to send water to a higher reservoir, a sand battery uses resistive heating to increase the temperature of the air, which is then transferred to sand through a heat exchanger.

With the melting temperature of the sand in hundreds of degrees Celsius, a tower of sand has a high potential to store energy. More importantly, sand store this energy for many months together, making it a viable long-term storage solution.

Naturally, the next question to be asked is if this technology is scalable, and through the establishment of their company, Polar Night Energy, the researchers have attempted to answer that as well.

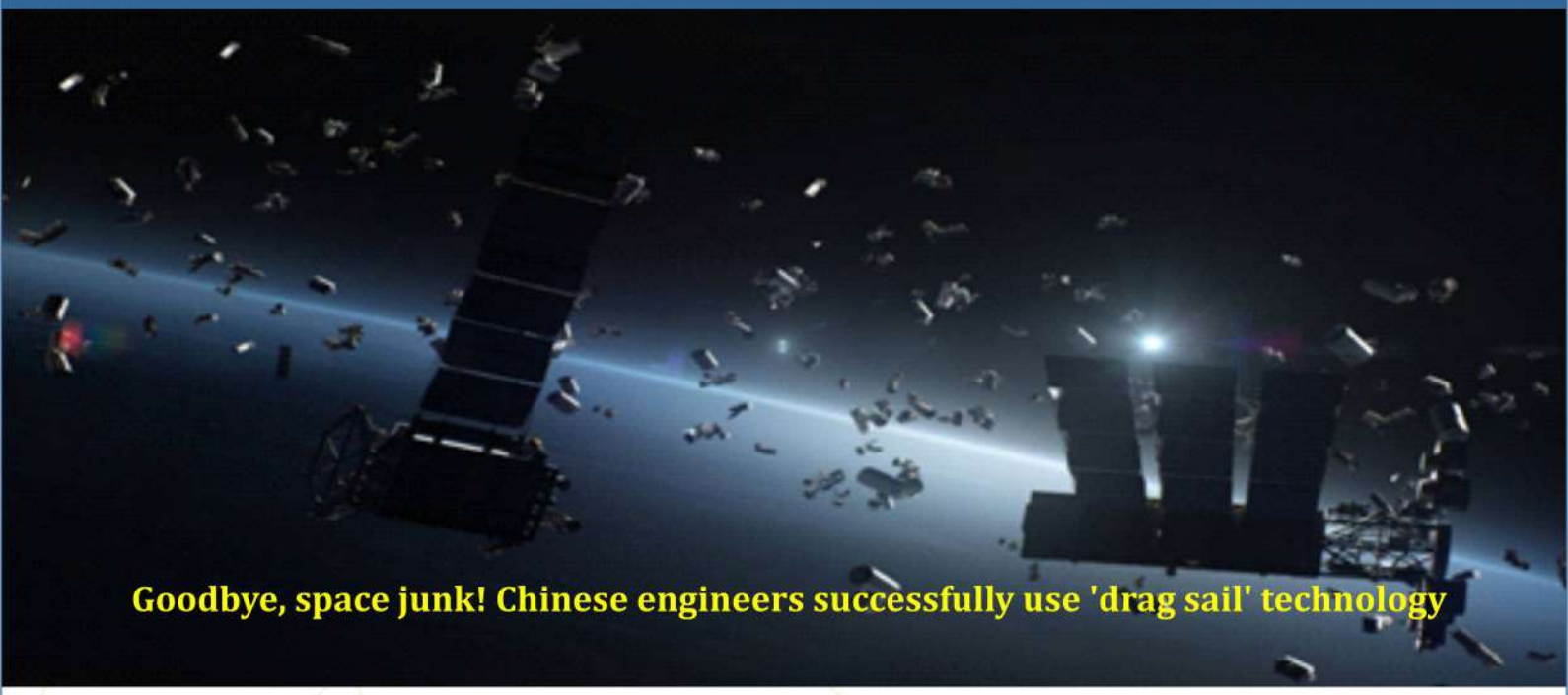
The first commercial solar battery

Working with a small power plant in the town of Kankaanpää in western Finland, Polar Night Energy has erected the first sand battery on a commercial scale. Filled inside a tall grey silo are about 100 tonnes of sand used in construction, a relatively inexpensive alternative to the lithium, cobalt, and nickel needed for other batteries.

Currently, the battery powers the central heating system for the district. When energy prices are higher, the hot air in the battery can be used to warm the water and then pumped to offices and homes in the region.

There are a few hiccups along with way since converting the heat back to electricity is not that energy efficient a process, BBC said in its report. Nevertheless, even as a mechanism to store heat, the battery would be extremely helpful for many industries.

Earlier last month, we reported how China was moving away from coal-fired power plants to nuclear ones in a bid to make its industrial heat requirements greener. A sand battery that could serve industrial needs using renewable energies could be a cost-effective and easy-to-implement system.



Goodbye, space junk! Chinese engineers successfully use 'drag sail' technology

Did you know that up to date, some 8,950 satellites have been launched into orbit? Based on the most recent estimates, about 5,000 of these satellites remain in orbit despite the fact that they have reached the end of their lifespan and no longer serve a purpose.

The ever-growing problem of space junk

It is estimated that only around 1,950 of these satellites remain operational, while the rest have become space debris. These now-defunct satellites are joined by thousands of bits of debris, which are collectively referred to as "space junk".

And this junk is a huge problem as there is currently no way to safely get this garbage out of space. Until now.

On 6th July 2022, the Shanghai Academy of Spaceflight Technology announced that Chinese scientists successfully unfurled a drag sail to deorbit a recently launched Long March 2 rocket. The event marked the first time such an experiment was done with a rocket.

The drag sail is a kite-like membrane that measures 25 sq meters (269 sq feet) when fully unfurled. It's also just one-tenth the diameter of a human hair in thickness which didn't stop it from increasing atmospheric drag and accelerating the orbital decay of the 300kg (661 pounds) rocket's final stage.

Drag sails offer a low-cost and mature technology solution that can be used on any kind of low-Earth orbit satellite that has become space garbage. Since they are highly flexible and lightweight, they can be folded into a small package and placed on a spacecraft before launch.

Once close to the debris, they unfurl automatically helping send the spacecraft back to the atmosphere, where it will disintegrate. Drag sails are a much speedier option than letting junk deorbit naturally, which may take years or decades.

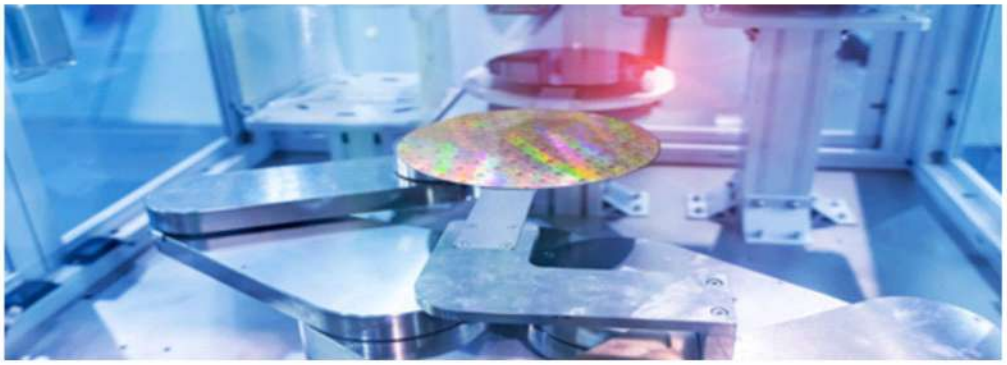
China's space debris problem

It is fitting that China should find a solution to this ongoing problem as the nation has been accused of allowing many of its craft to pollute space. Back in March of 2022, a piece of a China space rocket that was floating aimlessly through space after presumably taking part in an October 2014 launch slammed into the moon.

Luckily, no one was hurt by the collision, but the debris could have caused significant damage if it headed for the International Space Station.

Meanwhile, in November of 2021, a group of mechanical engineers, led by University of Utah professor Jake J. Abbott, devised a new plan for clearing space junk that utilizes spinning magnets to manipulate orbital debris, making it easier to manage and collect them. The new concept relied on subjecting debris to a changing magnetic field, which circulates electrons in the metal debris in charged loops.

IBM's 3D chip stacking process could revive a famous rule on computing power



IBM Research and Tokyo Electron (TEL) collaborated on a new breakthrough in 3D chipmaking that uses a novel method to keep Moore's Law in motion.

The two companies partnered on a chipmaking innovation that simplifies the process for producing wafers with 3D chip stacking technology, a press statement reveals.

They announced that they successfully implemented the new process for producing 300 mm silicon chip wafers for 3D chip stacking technology. It is the world's first 300 mm level example of this technology.

New chip-stacking process uses laser invisible to silicon

Chip stacking typically requires vertical connections between layers of silicon, called through-silicon vias (TSVs). The layers are usually extremely thin, having a thickness of less than 100 microns.

During the production process, each of these wafers is attached to a carrier wafer, which is usually made of glass that is temporarily bonded to the silicon. Once the wafer is processed, the glass carrier is then removed from the silicon with the use of ultraviolet lasers.

IBM and TEL's new process uses a 300 mm module with an infrared laser that carries out a debonding process. This process is transparent to silicon, meaning it allows standard silicon wafers to be used instead of glass wafers for the carrier. This means that silicon wafers can be bonded to other pieces of silicon, meaning glass carriers are no longer necessary in the manufacturing process.

IBM and TEL aim to alleviate the global chip shortage

The researchers behind the new method believe it can help to alleviate the strain on the global chip industry. "As the global chip shortage continues," IBM's statement reads, "We'll likely need novel ways to increase chip production capacity over the coming years. We hope our work will help cut down on the number of products needed in the semiconductor supply chain, while also helping drive processing power improvements for years to come."

IBM Research has been working with TEL since 2018 on this new process, which it says should also produce fewer defects and process issues during manufacturing that are associated with dissimilar wafer pairs. Next, the partners aim to further test their beta system to demonstrate how it can be implemented in the supply chain.

The global chip shortage came as a result of sky-high demand and factory disruptions caused by Covid. But even before the pandemic, the computer chip industry was feeling the pressure. Moore's Law, which states that the number of transistors on a microchip will double each year, was slowed down by the physical limitations of silicon. Experts say the transistor is approaching the point where it is as small as it can get while remaining functional, leading some to sound the death knell for Moore's Law. As a point of reference, IBM Research's smallest chip node is 2 nanometres wide.

Chip stacking is typically only used in high-end operations such as the production of high-bandwidth memory. However, it has the potential to expand the number of transistors in a specific volume. Moore's Law has traditionally focused on areas rather than volumes, meaning the new breakthrough allows the continuation of Moore's Law via a different interpretation of the famous 1965 observation. It may not be dead yet.

A new artificial muscle is stronger, more flexible than natural ones

Researchers at the University of California, Los Angeles (UCLA) have developed a new material to build artificial muscles that are stronger and up to 10 times more flexible than naturally occurring muscles, a university press release said.

Scientists have been keen to replicate the muscles in the body, which can then be used to make soft robots and new haptic technologies with a sense of touch. There are many soft materials that are known to material scientists that can do the dual job of delivering a mechanical output while also remaining viable under high strain conditions.

A class of materials called dielectric elastomers (DE) can deliver on both flexibility and toughness, and they are not only light in weight but also have high elastic energy density. DEs can be made from natural or synthetic compounds and are polymers that can change size or shape when an electric field is applied. This makes them ideal materials to make actuators i.e. machines that can convert electrical energy to mechanical work.

What needed improvement then?

Currently, DEs are manufactured using either acrylic or silicone and while these have been useful, they also come with certain drawbacks. DEs made from acrylic can handle high levels of strain but they require pre-stretching and lack flexibility. On the other hand, silicone DEs can be made easily but fail to handle high strains.

Working with the non-profit organization, SRI International (formerly known as Stanford Research Institute), the team at UCLA used commercially available chemicals and an ultraviolet (UV) light-based curing process to improve the acrylic-based DE.

The researchers were able to change the cross-linking in the polymer chains of the material to make the DE softer, flexible, and simpler to scale without losing endurance or strength. The changes in the manufacturing process allowed the researchers to make thin films of the DE, which they call processable, high-performance dielectric elastomer or PHDE.

How can PHDE be used?

A PHDE film is as thin as human hair and equally light in weight. Layering these films can help researchers make miniature actuators that can work like muscle tissue and produce enough mechanical energy to power a small robot.

Soft materials have been layered before. However, the method employed to do so involves the use of a liquid resin that needs to be first deposited and then cured. Such a "wet" process can result in an actuator with uneven layers, which results in bad performance. This is why artificial muscles you might have seen in the past are just one layer thick.

The UCLA researchers worked on this aspect too and implemented a dry process where the PHDE films are laid down in layers using a blade and then UV-cured. The simplified process has even allowed the researchers to manufacture actuators that resemble spider legs that bend and then jump, or even windup and then spin.

These new actuators can generate many times more force than biological muscles and are between 3-10 times more flexible than their natural counterparts, the press release claimed. In a demonstration, the researchers showed that the actuator could toss a ball that was 20-times its weight.

"This flexible, versatile and efficient actuator could open the gates for artificial muscles in new generations of robots, or in sensors and wearable tech that can more accurately mimic or even improve humanlike motion and capabilities," said Qibing Pei, a professor of materials science and engineering at the UCLA.

Abstract

Dielectric elastomers (DEs) can act as deformable capacitors that generate mechanical work in response to an electric field. DEs are often based on commercial acrylic and silicone elastomers. Acrylics require prestretching to achieve high actuation strains and lack processing flexibility. Silicones allow for processability and rapid response but produce much lower strains. In this work, a processable, high-performance dielectric elastomer (PHDE) with a bimodal network structure is synthesized, and its electromechanical properties are tailored by adjusting cross-linkers and hydrogen bonding within the elastomer network. The PHDE exhibits a maximum areal strain of 190% and maintains strains higher than 110% at 2 hertz without prestretching.

Genetically modified pig hearts transplanted into two more patients

The team of researchers who transplanted a genetically modified pig's heart into a living human earlier this year have completed two more pig heart transplant surgeries, setting the protocol for such operations.

In January this year, 57-year-old David Bennett became the first man on the planet to receive a heart from a genetically modified pig. Before this, researchers transplanted kidney from similarly modified pigs into patients that were brain dead.

The organs are sourced from a company called Revivicor which uses genetic engineering to remove specific genes in the pigs to help in reducing transplant rejection while adding some that make the organs more compatible with the human immune system.

Setting the protocol for such transplants

Researchers at NYU Langone carried out two more surgeries, one in June and another in July to develop a clinical protocol for such transplants. The procurement, transport, transplant, and immune suppression were carried out aligned with current clinical standards for a heart transplant.

"Our goal is to integrate the practices used in a typical, everyday heart transplant, only with a nonhuman organ that will function normally without additional aid from untested devices or medicines," said Nader Moazami, who led the investigational procedures.

Both surgeries were performed on brain-dead patients, and the newly transplanted hearts were maintained on ventilator support for 72 hours, during which no signs of rejection were observed.

In the case of Bennett, who died two months after the surgery, the transplanted organ was found to have been infected with a pig virus. Robert Montgomery, the director of the Transplant Insitute at NYU Langone, said that transplant studies with deceased donors were critical to gathering additional data to advance the field.

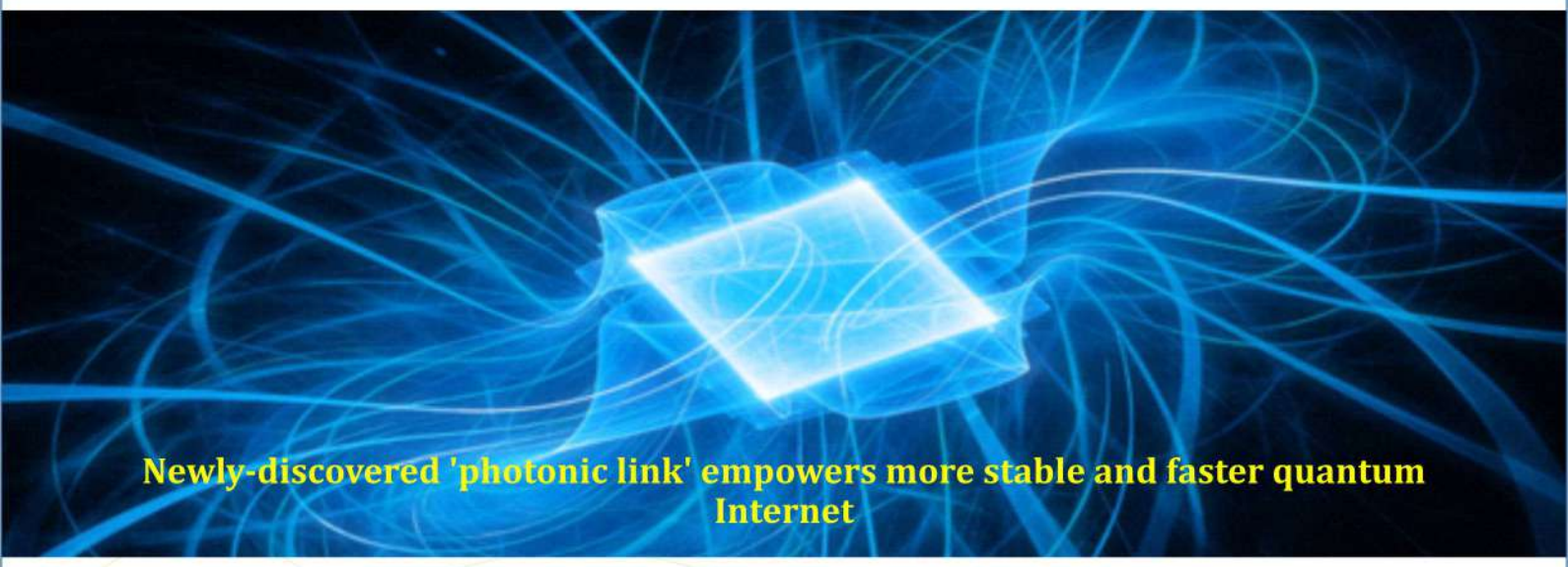
"Under normal circumstances, one donor can save up to eight lives. But in these special cases, donor heroes have the potential to save countless lives by participating in groundbreaking research," Leonard Achan, chief executive officer at LiveOnNY, an organization engaged in organ and tissue donation, said in the press release.

Enhancing the screening for infectious diseases

"Studies have shown that porcine cytomegalovirus (pCMV) may be a factor in the success of xenotransplanted organs," said Montgomery in the press release. For this round of surgeries, the research team added a new infectious disease protocol to detect the presence of porcine cytomegalovirus (pCMV).

Additional protocols were also introduced to check and monitor the transmission of porcine endogenous retrovirus (PERV). The operation theater, where the surgery was carried out, has also been taken offline and will only be used for xenotransplantation research in the future.

"This is the first step in developing a deep understanding of the mechanical, molecular, and immunologic aspects of xenoheart transplantation and the feasibility of utilizing standard clinical practice and tools to do so," said Alex Reyentovich, director of NYU's advanced heart failure program.



Newly-discovered 'photonic link' empowers more stable and faster quantum Internet

There is no shortage of quantum computing developments but still it seems we have not yet found the key to making these machines work — with some estimates stating the technology is still five years away.

Now, researchers at Simon Fraser University have made a significant breakthrough in the development of quantum technology that may enable an all-silicon quantum internet, according to a press release by the institution published on Wednesday.

All about the qubits

It all has to do with the qubits. In order for quantum computers to work, scientists must engineer both stable, long-lived qubits that provide processing power, as well as the communications technology that enables these qubits to link together at scale. In the past, studies have speculated that silicon can produce some of the most stable and long-lived qubits in the industry.

This work is the first measurement of single T centers in isolation, and, the first measurement of any single spin in silicon to be performed with only optical measurements," Stephanie Simmons, from the SFU Silicon Quantum Technology Lab in SFU's Physics Department, said in a statement

"An emitter like the T center that combines high-performance spin qubits and optical photon generation is ideal to make scalable, distributed, quantum computers because they can handle the processing and the communications together, rather than needing to interface two different quantum technologies, one for processing and one for communications."

T centers: the right choice for quantum computing

T centers are a particularly good choice for quantum computing because they have the added benefit of emitting light at the same wavelength that today's metropolitan fiber communications and telecom networking equipment use.

"With T centers, you can build quantum processors that inherently communicate with other processors," Simmons added. "When your silicon qubit can communicate by emitting photons (light) in the same band used in data centers and fiber networks, you get these same benefits for connecting the millions of qubits needed for quantum computing."

Silicon is also an excellent choice for quantum computing as it provides opportunities to rapidly scale the technology. Silicon computer chips are already being massively produced at scale making them good candidates for the production of quantum computers.

"By finding a way to create quantum computing processors in silicon, you can take advantage of all of the years of development, knowledge, and infrastructure used to manufacture conventional computers, rather than creating a whole new industry for quantum manufacturing," Simmons concluded. "This represents an almost insurmountable competitive advantage in the international race for a quantum computer."

Scientists just discovered the strongest magnetic field in the universe

The team behind the first Chinese X-ray astronomy satellite, Insight-HXMT, has discovered the strongest magnetic field directly measured in the universe hitherto.

It is a known fact that neutron stars generate the strongest magnetic fields in the universe. These magnetic fields, close to a neutron star's surface, can only be measured accurately and directly by looking for cyclon resonance scattering features (CRSF). The Insight-HXMT team discovered a cyclotron absorption line with an energy of 146 keV in the neutron star X-ray binary Swift J0243.6+6124, which translates to a surface magnetic field of more than 1.6 billion Tesla.

The findings were published last month in Astrophysical Journal Letters. They were obtained jointly by the Key Laboratory for Particle Astrophysics at the Institute of High Energy Physics (IHEP) of the Chinese Academy of Sciences and the Institute for Astronomy and Astrophysics, Kepler Center for Astro and Particle Physics, University of Tübingen.

Insight-HXMT breaks own measurement

Two years ago, the Insight-HXMT team reported the detection of a 90 keV cyclotron absorption line from a neutron star in the X-ray binary system GRO J1008-57, which corresponds to a surface magnetic field of 1 billion Tesla, which set a world record for direct measurement of the universe's strongest magnetic field at the time. Later, another record for a cyclotron absorption line—with its highest energy around 100 keV—was detected by Insight-HXMT from another neutron star in 1A 0535+262.

Time and again, the astronomy satellite has illustrated its ability to explore the energy spectrum. And this time, it beat its previous record by 60 percent.

Cyclotron absorption lines might be caused by resonant scattering

A neutron star X-ray binary system comprises a neutron star and its companion star. The gas of the companion star falls towards the neutron star, forming an accretion disk. In turn, the plasma in the accretion disk will fall along magnetic lines to the neutron star's surface, releasing powerful X-ray radiation. Such emissions result in periodic X-ray pulse signals, resulting in the name "X-ray accretion pulsar."

Prior observations have revealed that such pulsars have absorption structures in their X-ray radiation spectra, known as cyclotron absorption lines. This might be caused by resonant scattering and thus the absorption of X-rays by electrons moving along the strong magnetic fields.

This phenomenon can be used to directly measure the strength of the magnetic field near the surface of a neutron star as the energy of the absorption structure corresponds to the strength of the surface magnetic field.

First solid evidence

Now, ultraluminous X-ray pulsars, objects whose X-ray luminosity far exceeds that of canonical X-ray accreting pulsars, have previously been discovered in several galaxies far from the Milky Way.

Insight-HXMT made detailed and broadband observations of the outburst of Swift J0243.6+6124, the Milky Way's first ultraluminous X-ray pulsar, and unambiguously discovered its cyclotron absorption line. This particular line revealed energy up to 146 keV, which equals a surface magnetic field of more than 1.6 billion Tesla, resulting in not only the strongest magnetic field directly measured in the universe to date but also the first detection of an electron cyclotron absorption line in an ultraluminous X-ray source.

The direct magnetic field measurement by Insight-HXMT based on the cyclotron absorption line is an order of magnitude greater than that estimated using indirect means. This is the first solid evidence that a neutron star's magnetic field structure is more complex and nonsymmetric than a traditional symmetric component of a neutron star's magnetic field.

Students build electric vehicle that captures carbon as it drives

In electric vehicle (EV) news, a student team from the Eindhoven University of Technology has managed to develop a prototype electric passenger car that removes and stores carbon dioxide from the air as it rolls down the road. Designed with the aim of capturing more CO2 than is emitted during the full lifecycle of the vehicle, this vehicle would significantly improve the lifetime carbon footprint of producing and running EVs over their lifetimes.

The project, which was inspired by the 2018 Noah concept car and 2020 Luca, is the seventh for the tuecomotive students. Called The Zem (EM-07), the team's task was to construct a carbon net-zero electric vehicle.

In order to minimize material waste and emit "as little CO2 emissions as possible," the team employed additive manufacturing to manufacture monocoque and body panels. They also used recovered plastics, which can be shredded and reused for future projects.

The use of recycled plastics continues inside, along with sustainable materials like pineapple leather. The team chose polycarbonate over glass for the windows since it is deemed to be more environmentally friendly. Additionally, a modular lighting system, modular electronics, and a modular entertainment system were implemented. These components can all be employed in different products.

Like all other pure electrical vehicles, zero carbon dioxide is released while the Zem is being driven. Details on the drivetrain are lacking because the project's focus was on the car's carbon footprint and recyclable components, but the students told New Atlas that it has a 22-kW motor, nine 2.3-kWh modular battery packs, and "an old Audi differential with a relatively high gear ratio to increase the torque."

We also know that photovoltaic cells have been added to the upper surfaces to increase range and that regenerative braking has been added to squeeze a little more range out of the batteries. Digital mirrors are used to reduce aero drag, as well as bi-directional charging.

The team is currently attempting to patent the design

The students are attempting to obtain a patent for direct air capture technology, which flows through what appears to be a fairly typical grille and scrubs the air as the car moves. According to the team, for every 12,800 miles (20,600 km) traveled annually at an average speed of 37 mph (60 kph), up to 2 kg of CO_2 might be removed.

Although not much on its own, this technology has the potential to significantly aid global efforts to reduce carbon emissions if it were to be made available to the millions of cars currently on the road.

The Zem's filter currently reaches capacity after 200 miles (320 km), and it has been proposed that filters of this type could be cleaned with green energy, the CO2 they have already captured stored in a tank as the EV is topped off at charging stations, and then reused to capture the subsequent batch.

It's unclear what will happen to the CO2 that has been captured after it has dropped off, but there have been some interesting recent projects that hint at possible solutions. These projects include using the CO2 to make more environmentally friendly concrete, turning it into synthetic fuels and plastics using basic chemical building blocks, and even adding the fizz to bubbly water.

"It is really still a proof-of-concept, but we can already see that we will be able to increase the capacity of the filter in the coming years," said team manager Louise de Laat. "Capturing CO2 is a prerequisite for compensating for emissions during production and recycling."

In order to reuse or recycle as much of the vehicle and its parts as feasible, the students have also studied what happens to the Zem once its useful life is up.

Team members and the Zem will travel to the US in August for a tour of universities and businesses as work on the concept continues to advance toward carbon net-zero in the hopes that it would encourage others to take on the task.

"We want to tickle the industry by showing what is already possible," said the team's external relations manager, Nikki Okkels. "If 35 students can design, develop and build an almost carbon-neutral car in a year, then there are also opportunities and possibilities for the industry."

A new "floating carpet" of solar panels is coming to the North Sea

In sustainability news, a new project to create a "floating carpet" of solar panels in the North Sea has just been announced. As part of a more extensive collaboration to create "floating solar parks," the German energy company RWE will invest in a pilot project to deploy floating solar technology in the North Sea.

The 0.5-megawatt peak (MWp) pilot, known as "Merganser", is scheduled for installation in the waters off Ostend, Belgium. "Merganser" will be the first offshore pilot for Dutch-Norwegian company SolarDuck, according to a statement released by RWE earlier this week.

"Merganser", according to RWE, would give SolarDuck and itself "important first-hand experience in one of the most challenging offshore environments in the world."

The innovation of SolarDuck brings up new possibilities for solar energy, even in the abrasive conditions of the North Sea. RWE, according to its press release, has consequently chosen SolarDuck in its submission for the Dutch HKW VII contract (system integration).

Integrating an offshore floating solar plant at a pre-commercial scale with 5 MWp together with cutting-edge energy storage techniques into the offshore wind farm will be made possible by the winning offer.

To establish both stand-alone and hybrid commercial offshore floating solar parks, RWE and SolarDuck will continue to build on their partnership with project "Merganser" and HKW. The combination of SolarDuck's technological and commercial creativity and RWE's dominant position in the worldwide market creates the ideal framework for advancing the adoption of this high-potential technology.

What is so special about the SolarDuck system?

The offshore floating solar technology created by SolarDuck opens up new possibilities for solar energy. It offers a solution to the growing land shortage to produce renewable energy. Incorporating offshore floating solar into an offshore wind farm provides for synergies concerning the building and upkeep of the multi-source renewable energy plant. It is a more effective use of ocean space for electricity generation (using the space between the wind turbines).

The complementary nature of wind and solar resources leads to a more balanced output profile.

A system that can endure harsh offshore circumstances, such as high waves, strong winds, and a corrosive environment, is needed to move solar farms offshore. The triangular-shaped platform from SolarDuck, which has been certified by Bureau Veritas as the world's first offshore floating solar installation, is made to float several meters above the ocean and move with the waves like a carpet.

Thus, maintaining the integrity of the semi-submersible structure, keeping important electrical components dry, clean, and stable, and allowing safe operations with little maintenance.

Sven Utermöhlen, CEO of Wind Offshore of RWE Renewables states: "RWE is constantly looking for innovative ways to further improve the production of renewable energy offshore. We are very keen to further explore the potential of offshore floating solar together with our partner SolarDuck. For countries with lower mean wind speeds but high solar irradiation, this opens up attractive opportunities. With the SolarDuck pilot, we are gaining experience with highly innovative offshore floating solar technology. We want to contribute to accelerating the energy transition, have a positive impact on marine ecology, and help to integrate energy systems. Together we can make a real difference using tomorrow's technology for today's projects."

SolarDuck's CEO Koen Burgers states: "The need for secure, sustainable, and affordable energy demands new and immediate answers from the industry in Europe and also globally. SolarDuck is part of this answer, bringing solar energy into its next frontier, the oceans. Showcasing SolarDuck's robust technology in rough North Sea conditions will enable us to deploy the technology practically anywhere in the world. We are very pleased that we found in RWE a strong partner who shares our vision of electrifying the world with offshore floating solar. I look forward to our organizations working together to achieve just that."