ENGLISH SECTION

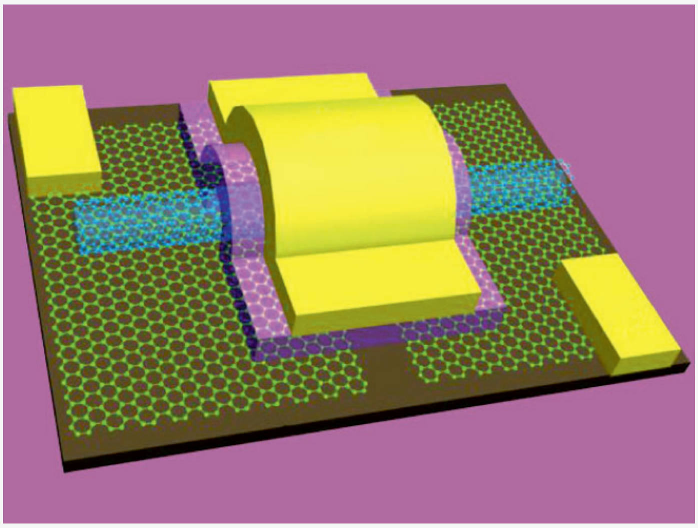
When I got enough confidence, the stage was gone... when I was sure of losing, I won... When I needed people the most, they left me.... When I learnt to dry my tears, I found a shoulder to cry on ... When I mastered the skill of hating, someone started loving me from the core of the heart... And, while waiting for light of hours when I fell asleep, the sun came out.... That's LIFE ! No matter what you plan, you never know what life has planned for you... Success introduces you to the World... But failure introduces the World to you... Always be Happy ! Often when we lose Hope and think this is the end... God smiles from above and says,"Relax Sweetheart; It's just a Bend, not the End...!

- Sophia Loren

INDEX

Carbon Nanotubes

Mr. Sanket Sanjay Devmore - S. Y. Electrical **(Informative)**



The end appears nigh for scaling down silicon-based complementary metal-oxide semiconductor (CMOS) transistors, with some experts seeing the cutoff date as early as 2020.

While carbon nanotubes (CNTs) have long been among the nanomaterials investigated to serve as replacement for silicon in CMOS field-effect transistors (FETs) in a postsilicon future, they have always been bogged down by some frustrating technical problems. But, with some of the main technical showstoppers having been largely addressed-like sorting between metallic and semiconducting carbon nanotubes-the stage has been set for CNTs to start making their presence felt a bit more urgently in the chip industry.

Peking University scientists in China have now developed carbon-nanotube field-effect transistors (CNT FETs) having a critical dimension-the gate length of just 5 nanometers-that would outperform silicon-based CMOS FETs at the same scale. The researchers claim in the journal Science that this marks the first time that carbon-nanotube CMOS FETs under 10 nanometers have been reported.

More important than just being the first, the Peking group showed that their CNT-based FETs can operate faster and at a lower supply voltage than their silicon-based counterparts.

At a 0.4-volt supply voltage, the current that flows through the CNT transistor is larger than what you'd get from the best silicon CMOS transistors at a 0.7-V supply voltage, according to Peking University's Lian-Mao Peng in an email interview with IEEE Spectrum. (The "best" according to Peng is Intel's 14-nm-node CMOS.) Because the gate's capacitance is smaller for a carbon-nanotube transistor, even if the silicon devices were scaled down to the size of the CNT device, the latter would still switch faster, he says. The intrinsic delay caused by the gate capacitance for 10-nm CNT CMOS is about 70 femtoseconds, says Peng. That's just one-third of the value (220 fs) of 14-nm silicon CMOS.

As with all the field-effect transistors, current flows through a channel between the source and drain under the control of voltage at the gate. In the Peking design, the channel through which the carriers move is made out of a single carbon nanotube and the source and drain are both graphene. This CNT channel is either p-type-conducting positive charge carriers, or holes-or n-type, which uses electrons. It is this combination of the p-type and n-type devices that constitutes the "complementary" of CMOS and keeps power consumption low when switching logic states.

Unlike most carbon-based and two-dimensional devices, the CNT FETs that the Chinese researchers have developed are not "back gated." Back-gated devices-in which the gate electrode lies beneath a layer of insulation and the nanotube lies atop the insulation-are generally more difficult to integrate into complicated circuits.

Instead, the device Peng and colleagues constructed uses a gate that drapes over the top of the carbon-nanotube channel. "Top-gated FETs can provide higher gate efficiency than the back-gated devices since the CNT is almost surrounded by the top gate," says Peng. "Also, top-gated FETs provide better stability than back-gated devices since the CNT channel is protected from influences of the outside world by the top gate."

While the researchers concede that the use of individual single-walled carbon nanotubes to construct their devices is not suitable for producing large-scale integrated circuits, they are confident they can overcome this without changing much.

"Now that we have confirmed the potential of CNT CMOS transistors in the work, we can construct CMOS FETs with similar performance on aligned CNT arrays with high density and high semiconducting purity using the same fabrication process."

With the ability to scale down silicon CMOS petering out in the coming years, there is some question as to whether there is enough time to replace silicon, or whether it is even worth the effort.

"We believe CNT electronics have a good chance to replace [silicon] CMOS technology at 5-nm nodes by 2022," says Peng. As optimistic as Peng is, he remains cautious about the engineering challenges that they still face.

"While we can use the currently available CNTs…to fabricate large-scale CNT ICs, it still requires one to two years to get the ideal CNT form for ICs," he says. Nonetheless, Peng believes that they will be able to make wafers full of ICs in the next few years using their process.

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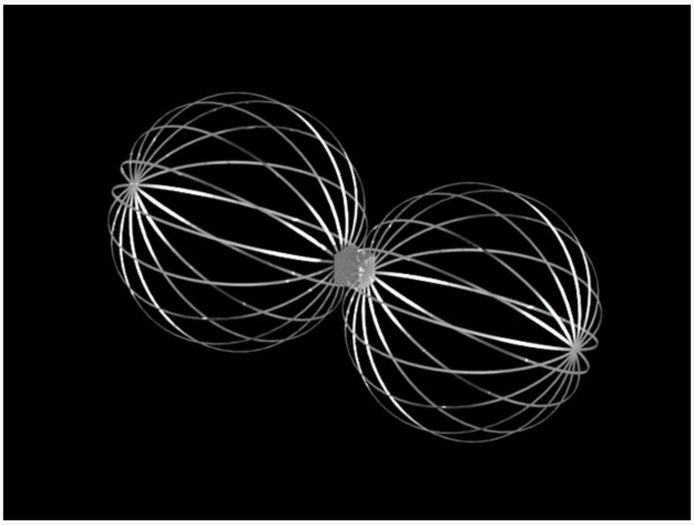
Dr. KotiHarinarayana - The brain behind India's first indigenously built combat aircraft

Tejas, which was the name given to the aircraft, saw first flight in 2001. Our country's first self-made light combat aircraft was built by HAL and developed by Dr. Koti. It was a result of the diminishing value of the country's soon to be obsolete Mig-21 fighter jets and, true to its name, made our defence sector's future a lot more radiant.

Electrostatic Glider Could Maneuver Around Asteroids without Expending Fuel

Dhanashri S. Kore - S. Y. CSE **(Thought Provoking)**



One of the biggest constraints on exploration of the solar system is fuel. Spacecraft need fuel to get where they're going, and they need even more fuel in order to do what they're supposed to do once they arrive. Though energy (electricity) can be replenished for years (or even decades) with solar panels or RTGs, once you run out of reaction mass, your spacecraft is through. (If you're smart, you'll have suicide it into something well before then.)

Propulsion systems like ion engines and electrospray engines can use small amounts of fuel very efficiently, but only postpones the problem of limited reaction mass as opposed to solving it. Fortunately, some very smart people are working on alternative means of fuel-free propulsion; one of the least crazy ones has been funded NASA as part of its Innovative Advanced Concepts Program. It's called E-Glider, and it uses electrostatic fields to surf through the charged dust found around asteroids, comets, and moons.

Around airless bodies, the objects in space that range in size from asteroids to either small moons or large space stations, you can reliably find a sort of haze of dust, caused by the solar wind as well as solar illumination imparting energy to the surface which results in dust particles "fountaining" up. This energy transfer also causes the dust to become electrically charged, with the illuminated side of the body exhibiting a positive surface potential and the dark side of the body accumulating electrons which results in a negative surface potential. The terminator (the area between the dark side and illuminated side) can have an electrical potential of several hundred kilovolts per meter, while on average, the surface of an asteroid could exhibit electric fields of around 1 kV/m.

Usually, dusty and variably electrically charged environments are something that spacecraft do their absolute best to avoid, but JPL thinks that there may be a way to leverage this kind of environment to propel a spacecraft. A field of 1 kV/m has enough electrical potential to "lift" a small vehicle weighing about one kilogram. The vehicle would use 1-meter-diameter metal "wings" for electrostatic (rather than aerodynamic) flight, articulating them to move through ambient electrostatic fields. The energy to do this comes from the solar wind by way of whatever body the vehicle is next to, giving the craft maneuvering fuel that won't run out until the sun shuts down (at which point you likely have bigger problems).

This E-Glider concept is very, very conceptual, even for this particular program, which is all about concepts. But the researchers think that it will likely work. Probably. Well, at least there aren't an overwhelming number of physical reasons that should prevent it from working. They're currently in the middle of a bunch of modeling, and they've done a few very preliminary small-scale experiments with some wings that use electrostatics to "inflate."

The next step is to try to better understand the electrical environment around asteroids, along with more preliminary design and testing of individual components. JPL also tantalizingly suggests that this research could, potentially, lead to "new forms of transportation on the Earth."

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Flame Retardant in Lithium-ion Batteries Could Quench Fires

Shridhar Sutar - F. Y. Automation & Robotics **(Critics)**

A powerful flame retardant added to lithium-ion batteries that only gets released when the devices get too hot could help keep them from catching on fire, a new study finds.

When lithium-ion batteries overheat, they can burn through clothing, burst into flames and even explode. Such "thermal runaways" have led some engineers to explore the creation of lithium-ion batteries with their own fire alarms or chemical additives that can prevent short circuits.

Researchers previously tried adding flame retardants directly into the batteries' electrolytes, which connect the electrodes of the energy storage devices. However, these approaches significantly reduced battery performance.

Now researchers have designed a lithium-ion battery in which the separator, the component that keeps the battery's positive and negative electrodes apart, contains a cheap, powerful, and commonly used flame retardant known as triphenyl phosphate.

During normal battery operation, the flame retardant stays encapsulated within plastic fibers. If the separator gets hotter than 150 degrees C, the plastic melts, releasing the flame retardant. In experiments, the chemical completely quenched flaming electrolyte in 0.4 seconds. The scientists detailed their findings online in the 13 January edition of the journal *Science Advances*.

"Using our 'smart' separators, battery electrochemical performance will not be affected by the flame retardant under normal conditions," says study senior author Yi Cui, a materials scientist at Stanford University in California. "However, once there is a potential thermal runaway, the flame retardant will be activated and nip the fire or explosion in the bud."

Future research can explore how well this separator responds to electrical abuse such as overcharging or discharging too deeply, or physical abuse such as crushing or penetration, Cui said that We believe our safe separator should find broad applications, considering that more and more fires and explosions of lithium-ion batteries have been reported recently.

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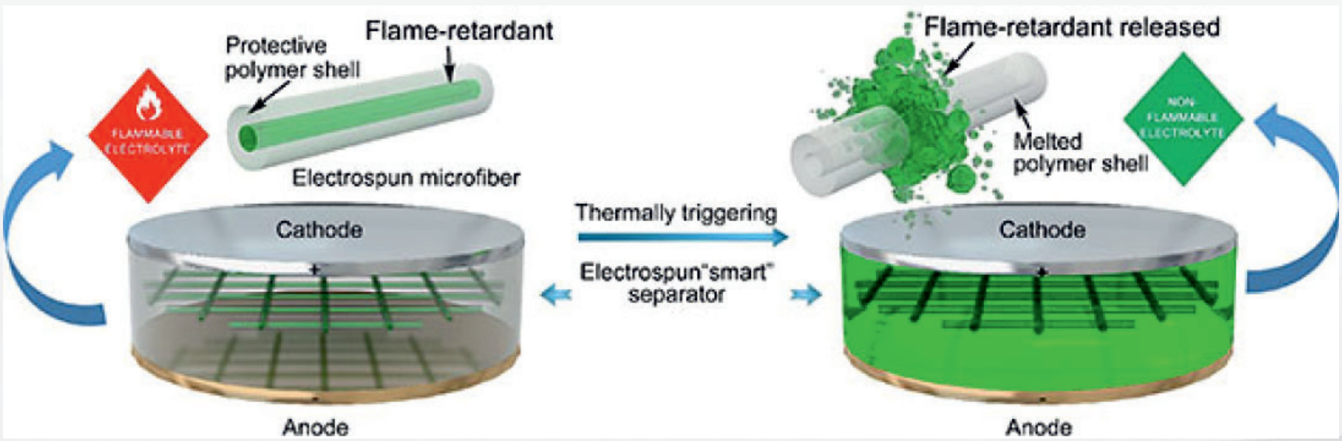

Future Airplanes - Fly On Twistable Wings

Replacing traditional flaps with bendable bits will reduce noise and save fuel

Vaishnavi Khalkar- S. Y. Automatoin & Robotics **(Informative)**

More than a century ago, the first aviation pioneers figured out a way to use rigid wings with flaps to generate enough force to lift a heavy craft into the sky. It was one of the great advances in human history and also the beginning of a new era in transportation. Airplanes, and the airline industry that depends on them, are now among the world's largest businesses, with air travel producing over US $700 billion in annual revenues.

However, commercial airlines spend more than 25 percent of their operating expenses on fuel, earning the industry a reputation for razor-thin margins that will eke out just $39 billion in profits this year. Meanwhile, modern aircraft wings and engines have reached near-peak levels of efficiency, making it exceedingly difficult for engineers to generate additional savings.

And yet, there is one promising strategy that remains—changing the shape of the aircraft wing during flight. For three decades, engineers at aerospace companies, universities, and defense labs have been working on twistable aircraft wings that could be instantaneously and minutely adjusted to improve fuel efficiency. With these wings, aircraft designers could get closer to optimal performance by increasing an airplane's lift-to-drag ratio, which is a measure of aerodynamic efficiency, in response to variations in speed, altitude, air temperature, and other flight conditions.

This modern pursuit has a notable historical precedent. Way back in 1905, Orville Wright steered the brothers' pioneering airplane by lying prone in a saddle and twisting the tips of the plane's fabric-and-wood wings with a sway of his hips. Soon after, as aircraft became heavier, engineers switched to stiff wings controlled by rigid flaps and ailerons, and morphing these surfaces proved impractical.

Decades later, in the mid-1980s, the U.S. Air Force tested Mission Adaptive Wings that were built by Boeing and installed on an F-111 aircraft. An automated control system reshaped the thin outer covering of these wings to change their curvature, thereby reducing drag by up to 20 percent, for supersonic flight. Unfortunately, the added weight and power demands of this technology made the aircraft less efficient overall. From 1996 to 2005, the U.S. Air Force collaborated with NASA to develop an Active Aeroelastic Wing, which used the power of the airstream to twist itself for better roll control during high-speed maneuvers. But that technology was intended only for fighter jets, and the program eventually lost support.

The flexible wing concept has matured greatly since then. My colleagues and I have built a shape-changing control surface that in recent tests, conducted with the technology installed in place of traditional flaps on the wings of a Gulfstream III jet, reduced drag to a degree that could improve airplanes' fuel efficiency by up to 12 percent. The flexible surface adjusted the curvature of the wings' trailing edges to deliver an optimal lift-to-drag ratio throughout the test flights, whereas flaps on today's airplanes pivot to generate lift or drag only during takeoffs and landings. In addition to saving fuel, analyses by NASA and other researchers have shown that this surface could also

lead to quieter landings and possibly even less turbulent flights.

Gear Up: NASA and the U.S. Air Force retrofitted this Gulfstream III aircraft with FlexFoil, a flexible wing technology, for a series of 22 flight tests over NASA's Armstrong Flight Research Center in Edwards, Calif. that began in 2014. Shape-changing control surfaces installed on airplane wings' trailing edges can improve fuel efficiency, reduce noise, and lessen turbulence during flight. These surfaces will replace traditional flaps entirely on brand new planes or be integrated into existing flaps on today's commercial aircraft.

Flexible wings solve an old problem in fixed-wing flight. Airplanes need the right blend of lift and drag to handle changing flight conditions. Generally, a pilot's goal is to reduce drag in order to preserve fuel. However, an aircraft's wings are designed to produce minimum drag at only one particular flight condition, which is determined by the aircraft's anticipated cruising weight, speed, altitude, and range. And the flaps and other control surfaces can be adjusted only in relatively crude increments to improve the lift-to-drag ratio as conditions change.

Unlike traditional wings, though, wings with shape-changing control surfaces can minimize drag for a wide range of conditions—a feat that has never before been achieved in commercial flight. Our most advanced version of the technology will be integrated into existing flaps along the wings' trailing edges on retrofits or installed in place of flaps on new planes. If all goes well, we will be able to test it on a commercial airliner within the next three years.

The initial flash of inspiration for my flexible wing struck me as I was driving on a rainy day in Michigan in the early 1990s. As the windshield wipers swished back and forth, I realized their shape did not fit the face of the glass. It occurred to me that even when designing a wiper for a curved windshield, engineers still use straight, rigid parts connected by joints prone to wear and tear.

Smooth Moves: For takeoff, FlexFoil bends down by as much as 40 degrees to maximize an aircraft's lift-to-drag ratio. While cruising, FlexFoil can gradually flatten the wing's camber (or curvature) to save fuel. When encountering turbulence, FlexFoil can rapidly twist into new shapes to redistribute heavy loads. For example, a flight control system can simultaneously raise one end of the control surface and lower the other end. To minimize drag, FlexFoil fits seamlessly against a wing's trailing edge with weblike connectors at each end that stretch as the surface changes shape.

I began to think about objects whose performance might benefit from their ability to change form. I had once taken a design course on aircraft wings and knew that, when designing a new plane, aerospace engineers assume a wing's shape will not change during flight. But it seemed to me that a hingeless, gapless, shape-changing wing could improve fuel efficiency for many more flight conditions.

The traditional aircraft wing is a relatively rigid structure with various movable control surfaces: flaps, ailerons, and spoilers. Flaps, which are panels on the trailing edge of the wing, are used during takeoffs and landings to generate lift at low speeds. Ailerons are segments on the trailing edge near the wing tips. Operated in pairs, one on each wing, they cause one wing to go up and the other to go down, to make the aircraft roll into a turn. Spoilers are panels on the top of the wing that, when rotated upward, increase drag and quicken a plane's rate of descent.

Although these control surfaces work quite well, they can only pivot rather than morph their shape. And flaps are typically not deployed during flight because their joints and hinges are full of gaps, which would cause too much drag. Though some new airliners allow pilots to make minute adjustments to ailerons and flaps to reduce drag while cruising, pilots still can't truly tailor the aerodynamic performance of traditional wings in response to warmer temperatures, higher altitudes, or stronger wind speeds. The result is not unlike riding to the top of a hill on a bicycle in the wrong gear—you may get there, but with considerably more effort than if you'd switched to a lower gear.

A plane could switch gears, so to speak, and achieve a more optimal lift-to-drag ratio by changing the shape of its wings. To understand how this would help, first consider how wings generate lift. A standard airplane wing is more curved on top than on the bottom, so that it diverts masses of air downward, providing lift. The curved top surface of the wing is mainly responsible for pushing the air downward, so, to some extent, enhancing the camber (or curvature) of this surface can improve a plane's lift-to-drag ratio.

For any airplane's combination of weight, altitude, and speed, there is an ideal wing camber that delivers the required lift and also achieves the lowest drag. Much of the aerodynamic research to figure out which camber adjustments would deliver the best performance under specific conditions has already been done. But the experts who carried out that theoretical work have had no means of implementing it on an actual plane until now.

Unlike wings with flaps, a flexible wing can smoothly adjust its camber to minimize drag during flight. In fact, a flexible wing could assume many more positions than a wing with a traditional flap, allowing for much finer control over the lift-to-drag ratio to match the evolving demands of a flight. And if the flexible control surface fits smoothly against the rest of the wing, these adjustments would create no additional drag from protruding joints and hinges.

The upshot is that altering the wings' camber during flight allows aircraft designers to minimize drag depending on how much lift a plane needs for specific conditions. For example, the burning of fuel during flight diminishes the overall fuel weight, so the plane gradually requires less lift. Currently, pilots contend with this weight loss by reducing the aircraft's angle of attack, which is its angle relative to the oncoming flow of air. A flexible wing could simply morph the surface of its trailing edge continually throughout an entire flight to achieve the optimal camber for its current fuel weight

The ability to fly well in a variety of flight conditions is important because aviation rules limit the speeds and altitudes at which airplanes can travel. In the United States, the Federal Aviation Administration, for example, reservesodd-numbered altitudes (such as 31,000 feet) for flights traveling north and east while south- and westbound flights stick to even-numbered levels. Invariably, planes wind up cruising at a combination of speed and altitude that is not aerodynamically optimal. But a flexible wing could be tailored to fly more efficiently at any assigned altitude or speed.

Aside from reducing drag, there is another potential benefit of shape-changing wings that passengers especially will appreciate. These wings can also dampen the shaking of the fuselage due to turbulence. This can be achieved by twisting the wings' trailing edges in just the right way so as to reduce the loads caused by turbulence and thus minimize the movement transmitted to the fuselage. This twisting would be done automatically by a sophisticated flight control system.

When I began to sketch the original diagrams for my flexible wing in my home office, in 1994, I had no background in aerospace engineering. I was also oblivious to the many failed attempts to design a shape-changing wing that preceded my own. I later learned that those earlier designs were complex affairs incorporating hundreds of parts and dozens of motors.

From the start, I resolved to make my design strong but flexible, with no joints or hinges, and to forge it from a single piece of material. Powered by one or two electric motors, it would perform all the necessary functions for flight while enduring the massive aerodynamic pressures created by heavy aircraft flying at high speeds.

At this point, I was still working from home in my free time and without a cent of external funding. Not long after I had completed the first batch of sketches, though, I read a magazine article about the U.S. military's latest attempts to develop a shape-changing airplane wing at Wright-Patterson Air Force Base in Dayton, Ohio. I visited the base and showed the research team my designs. Then in 1998, Wright-Patterson's Air Force Research Laboratory awarded me a $100,000 contract to develop a feasibility analysis for flexible wings. I didn't know it at the time, but that funding was the first of more than $50 million the U.S. government would spend over the next 18 years to test my concept in various wind tunnels, and in flight.

To start, I spent the first check from Wright-Patterson to design and rapidly prototype (using what is now called 3D printing) a plastic model of my wing and rent a wind tunnel at the University of Michigan, where I am a professor of mechanical engineering, to conduct a few basic tests. My design performed well in the wind tunnel and appeared scalable, so in 2001 the Air Force awarded me another contract and more money to build a larger prototype that could be tested at higher wind speeds.

It was about this time that I founded FlexSys in Ann Arbor, Mich., and dubbed my wing FlexFoil. After several more successful tests with the larger prototype, my Air Force collaborators said they were ready to test our design on an actual flight of a White Knight aircraft, which is the same plane that carried the pioneering private space vehicle Space Ship One.

For these tests, as a safety precaution, we hung a 127-centimeter aluminum version of the FlexFoil control surface vertically from the underside of the aircraft rather than attaching it directly to the plane's wings. During flight, we manipulated the camber and shape of FlexFoil remotely from the cabin and monitored performance through pressure ports and thermal sensors that we had installed on the suspended prototype to measure lift and drag.

The White Knight flew multiple tests for us in the Mojave Desert in the summer of 2006. In all of them, FlexFoil demonstrated a significant reduction in drag while enduring the stresses and temperature fluctuations of flight. We also showed that at every stage of flight from takeoff to landing, FlexFoil could reduce drag for a given amount of lift. Another analysis by NASA showed that the technology could improve lift over drag by up to 10 percent.

The best news, though, was that measurements collected during those flights suggested that FlexFoil would boost fuel efficiency by 8 to 12 percent if installed in place of flaps on new airplanes, and by about 3 percent for retrofits, in which the technology would be integrated into the existing flaps along the wings' trailing edges. For comparison, the new winglets that have recently been installed on many planes cost at least $1 million per pair and deliver fuel savings of 4 to 5 percent.

Encouraged by this success, in 2009, the Air Force Research Lab at Wright-Patterson and NASA asked us to retrofit a Gulfstream III aircraft. This time, the mission would be to test FlexFoil on the wings of the airplane rather than dangling it from below, as we did during the White Knight flights.

For this round, we made a new prototype and replaced each of the jet's flaps with a 7-meter span of FlexFoil that ran along the length of the wings' trailing edges. This installation is similar to what we would do for an installation on a brand new airplane.

This prototype was made from common aerospace-grade materials such as aluminum alloys and composites. We built it with design tools and algorithms produced by my team that allowed us to arrange curved and straight structural beams into a pattern so that each beam bent like a bow in response to force. This pattern formed the internal skeleton of a FlexFoil span. Placing pressure at one or two points on the structure changed the entire span's shape depending on how much force was applied and where it was placed.

The finished control surface weighed approximately 110 kilograms (about 240 pounds), which was roughly the same as the flaps and associated guide tracks that it replaced. At each end of the span, elastic mechanisms covered in an elastomer skin formed an accordion-like bridge to the wing that expanded and contracted as FlexFoil morphed, with no external joints or hinges to hinder the flow of air.

NASA's acoustic experts have estimated that this seamless covering would allow FlexFoil to potentially reduce a plane's landing noise by 40 percent. The agency was scheduled to conduct flight tests to verify such benefits beginning this month. Airframe noise, which is much louder than engine noise during landings, is caused by air flowing through the gaps between traditional flaps and wings.

In a conventional airplane wing, the flaps are moved by a pair of hydraulic cylinders. For simplicity, our prototype was designed to connect to those cylinders as well. As I envision the commercial version, a flight control system could change the camber of FlexFoil using only one motor per wing, while twisting its shape would require two (one to pull, and one to push). Because these motors already exist in a typical large aircraft wing, the design would not be subject to the additional testing that regulators would require if I were to bring a new power source on board.

After the Air Force invited us to outfit the Gulfstream III, it took five years to complete the design, installation, ground testing, and scheduling required for the first flight. FlexFoil and the aircraft were again fully instrumented by NASA to record flight conditions and measure how well the technology endured high wind speeds, low temperatures, and sudden changes in air pressure. FlexFoil alone had 112 strain gauges, 60 accelerometers, and enough sensors to gather over 4,300 data points during each flight.

On 6 November 2014, the Gulfstream III took to the skies of the California high desert, held aloft by the world's first modern pair of flexible wings. For safety during these initial tests, we did not change the wings' shape throughout flight, but rather manipulated FlexFoil on the ground. Over a series of 22 flights above NASA's Armstrong Flight Research Center in Edwards, Calif., those wings took on shapes that varied their camber from 2 degrees up to 32 degrees down. In other words, the wings' trailing edges raised slightly and then rotated down to about the same position used by traditional flaps for takeoff.

Afterward, our data showed that FlexFoil produced a maximum of 5,000 kilograms of lift while it was set into these positions. It achieved this lift while the aircraft executed a range of maneuvers at altitudes of 20,000 to 40,000 feet under heavy loads. During the tests, the aircraft was subjected to a maximum dynamic pressure of 1,875 kilograms per square meter, which is well above the load that any commercial aircraft would ever experience. In every case, FlexFoil performed flawlessly.

Based on data from the tests, FlexFoil was able to withstand temperatures ranging from –53 °C to 82

°C and estimated to last five times the life cycle of a commercial aircraft. The results showed for the first time that practical, lightweight, and durable shape-changing surfaces installed on modern aircraft can deliver top performance under a wide range of flight conditions.

Our priority now is to make aviation leaders, who are understandably cautious when it comes to radically new technologies, aware of the advantages and reliability of our shape-changing wing. Last November, we entered into a joint venture with Seattle's Aviation Partners, which sells efficiency-boosting winglets for airliners. Together, we created a new company called Aviation Partners FlexSys to commercialize FlexFoil. We plan to test it on a commercial aircraft by 2020.

The technology also fits very well with a coming generation of aircraft that, aviation experts predict, will blend wings and fuselage together in one seamless design. In particular, Boeing and NASA have experimented with a futuristic blended-wing aircraft, which FlexFoil could transform into a fantastically smooth, quiet, and efficient flier.

In the more distant future, our flexible control surface could find applications beyond fixed-wing flight. Any object moving through air, or water, could benefit. My colleagues and I have already developed prototypes of helicopter rotor blades that would morph their leading and trailing edges several times per revolution to improve performance. Early demonstrations show that these blades can change shape up to 15 times per second, which could improve a helicopter's lift-to-drag ratio and reduce vibration. Other applications might include components for submarines, automobiles, and wind turbines.

It's not unusual for it to take at least 15 years to develop and test a new technology for commercial flight, but the turnaround time for these other applications could be much faster if engineers embrace flexible design as a principle that can deliver more efficient shape-changing forms, as I have found to be true for flight.

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K. Radhakrishnan and his team - In charge of the Mars Orbiter Mission, need I say more?

Also known as Mangalyaan, or Mars-Craft, this program by our very own space research organisation has been lauded as one of the most low cost but high functioning space missions till date. We can now proudly claim to be the only nation to reach Mars orbit on its first attempt. The brain behind the operation is actually credited to 14 scientists at ISRO.

Cap Camera

Samiulla J. Patel - S. Y. Automation & Robotics **(Informative)**

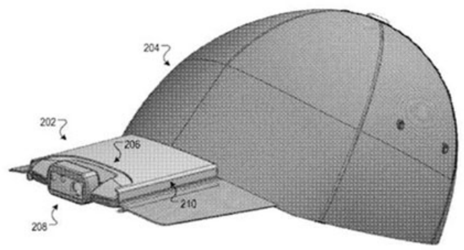

FIG. 2A

Google recently filed a patent for a technology-enhanced baseball cap that can take still photos and capture video from a camera mounted on the brim, according to news reports.

The high-tech cap may be the tech giant's follow-up to its failed Google Glass and could offer competition to similar wearable devices, including Snap's Spectacles.

The patent, granted on Tuesday Feb. 28 2017, describes a hat-and-camera system that offers users an interactive experience for social media purposes, and it can also be used for personal safety, reported Silicon Beat. Users could share photos or video directly from what's been dubbed the Google Hat to a social media account, but the hat's technology could also be useful in an emergency.

The patent indicates that the wearable camera hat could protect the user from a threatening situation, according to Silicon Beat.

"The user can activate an emergency situation indicator and cause the wearable camera system to transmit a video feed to an appropriate emergency handling system, potentially deterring a dangerous person near the user," according to the patent filing, reported Silicon Beat.

Along with the patent for the Google Hat, the tech company was also granted one for a "camera bracelet," according to Silicon Beat. Drawings of the bracelet show a digital screen and two camera lenses, but potential application details were not included in the patent application.

Another camera-equipped wearable device, Spectacles by Snap, recently became available online. These sunglasses are integrated with camera lenses and wireless technology that allow users to upload their point of view directly to Snap's social app, according to the tech company.

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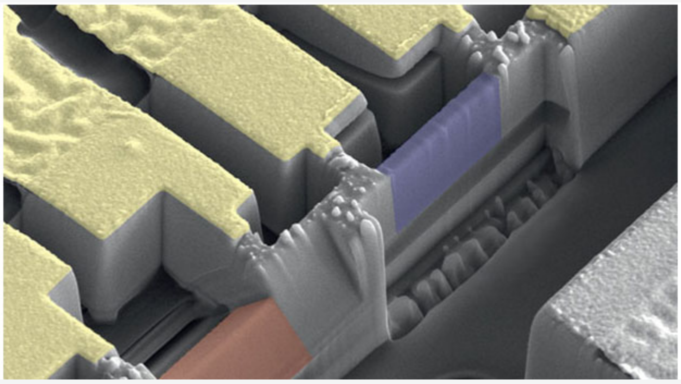
MylswamyAnnadurai (ISRO) - Behind Chandrayaan 1, India's first moon probe

This space probe was successfully inserted into the lunar orbit in 2008 and pushed India's space program into the world map, placing us side by side with NASA and the European Space Agency. Chandrayaan's greatest achievement was the discovery of the widespread presence of water molecules in the lunar soil.

Novel Nanomaterial

Yash Dilip Kumbhar - S. Y. CSE **(Informative)**



Empirical evidence is continuing to pile up confirming that so-called topological insulators—materials that behave as conductors near their surfaces, but act as insulators throughout the bulk of their interiors—do exist.

Now, researchers at the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab), in cooperation with the Max Planck Institute for Chemical Physics of Solids in Germany, have produced a new type of topological matter. It can carry an electrical current on its surface at room temperture and then get that electrical current to transport itself to the other side of the material. The key to performing this trick was producing nanoscale slices of a material called cadmium arsenide, an inorganic semi-metal that is a semiconductor.

What is intriguing about cadmium arsenide is that it exhibits some of the same electronic properties as graphene. Researchers from Oxford, Stanford, and the University of California at Berkeley discovered in 2014 that electrons within cadmium arsenide act as though they have no mass at all, just as they do in graphene. But unlike graphene, cadmium arsenide is a stable 3-D material that is comparatively easy to produce in bulk and simple to fabricate for use in electronic devices.

In research described in the journal Nature, the team used focused-ion beams to shape the cadmium arsenide so that electrons rotated around one side of the material like they were on a race track and then traveled through the bulk of the material to then rotate on the other side. One of the implications for this kind of movement is the ability to transport charge and energy through a material without loss.

"This had been theorized by Andrew Potter [an assistant physics professor at the University of Texas at Austin] on our team and his co-workers, and our experiment marks the first time it was observed," said James Analytis, a staff scientist at Berkeley Lab and assistant professor of physics at UC Berkeley, in a press release. Analytis, who led the research, added that, "It is very unusual—there is no analogous phenomena in any other system. The two surfaces of the material 'talk' to each other over large distances due to their chiral nature."

Chirality is a quantum property in which a particle's (in this case an electron's) spin is coupled to its momentum, providing it with clear left-handed or right-handed properties. In this experiment, the researchers observed that the motion of the electrons possessed a dual handedness. In other words, some electrons traveled around the material in one direction while others moved in the opposite direction. The researchers believe that this experiment shows way toward exploiting this chirality to transport charge and energy through a material without loss. Researchers have predicted that this would alleviate much of the overheating experienced in today's chips as dimensions become ever smaller.

In the experiments, the researchers applied an electric current to slices of cadmium arsenide only 150 nanometers thick; electrons began to race around in circles until their path took them through both the surface and the bulk of the material.

When the researchers applied magnetic field to the material, it pushed the electrons around the surface. When the surface electrons reached the same energy and momentum of the bulk electrons, they were pulled by the chirality of the bulk and pushed through to the other surface. This strange back and forth motion is repeated until defects in the material completely scatter the electrons.

The scientists say that, in future research, they would like to use fabrication techniques on the cadmium arsenide that build the magnetic properties directly into the material so that an external magnet will not be required to achieve this effect.

If they're successful, then it's possible to foresee its use in fabricating interconnects between computer chips in so-called "spintronic" devices that exploit the spin of an electron rather than its electrical charge to process data.

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Suneet Singh Tuli -
Empowering students with the Aakash Tablet

Empowering millions of Indians with tablets to study and access the internet, the low cost Aakash tablet comes pre-loaded with huge amounts of educational material.
It is being distributed to students all over the country at highly subsidised rates so as to give everyone an equal oppurtunity.

Superfast Camera

Chirag Anil Karande - S. Y. CSE **(Informative)**

A camera system that capture a snapshot of overlapping light waves in a tiny fraction of a second could lead to new methods for imaging, allowing scientists to watch the brain's neurons interacting or see neutrinos colliding with matter.

The camera system took snapshots at a rate of 100 billion frames per second, fast enough to capture a pulse of laser light spreading out in a Mach cone, the optical equivalent of the sonic boom created by an airplane traveling faster than the speed of sound.

"You can think of the laser source as the supersonic jet and everything is dragged behind. Instead of generating a sound we're generating a scattered wavelet," says Jinyang Liang, a postdoctoral research associate in Lihong Wang's Optical Imaging Lab at Washington University in St. Louis. They and their collaborators from Tsinghua University in China and the University of Illinois at Urbana-Champaign describe their work in today's issue of Science Advances.

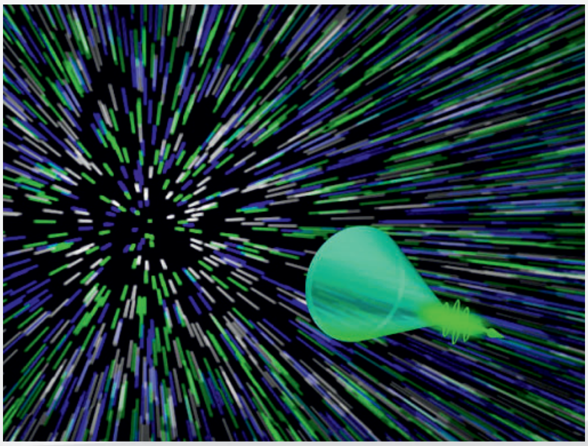
An airplane creates a Mach cone when it passes Mach One, the speed of sound. Because the source of the noise—the plane's engines—is moving faster than sound itself, the soundwaves get compressed and spread out in a cone shape behind the aircraft. The same thing can happen to light.

To generate their optical Mach cone, the researchers made two silicone display panels, which they laced with aluminum oxide powder to scatter the light toward the cameras. They placed the panels on opposite sides of an air-filled tunnel, then threw in a chunk of dry ice to create a fog meant to scatter light. The researchers then fired a laser beam through the tunnel. Because the silicone has a higher index of refraction than the air, light striking the panels moves more slowly than the light striking the fog, so the source of the light waves is "moving faster" than the waves in the silicone are, the same as with the supersonic jet.

To capture an image of the light waves, the team used three CCD cameras. One was a streak camera, which converts photons into electrons and lets them flow between two plates, where a voltage is quickly increasing. As the voltage increases it bends the path of the electrons, and this bend gets greater over time, so seeing where the electrons land in a streak across a detector tells you when they passed between the plates, allowing you to recreate the movement of a wave. This method has been in use for a while, but only provides a narrow, 1-dimensional view of a phenomenon. In this case the researchers opened the slit of the streak camera wider than normal to get a 2-D view.

They also used a patterned filter to impress a series of what were essentially bar codes on the image. Just as a CT scanner uses slices of an x-ray to build up a 3-D picture of an organ, these "bar codes" allowed a computer to divide the single snapshot into slices and rebuild them into a 3-dimensional data cube that separated the slices in time and space, giving shape to what would otherwise have been just a smudge of light. The system also contained two external cameras that did not use the streak approach, to get different perspectives and increase the final resolution of the image.

Whereas existing imaging technologies allow scientists to see small clusters of neurons firing, or view a larger neural network but not the individual activity, this method may give them both a broad and detailed view simultaneously, Liang says.



The 2017 Acura NSX: A Hybrid Supercar

Sumit Suresh Mangore - S. Y. Mechanical **(Informative)**

Honda's new Acura NSX is the first to marry a V-6 engine to three electric motors for high-speed steering

One. Two. Whoosh. By the time I count to three, the Acura NSX's automated launch control leaps from a standstill to 60 miles per hour. But there's not a trace of wheel spin and smoking rubber, the usual hallmarks of a neck-snapping drag-strip run here at the track in Thermal, Calif. Oh, there is drama, only it's largely confined to what's happening under the Acura's swoopy skin.

This Acura is a plug-in hybrid, part of an electron-pumping vanguard that's changing the very definition of a performance car. From showrooms to race paddocks, the clock is ticking for fuel-slurping gasoline engines. Battery-boosted cars, whether hybrid or full electric, are rushing to fill the gap. In our highly regulated future, these may be the only kinds of sports cars you'll be able to buy, and the trippy journey to such a world seems to be taking place at warp speed.

Back in 1990, the original Acura NSX challenged every notion of what a supercar was supposed to be. Coming from Honda, the manufacturer of the Acura luxury brand and a company known for safe, affordable, and ultrareliable cars, the NSX wedded those practical virtues to a gorgeous lightweight body designed by Italy's Pininfarina. Smack at its center rested a modest 3-liter V-6, capable of 200 kilowatts (270 horsepower). Packing more lightweight aluminum than anything from Ferrari, Lamborghini, or Porsche, the Acura defied expectations again with a shocking US $60,000 price, a fraction the cost of its highfalutin rivals. In a final coup, Brazilian Formula One superstar Ayrton Senna, then driving for McLaren-Honda, helped tune the NSX's suspension and performance prior to its release.

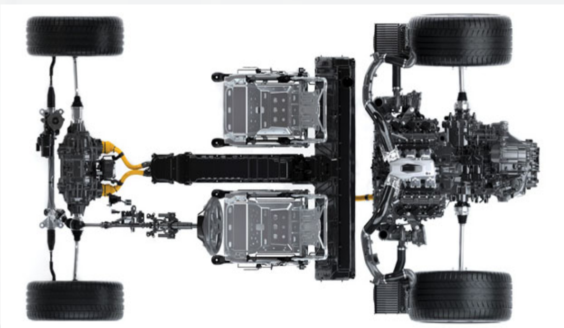
Ferrari and Co. were instantly forced out of their complacency on technology and quality alike. The NSX topped the Ferrari 348, and most every other competitor, in handling and daily drivability.

So when Honda found itself developing a reborn NSX in 2011, the new car had massive shoes to fill. Oddly, Honda's engineers originally planned to power their new roadster with a prosaic V-6 derived from an Odyssey minivan. No wonder that project was aborted midstream. To deserve the storied name, any Son of NSX would have to be an "everyday supercar" while again moving the needle on technology. Ted Klaus, chosen to head up the NSX's global R&D team—which is now run out of Ohio, rather than Japan—knew that electricity was the answer, not just to power the car but to perform handling magic as well.

"We had been working for years to come up with drive force that could help turn the car right and left," Klaus recalls. "We asked ourselves: What if we could marry emerging hybrid e-drive technology with yaw-control tech [that is, steering]? Would it be possible?"

The answer was yes. But the tight-knit NSX team was facing three more years—and an increasingly skeptical media and fan base—to create that ambitious design from scratch: a hybrid supercar that converts electricity into mechanical commands, not just for explosive, efficient propulsion and regenerative braking but also to steer and stabilize the car.

As it happens, Porsche was developing an all-wheel-drive hybrid with similar characteristics, the 918 Spyder; it would arrive priced at a mind-boggling $845,000. The 2017 NSX that I'm testing near Palm Springs costs $157,800. **Photos: Acura**



And unlike the Porsche, which has just one electric motor to power both front wheels, the Acura has two electric tricks up its sleeves: the so-called Twin Motor Unit. This dizzyingly complex electric duo, mediated through a planetary gear set, cranks out up to 27 kW (36 hp) and 73 newton

meters (54 foot-pounds) of torque to either wheel, divvying it up as needed. This is true torque vectoring, able to independently speed up or slow down either wheel, helping the Acura dive into turns and dig out the other side. Discreetly nestled behind pilot and passenger, the roughly 1-kilowatt-hour lithium-ion battery is designed to rapidly charge and discharge for generous squirts of performance. A larger battery might have contributed more all-electric driving range, but it would have come at the expense of weight and ultimate performance.

The instant the driver rotates the steering wheel, sensors sample the car's controls, and then software processes the data in just 10 to 20 milliseconds. The time it takes the electrical system to convert that input into steering response, Klaus says, is on the order of 50 ms. Yes, that's fast. Front-axle motors deliver their full monty of instantaneous torque at every possible engine speed between 0 and 2,000 rpm; 2,000 rpm is the point at which the gas engine rouses itself to take over the majority of propulsion. The electric motors can still help propel the car at up to 200 kilometers per hour (124 miles per hour) and assist in turning right up to the car's 300-km/h top speed.

To provide shove at the rear wheels, a 3.5-L racing V-6 shares nary a bolt with any production Honda engine ever built before. A 75-degree angle between its cylinder banks lowers the center of gravity, in unique contrast to the industry's typical 60-degree V-6s. And it churns up 373 kW (500 hp) and 550 nm (406 foot-pounds) of torque. A third electric traction motor, with 35 kW and 148 nm of torque, sandwiches between the engine's crankshaft and nine-speed, dual-clutch automated gearbox. The motors even help smooth gear changes, adding power as engine speeds fall during shifts.

Add it up and the NSX sends 427 kW (573 hp) and 633 nm (476 ft.-lbs.) to the wheels, on par with gas-only supercars like the Audi R8 V-10 that have more cylinders and consume much more fuel.

Whether the subject is street cars or the pinnacle of motor sports in Formula One—and its offshoot, the all-electric Formula E series—the purists' complaints have been as loud as the cars are quiet: Electricity will silence the shriek and dull the visceral sensations that have thrilled drivers and spectators for more than a century.

Cars like the Acura may never wail like a V-10 Lamborghini, at least not without the artificially synthesized sound of cars like the BMW i8, the autosport equivalent to lip-synching. But nor does the Acura slurp premium unleaded as shamelessly as a '60s muscle car. The U.S. Environmental Protection Agency credits the NSX with 11.2 liters per 100 kilometers (21 miles per gallon), commendable for a supercar that can hang with a Ferrari 458,Lamborghini Huracán, or Porsche 911 Turbo. This being Honda, the NSX team set itself another lofty goal, creating what they believe is the world's safest supercar. Klaus and his team say the NSX is measurably more crashworthy than its rivals. Maybe that's not sexy, but it might save a driver's life in a car designed for pushing the envelope. The team also developed numerous fail-safes to ensure consistent, trustworthy performance.

Despite all the integrated systems and all the electronic oversight, the Acura must still feel like a natural, involving sports car. The bravura brake-force simulator is a shining example: All supercars go, but the NSX is special for how it stops. The problem is that any hybrid car that wants to save fuel must brake regenerative: Those electric motors must also be able to function as generators during braking, turning kinetic energy into electricity that is shunted to the battery for reuse. But that tends to give brakes a nonlinear, mashed-potatoes feel.

The Acura corners with near-Italian brio, its variable-ratio steering finely weighted, though the steering is not especially good at transmitting information on the road surface into your hands. That's surely due to the filtering effect of its electric systems. Ultrawide-range magnetic dampers stiffen or soothe the car at all four corners, pancaking the NSX to the road with extra syrup. Maybe this Acura has a heart after all, beneath that sleek aluminum skin and layers of technology.

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Vanilla' Drone

Prabhat S. Hiremath - S. Y. Automatoin & Robotics **(Science & Technology)**

The VA001, a small unmanned aerial vehicle (UAV) or drone made by Vanilla Aircraft, stayed in the air for more than two days and two nights, setting the record for the craft's weight and power class. After taking off Nov. 30 from New Mexico State University's Unmanned Air Systems Flight Test Center, the drone flew at an altitude of between 6,500 and 7,500 feet (1,980 to 2,286 meters) and averaged 65.6 mph (105 km/h) before landing on Dec. 2.

The drone project is backed by the Defense Advanced Research Projects Agency (DARPA), the Pentagon's research arm. Drones already play an important role in military efforts, with functions ranging from surveillance missions to equipment delivery, DARPA said. Vanilla's VA001 is designed to stay aloft for up to 10 days of nonstop flight, carrying a 30-lb. (14 kilograms) payload.

Vanilla's record-breaking flight was actually cut short by several days, due to incoming bad weather. When the drone landed, more than half of its fuel was still on board, according to DARPA officials. The agency said the VA001 could set more world records for drones in future flights.

"This record-breaking flight demonstrated the feasibility of designing a low-cost UAV able to take off from one side of a continent, fly to the other, perform its duties for a week and come back — all on the same tank of fuel," Jean-Charles Ledé, DARPA program manager, said in a statement.

Potential applications of the Vanilla aircrafts include UAV-based communications and intelligence gathering, Ledé said. UAVs not only allow for stealth, Ledé said they also reduce personnel and operating costs.

DARPA is working on several drone projects as the technology has continued to advance, the agency said. The "Gremlin" program aims to build swarms of small drones that can be deployed from manned aircrafts to gather intelligence. Another project focuses on the monitoring of small-drone activity in cities. This so-called "Aerial Dragnet" would help the continuous surveillance of drones.

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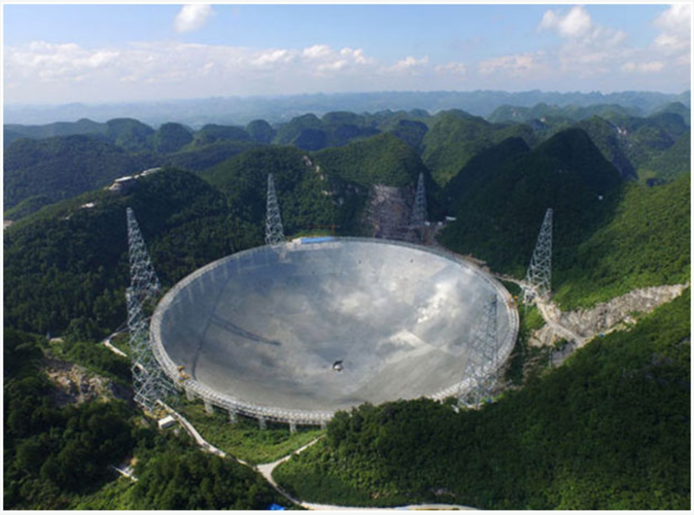
World's Largest Single-Dish Radio Telescope

Poonam Chougule - T. Y. Mechatronics **(Informative)**



Move over Arecibo. The title of "world's largest

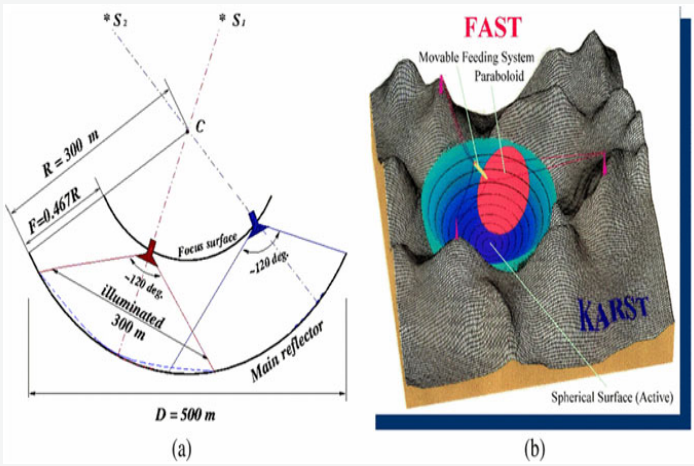
Source:-Bo Peng et al, Proceedings of the IEEE (Volume: 97, Issue: 8, Aug. 2009) FAST's dish can be deformed to target different areas of the sky. A subset of the mirror (left) can be used to create a parabolic surface (pink region, right).

According to the FAST site, the telescope will have double the raw sensitivity of the Arecibo Observatory. Among other things, it is expected to be able to hunt for the universe's first stars, search for signals from an extraterrestrial intelligence, and enable the detection of new pulsars—the spinning remnants of dead stars—in our galaxy and others.

single-dish radio telescope" now belongs to China's Five-hundred-meter Aperture Spherical Telescope (FAST).

The telescope, which had its official launch on Sunday, has already received astrophysical signals, China's press agency, Xinhua, reports. The almost 1.2-billion-yuan ($180 million) project was spearheaded by the Chinese Academy of Sciences.

Like the 305-meter-wide dish of the Arecibo Observatory in Puerto Rico, FAST consists of a spherical reflector dish that collects radio signals and focuses them onto the receiver system suspended above it. But FAST, which was built in a natural hollow in southern Guizhou province, also boasts an active reflector surface: triangular panels that make up its dish can be moved to form a smaller, transient reflector, in order to focus and target different locations on the sky.



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Khashaba Jadhav : Poket Dynamo

Aakanksha Gajanan Kalantre- CSE Dept **(Informative : Article / Biography)**

Khashaba Dadasaheb Jadhav

(15 January 1926 - 14 August 1984)

K. D. Jadhav was an Indian athlete. He is best known as a wrestles who won a bronze medal at the 1952 summer Olympics in Helsinki He was the first athlete from independent India to win an individual medal in the Olympics. He is the only Indian Olympics medalist who never received a Padma Award Khashaba was extremely nimble on his feet. Which made him different from other wrestlers of his time.

Born in a village called Goleshwar in Karad taluka of District Satara in Maharashtra state. K. D. Jadhav was the youngest of five sons of renowed wrestler Dadasaheb Jadhav. He did his schooling in Tilak High School in Karad taluka of Satara diatrict bet 1940-1947 He grew up in a household that lived and breathing wrestling. His father Dadasaheb was a wrestling coach and he initiated Khashaba into wrestling at the age of Five. His wrestling mentors in college were Baburao Balawade and Belapuri Guruji.

Jadhave's First Feel of the big stage was at the 1948 London Olympics his journey was funded by the Maharaja of Kolhapur. During his stay in London. He was trained by Rees Gardner a former lightweight world Champion from the United States. It was Gardner's guidance that saw Jadhav finish Sixth in the flyweight section, despite being un familiar with wrestling on the mat. He stunned the audience by defeating the Austrialian wrestler Bert Harr is in the first few minutes of the bout. He went on to defeat Billy Jernigan of the Us, but lost to Mansour Raeisi of Iran, to be eleminated from the Games.

--- for the next four years. Jadhav trained even harder for the Helsinki Olympics where he moved up in weight and participated in the 125 Ib bantaweight category which saw wrestlers from 24 countries, hw increased the tempo of his preparation for the next Olympics in Helsink.

After the marathon bout, he was asked to fight Soviet Union's Rashid Mammadbeyov As per the rules a rest of atleast 30 minutes were required between bouts, but no Indian official was available to press his case, a tired Jadhav, failed to inspire and Mammadbyov cashed in on the chance to reach the final. Defeating the wrestlers from canada, Maxico and Germany, he wan broze medal on 23 July 1952 there by creating history by becoming Independent India's first indidual medal winner.

Jadhav was the primary attraction of India's contingent that returned home after the Olympics. Crowd hathered at the Karad Railway Station to welcome their hero, a cavalcade of 151 bullock carts and dhols, carried their hero for about 10 Km and passed through the village of Goleshwar.

In 1955, he joined the police force as a sub - inspector where he won several competitions held with in the Police department and also performed National duties as a Sports instructor. Despite serving the Police department for 27 years and retiring as an Asst Police Commissionar, Jadhav had to fight for pension latter on in his life for years, he was neglected by the sports fedration and had to live the final stages of his life in poverty. He died in a road accident in 1984, his wife struggled to get assistance from any quater.

Later on, he was honoured by making him a part of the torch run at the 1982 Asian Games in Delhi. The Maharashtra Government awarded the Chhatrapati Puraskar post humously in 1992-1993. Also he was post humously honoured with the Arjun Award in 2001. The newly built wrestling venue for the 2010 Delhi common wealth Games was named after him to honour his achievement.

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Lifestyle In City

The Standard of life
is rising in city, But
dangerous noises
are not so pretly

For status they are
always be positive But
pollution is a cause
for blood group negative

Money is a key for
any closed lock But
mindset for health
lik a sewage fully block

Every second & second
connect with technology But
in any relationship
forget apology

So be a human and
connect with people But
stay epic thought
along lifestyle simple

Pranil Swami

Your Success Depend's On Your Mindset....

In real life our thoughts control your reality in your life only. You can change your life from your thought's. life is only depends upon what we do in your next step. When your mind say to you or realise some thing's which is happened in your past then your all time is totally wasted or realising on your past thing's but we know our Futhure only depend's on your present not post. So in that case we make futhure only present and our thinking automaticaly convert into positive thought's then our real life will be amazing. We take example: if you think your carrier life will be bright then your mind start to or that thing's convert into reality. Mean's that flow of positive thought's our mindset start to do hard work throught you and your hard work will convert your futhure in bright.

If you create your reality through what you focus on everything around is created in your mind based on what you decide to think about. If you build your thinking great then that's source's our daily life's improve's Book's, successful persons which get or reach their goal's their story of their own life.

Our life gives us new lessons each day not for learning but to improve our understanding & thinking.

"One I said to you we cannot change anything if we cannot change our thinking." The purpose of yout life is to be happy if you only thing that come's your mind then you realise your one second and all day are very important in your life each as a every minute's.

So I am only said from that artical.

"Thing's are simple but our life some complicated situation are come so you are the fighter of your life and win that fignt with your midset and your vision will be improve to look for the situation's." (if your thinking is good).

Pranil Swami

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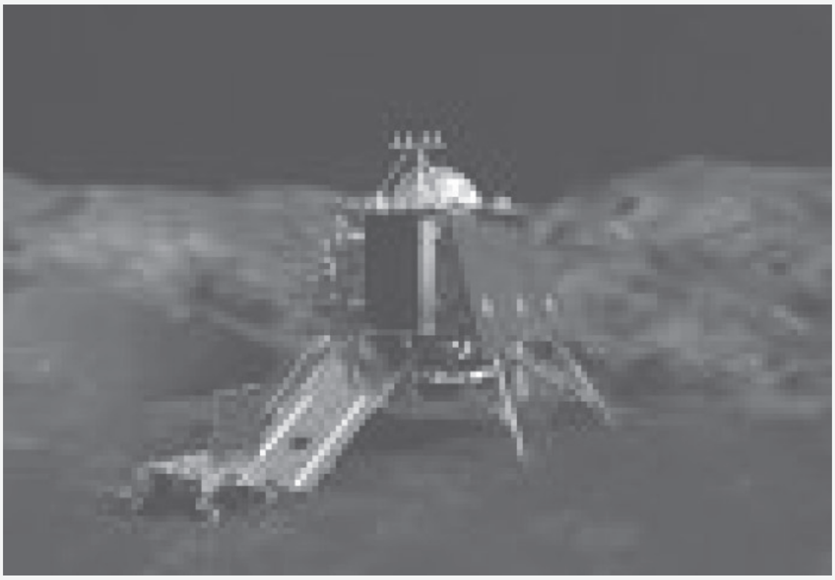
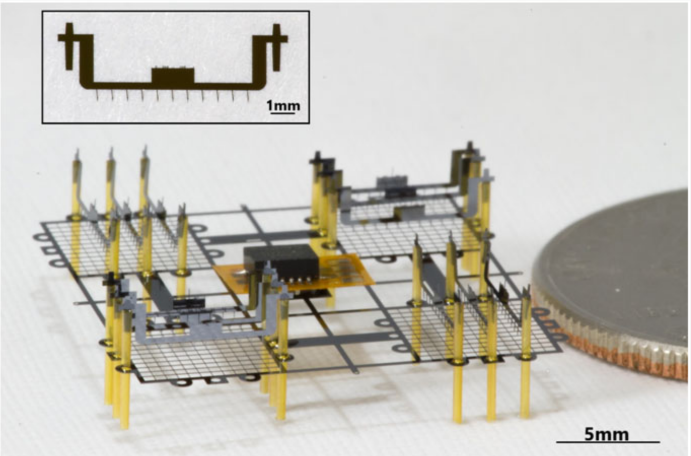
ENGINEERING MIRACLE



INDEX

A drone powered by electrohydrodynamic thrust

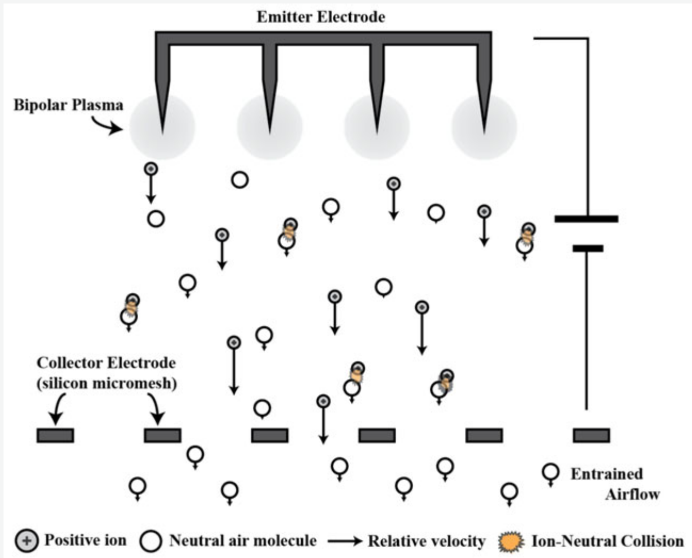
Divyani Mahadev Awate - T. Y. Electrical



Insect-scale flying robots are usually designed to mimic biological insects, because biological insects are masters of efficient small-scale flying. These flapping-wing micro air vehicles (FMAVs) approach the size of real insects, and we've seen some impressive demonstrations of bee-size robots that can take off, hover, and even go for a swim. Making a tiny robot with flapping wings that can move in all of the degrees of freedom necessary to keep it controllable is tricky, though, requiring complicated mechanical transmissions and complicated software as well.

It's understandable why the biomimetic approach is the favored one—insects have had a couple hundred million years to work out all the kinks, and the other ways in which we've figured out how to get robots to fly under their own power (namely, propeller-based systems) don't scale down to small sizes very well. But there's another way to fly, and unlike wings or airfoils, it's something that animals haven't managed to come up with: electrohydrodynamic thrust, which requires no moving parts, just electricity.

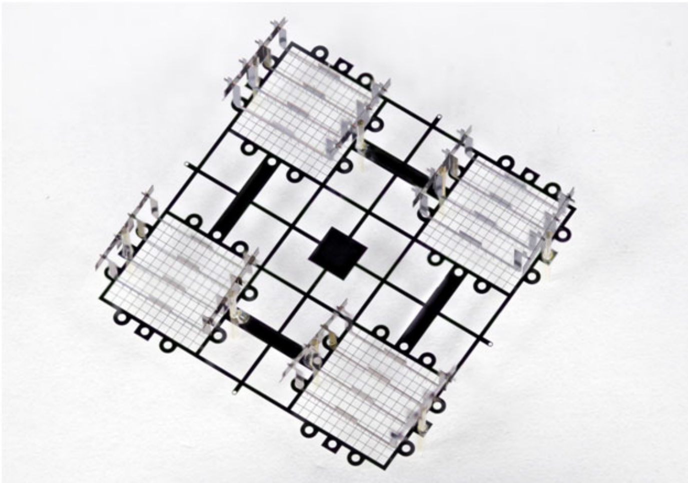
Electrohydrodynamic (EHD) thrusters, sometimes called ion thrusters,* use a high strength electric field to generate a plasma of ionized air. The ions (mostly positively charged nitrogen molecules) are drawn toward a negatively charged grid, and along the way, they smack into neutral air molecules and impart momentum to them, which is where the EHD thrust comes from.



This schematic shows the cross section of an emitter wire and collector grid electrode pair. Thrust is produced when positive ions, generated in the corona plasma region near the sharp tips of the emitter electrode, drift in the applied electric field and collide with neutral air molecules and impart momentum.

This isn't a particularly new concept; the general phenomenon has been understood for a few hundred years, and for a while, folks thought that it might be possible to use it in manned aircraft, although you'd need a crazy big structure of emitters and collector grids to lift a person.

There was a mouse named Orville that took flight in an improbably large EHD aircraft back in 2003 (plenty of cute pictures here), but as far as we know, that's about as fancy as large EHD-powered aircraft ever got. Going the other direction, though, could be where this



technology becomes practical.

This is the ionocraft, currently under development at UC Berkeley. It's tiny— just 2 cm x 2 cm, weighing 30 mg, plus a 37-mg IMU (although power is supplied through a tether). At small scales, the lack of moving parts becomes a real asset, because you don't have to worry about figuring out how to scale mechanical things like transmissions down beyond a point where it will be really frustrating at best and impossible at worst. Including its IMU payload, the ionocraft was able to take off and hover with an input of 2,000 volts at just under 0.35 mA:

No moving parts, completely silent, and it flies! Large scale EHD thrusters might be impractical, but scaling things down actually makes EHD thrusters better, since the electrostatic forces are scale invariant. That means smaller thrusters have a better thrust-to-weight ratio, as well as lower voltage requirements. And at small scales, an advantage that the ionocraft has over similarly sized FMAVs is that you can design a controller with a quadrotor as a starting point, as the ionocraft uses four thruster grids in a similar configuration. Since it doesn't have rotating propellers, it can't take advantage of angular momentum changes to yaw in place, but it turns out that "quick, repeated sequences of pitch and then roll" can result in a yawing motion, as long as you have a little bit of wiggle room.

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Vijay P. Bhatkar - Conceptualised India's first supercomputer

Called the **PARAM 800** and unveiled in 1991, PARAM stood for parallel machine.
Living up to it's nomenclature of 'supreme', this machine, built indigenously by the Centre for Development of Advanced Computing , placed India second after USA in the field of supercomputing.

A Non-Toxic Thermoelectric Generator for Wearable Tech

Sandhya Babaso Patil - T. Y. Electrical

Made with cotton, this generator harvests body heat to power wearable electronics.

A new way to harvest electricity from body heat could inspire new wearable devices that never need to be plugged in. The millivolts of electricity this thermoelectric technology produces mandates slim power usage from any electronics plugged in to its feed. However, the developers say there already are fitness trackers and medical monitors today that could work within their device's power envelope.

The new, wearable thermoelectric generator is also sourced from non-toxic and non-allergenic substances, making it a viable candidate for wearable technology.

In fact, says Trisha Andrew, associate professor of chemistry at the University of Massachusetts, Amherst, the substrate on which the generator is built is plain old cotton fabric.

More precisely, it's a vapor-deposited strip of cotton fabric—coated with a material called, brace yourself, "persistently p-doped poly(3,4-ethylenedioxythiophene)" a.k.a. PEDOT-Cl. One end of the fabric touches a person's skin and is thus at a person's body temperature. The other end, ideally, is exposed to the open air. The greater the difference in temperature between the two ends, the greater the electrical output.

Andrew says other labs have previously experimented with very efficient energy harvesting devices—that unfortunately were also made of toxic and expensive rare earth materials like bismuth telluride. Alternately, she says, more biocompatible thermoelectric generators made from polymers have also been considered. But these are often such poor energy harvesters that they can only muster small fractions of a single millivolt.

However, Andrew and her graduate student and co-author, Linden Allison, may just have threaded the proverbial thermoelectric needle. The innovation here was to vapor deposit their polymer only onto the surface of the cotton fibers—and not soak the entire cloth in the polymer.

“The process is very much akin to how semiconductors are made,” Andrew says. “But our lab developed a chemistry to translate that process to make fully organic materials.”

By keeping the semiconducting material on the surface, they could allow for charge to flow through the material while still thermally insulating one end of the generator from the other.

“The coating is the important part” of the new technology, Andrew says.

This stems from the competing demands of a good thermoelectric conductor. The ideal material must somehow keep one side hot and the other side cold—in other words, the material must be thermally insulating. However, it must at the same time conduct electrons. Electrical current needs to flow, or it’s not a very good generator.

With this vapor deposition trick, she says, “The polymer can be really, really electrically conductive." And PEDOT-Cl fills that bill. However, because the polymer is only coated on the outer surface of the cotton fibers, the bulk of the material (i.e. the cotton) is still able to perform its thermally insulating role.

Andrew and Allison, whose research has been published in the journal Advanced Materials Technologies, say they’ve applied for patents for their technology. And they’re already in talks with electronics companies who are considering this technology for possible use in future wearable products. The researchers said they could not name any companies they’re in touch with. However, Andrew says, “you’ve heard of some of them.”

One realm of early applications could be in the medical device field, says Andrew. The prototype they’ve done most of their testing on is a wristband that Allison made with a slit to allow one end of the PEDOT-Cl-infused fabric to touch the person’s skin, with the other end open to the air.

Allison says most applications for the technology will likely come from room temperature or colder weather environments. (In fact, she points out, sweat helps to increase the conductivity, so it’s possible the device could be used in athletic or workout-related wearables.)

However, she says, there’s no reason why the end of the device at human body temperature couldn’t instead be the cool end of the thermal gradient. In other words, in a hot desert environment where the air temperature is consistently above 37 degrees C (98.7 degrees F), the device could potentially work as well.

Whatever the case, Andrew says, it’s unlikely the generator would be plugged directly into a device. It’s too variable a current source, she says. Rather, the technology seems better suited to being a steady trickle charger for a battery that, in turn, powers one’s wearable electronics.

For instance, Andrew says, some wearable heart rate and glucose level monitors rely on a 0.5-volt battery. The 10 millivolts that even their wristband lab demo generated would be sufficient to serve as a trickle charge source for the battery—possibly freeing the device owner from worrying about plugging their device in.

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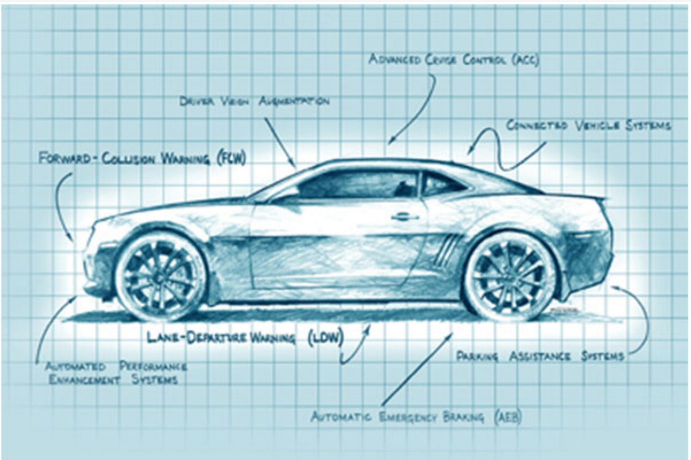
Advanced Driver Assistance Systems

Namrata Patil - S. Y. Mechatronics



If you think the drive toward more vehicle autonomy and connectedness won't impact your business, think again. Advanced driver assistance systems (ADAS) and connected vehicle technologies (CVT) are already flooding the OEM marketplace and rippling through the aftermarket in new and unexpected ways, reshaping the design, production, sales and servicing of a surprising array of parts and accessories. The only question is whether your business is ahead of, keeping pace with, or behind the rapid wave of opportunities heading our way.

"Transformative technologies are changing how cars are designed, developed, customized, sold, serviced, shared and owned," said John Waraniak, SEMA vice president of vehicle technology. "We are witnessing one of the most fundamental shifts in the history of the automotive industry. New vehicle technologies from ADAS to autonomy are driving this shift, and it's also being shaped by demographic, regulatory, social and environmental pressures.

The tremendous opportunities that lay ahead for the automotive specialty-equipment industry are underscored in a new SEMA-led Advanced Vehicle Technology Opportunities report conducted with Ducker Worldwide and the Center for Automotive Research. It is set to be unveiled at the 2017 SEMA Show.

This groundbreaking research estimates the current value of the ADAS aftermarket at just under $1 billion, with that dollar value expected to increase at a 9%–10% compound annual growth rate through 2021, when it will reach $1.51 billion.

What's the single biggest opportunity for the automotive specialty-equipment industry? Equipping the 200 million vehicles already on the road with today's ADAS. Safety features such as lane-departure warning, passive park assist and forward-collision alerts are at an all-time high, with interest continuing to grow. The opportunity for the aftermarket to modify older vehicles or vehicles without ADAS is growing as well.

Learn how the aftermarket is responding at this special SEMA Show media event, to be held at SEMA Central (located in the lower Central Hall), where industry experts will unveil the newest findings and outline what the future has in store.

With the ADAS safety, connectivity and navigation market projected to grow to $1.5 billion over the next five years, SEMA Central will also host a dedicated ADAS exhibit along with related resources throughout Show week. Whether you're a manufacturer, buyer, reseller or member of the media, the SEMA Show's seminars and ADAS-focused displays and events are an ideal way to familiarize yourself with these evolving trends.

Currently, passive park-assistance units make up the bulk of aftermarket offerings, but other yet-untapped areas can be expected to grow as well, driven by several key factors:

1. The lower cost of aftermarket ADAS alternatives to OEM products, which are often bundled into higher

trim and option packages.

2. The potential for aftermarket brands to fill the gap with ADAS products lacking sufficient annual take-rates for OEMs to offer.

3. The aftermarket's ability to retrofit older vehicles and lower new-model trim levels.'

4. The improvement and simplification in aftermarket systems, such as passive parking assistance, that allow for easier self-installations.

5. The increasing consumer interest in the safety and awareness that ADAS delivers.

The report also identifies several challenges that the aftermarket will have to overcome along the way. They include heavy integration of ADAS and related CVT into OEM vehicle control systems; increasing regulatory requirements that favor OEM installations; liability and insurance concerns; compatibility issues in emerging vehicle-to-vehicle and vehicle-to-infrastructure across state lines; a lack of U.S. Department of Transportation standards to build and test to; and continuing cybersecurity concerns.

Ready or not, however, ADAS and CVT are already exploding onto the scene, and aftermarket sales and service outlets will soon be grappling with the need for the right equipment and skilled personnel to keep up with market growth. While OEMs have a tight grip on these technologies now, it's expected that new legislation and aftermarket refinements will open new sales and repair channels. In short, the specialty-equipment industry can't ignore the trend toward ADAS/CVT. Manufacturers, retailers, service and repair providers must begin now to not merely adjust to the new reality but also grasp its tremendous growth potential.

The Drive toward Safety:-

Presently, the aftermarket's greatest growth potential lies in low-complexity passive safety systems. These include lane-departure, blind-spot and forward-collision warning systems, heads-up displays, and parking-assistance systems encompassing backup cameras and/or radar.

Aftermarket ADAS Systems 5-Year CAGR

Blind-Spot Warning 14%

Lane-Departure Warning 11%

Passive Park Assist 8%

Passive Forward-Collision Warning 14%

Heads-Up Display 12%

According to Waraniak, Millennials especially covet these vehicle features. A recent Foresight Research's "Accessories Immersion Report" found that today's 18–35 demographic values seamless technology and advanced safety performance to the point that they'll spend an average of $2,220 to tailor their vehicles accordingly.

"The consumer now is becoming more and more aware of the availability of safety features and options in new cars, and they want those same conveniences and safety features for their older vehicles, so that's a great opportunity for the industry," said Brett Riggs, AAMP Global vice president for integration and infotainment.

To meet that rising demand, AAMP recently relaunched its Echo Master brand, which encompasses everything from basic backup cameras to blind-spot detection sensors, front cameras, 360-degree cameras, DVR products and more.

“A whole new category is integrated safety, where we can integrate those cameras, sensors and so forth into either the factory radio screen of the vehicle or an aftermarket radio where the [factory unit] has been replaced,” Riggs explained.

Available from a range of infotainment manufacturers, current aftermarket safety-enhancement products already run the gamut from do-it-yourself (DIY) to professionally installed items, with price points to match. Indeed, DIY backup cameras and rearview mirror replacements with integrated view screens are now popular offerings at virtually every big-box chain. However, it’s not just traditional vehicle sound and entertainment manufacturers that are jumping into the ADAS/CVT marketplace. Entirely new companies are forming around those technologies—and for good reason.

“We’ve been coming across National Safety Council and other government reports on the safe-driving movement and finding that there’s a huge opportunity for the aftermarket,” said Jeff Varick, president of Brandmotion.

Founded in 2006, the company made high-tech safety solutions its main focus three years later.

“The biggest thing I’ve been talking about lately—and we’re doing something pretty exciting with it at the upcoming SEMA Show—is the fact that 10,000 of the 40,000 lives lost on American roads last year could’ve been saved if every vehicle on the road had the same safety technologies as new vehicles coming out of the factories,” Varick said. “The fascinating thing about that is those are lives that only the aftermarket can save, because the cars have already left [the factories]. They’re already part of the [millions of] vehicles on the road.”

Varick noted that such studies urgently call for equipping all vehicles with forward-crash avoidance, blind-spot detection, night vision, lane-departure warning, adaptive front lighting and surround-view camera systems, including features such as backup cameras and sensors.

“Of that list of technologies, six are being done in the aftermarket today, and Brandmotion is doing five of them,” Varick said, adding that adaptive lighting, in which headlights anticipate and adjust for changing road conditions, is proving trickier for aftermarket companies than for OEMs, making it a sort of Holy Grail technology.

On the other hand, blind-spot detection, a relatively simple technology for the aftermarket, is currently offered on only about 22% of new vehicles, but J.D. Power research indicates that 60% of auto purchasers want it. The irony, Varick said, is that most consumers remain unaware of their aftermarket options, making consumer education a major priority. To that end, Brandmotion will use the 2017 SEMA Show not only as a platform to launch fresh ADAS products but also to announce a new nonprofit initiative aimed at educating and equipping drivers who otherwise lack the means with these advanced technologies.

On the Front Line:-

While aftermarket manufacturers rush in to supply a consumer demand that can only mushroom for ADAS/CVT products, the collision-repair segment is already embracing the opportunities—and challenges to traditional business models— that come with these rapidly emerging technologies.

“The conversation surrounding this has really taken the industry by storm over the last couple years,” said Aaron Schulenburg, executive director of the Society of Collision Repair Specialists (SCRS). “[ADAS products] are becoming far more standard in baseline vehicles, and obviously our job as collision repairers is to restore a vehicle and its functionality to its pre-loss condition.

In doing so, the SCRS is working diligently to promote new tooling and diagnostic best practices, educate shop professionals and consumers alike in ADAS technologies, navigate rapidly changing OEM standards and government mandates, and deal with the fresh liability issues the technology inevitably raises.

"There's some great technology in these vehicles that really does a great job today of identifying flaws or failures within them and communicating that to the repair professional when you speak to it properly with the right equipment and with the right diagnostic background, skill sets and expertise," Schulenburg explained. "But we have to go through those processes. We have to make sure that we're following the specific requirements of those specific vehicles and not a more generalized or standardized practice.

"Each of the automakers provides specific requirements relative to each make and model, and that's one of the pieces for our industry. We have third-party payers paying for repairs, [and] there has been a lot of resistance over the costs associated with performing some of this diagnostic work—especially the concept of pre- and post-scanning—because it is a newer conversation, even though the diagnostic requirements have been part of the repair manual procedures for many years."

In addition to knowledge and best practices surrounding OEM systems, Schulenburg pointed out that repairers must also become adept in restoring and calibrating the functionality of aftermarket ADAS options as they become increasingly integrated into customer vehicles. He views the biggest business challenges ahead as cultural—creating a shop of highly trained professionals with a firm understanding of the implications of not following best practices or properly documenting their work.

"The education and information needs to be as much about restoring the vehicle for the consumer as it is about protecting the business that's working on that vehicle," he explained. "You look at some of the sad and horrific incidences of vehicles out there where the systems didn't perform as anticipated. If there were repair professionals or modifiers—or anyone who was in between the sale of that vehicle, the customer and that incident happening—[a shop would] certainly want to be able to go back and point to the fact that you restored the system and have documentation of that."

Rethinking Everything

Waraniak asserted that this cultural shift will apply to the entire aftermarket as well.

"ADAS sensors, cameras, radar and computer processors are often integrated in the parts and systems that SEMA companies are providing modifications for or in many cases replacing," he noted. "Most ADAS technologies are not yet regulated and can be addressed today with functional compliance testing, system evaluation and full-vehicle scanning and software tools. Automakers have guidelines and best practices available to dealers and collision repair shops to help ensure that ADAS technologies are calibrated and function as intended after a vehicle has been modified or repaired. If SEMA members are not using these tools and checking the OEM information data base, they may be missing an important step in the customization and modification process of late-model vehicles."

Indeed, the trend toward ADAS can affect virtually any vehicle modification down to the bumpers. Innovative Creations Inc. (ICI), based in Peoria, Arizona, found that to be literally true in the manufacturing of the Magnum Series Ford Raptor and Super Duty bumpers it's exhibiting at the 2017 SEMA Show.

"We like to accommodate the safety and convenience features that come from the factory so that our customers don't have to sacrifice the options that came on their truck," explained ICI Lead Product Development Engineer Kyle Dahlquist, who added that the engineering involved more than providing a few cutouts for sensors. "Any time you eliminate any of these features, you will run into problems in the form of check-engine and error messages that are nearly impossible to clear."

Those types of modules and sensors do not work well when they are moved from the factory locations, so ICI had to take that into consideration while designing its Tundra rear bumper with side-impact sensors and the new Ford models with adaptive cruise control.

"In both of those cases, the sensor locations are within the bumpers," Dahlquist said. "Those sensors cannot detect anything through steel, so we had to use another composite material to cover the sensors so they would fit into our design and still work properly. With our new Raptor and Super Duty bumpers, one of the best features is that they work with both ACC and non-ACC equipped trucks. This eliminates the need to have multiple part numbers and additional warehouse space for distributors. It also causes less confusion to the consumer and cuts manufacturing and design costs."

Greater Connectedness:-

No discussion of ADAS would be complete without at least a glance at vehicle connectivity—a closely related field of emerging technology. Even as the aftermarket evolves, a new segment is forming within the mobile-electronics category—one that is driven by software, digital connectivity and cloud-data sharing

A case in point is Voyo, a recently debuted aftermarket telematic system that essentially connects a vehicle's OBD-II port to the "Voyo cloud" to enable a suite of convenience, security and fuel-saving applications. Plug-and-play, the Voyo unit interfaces with a smartphone or other mobile device via Bluetooth, allowing users to remotely locate, lock and unlock their vehicles; monitor malfunctions, driver behavior and speed; read detailed diagnostic codes; and more.

"We're a combination of Silicon Valley and Detroit automotive," said Peter Yorke, CEO of Voyomotive, the device's manufacturer. He sees huge, untapped product-development and market potential in vehicle data.

"We're one of the few companies, if not the only one, that is actually reverse-engineering data from vehicles so that we can get very advanced data from vehicles that we can make available for apps for consumers, for fleets as well as for channel partners, whether it be insurance companies, dealerships or service centers," he explained. "Typically when data is acquired from an OBD-II port of a car, its use is very narrow in focus. It is data used for emissions testing that the companies have to, by law, make readily available. We're getting the other 99% of the data that is generally out of reach both for consumers as well as for fleets.

"For instance, we [can] know things such as when is your oil change? What is your remaining oil life? Have you gotten a flat tire? Has there been a malfunction code in the vehicle? So we're getting 70–100 non-generic parameters off the vehicle, and those look at how the vehicle is being operated, how the driver is driving the vehicle, and even parameters related to the weather. That allows us to determine if the vehicle is in good operating condition and if it's being driven safely."

Voyo's implications are vast. For one, parents can monitor teen driving habits from a home computer or smartphone. Fleets can network vehicles, and crowdsourcing can serve up routes and road conditions to consumers in ways that rival current navigation apps. But beyond even that, Yorke sees a future in licensing Voyomotive's application programming interface to third-party developers who can mine the data trove to innovate countless other applications, products and services. The company is also in the process of supplying its data analytics to Tier 1 companies researching vehicle handling characteristics, driver habits and related information for the development of next-generation products.

"We've seen in the last 20 years that many of the products and businesses that have changed the way we live have been digitally based," said Yorke. "Vehicles have kind of lagged in that field, and now are racing to catch up with the advent of driverless cars, [vehicle] intelligence and safety features. Cars were wide open in the days of do-it-yourself fixing it at home. The risk is that the data and what you can learn about the car is becoming more closed as you add more electronics. What we and others are saying is that we should be opening up this data, not only for consumers or for fleets but also for the distributors and channels that want to provide additional services and goods to their customer base. At the end of the day, I think history has shown that the ones who opt for more open solutions and support consumer preferences will be the ones who win."

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AI Can Now Decode Words Directly from Brain Waves

Prathmesh Manohar Shinde - S. Y. (AIDS)

Neuroscientists are teaching computers to read words straight out of people's brains.

Kelly Servick, writing for Science, reported this week on three papers posted to the preprint server bioRxiv in which three different teams of researchers demonstrated that they could decode speech from recordings of neurons firing. In each study, electrodes placed directly on the brain recorded neural activity while brain-surgery patients listened to speech or read words out loud. Then, researchers tried to figure out what the patients were hearing or saying. In each case, researchers were able to convert the brain's electrical activity into at least somewhat-intelligible sound files.

The first paper, posted to bioRxiv on Oct. 10, 2018, describes an experiment in which researchers played recordings of speech to patients with epilepsy who were in the middle of brain surgery. (The neural recordings taken in the experiment had to be very detailed to be interpreted. And that level of detail is available only during the rare circumstances when a brain is exposed to the air and electrodes are placed on it directly, such as in brain surgery.). As the patients listened to the sound files, the researchers recorded neurons firing in the parts of the patients' brains that process sound. The scientists tried a number of different methods for turning that neuronal firing data into speech and found that "deep learning" — in which a computer tries to solve a problem more or less unsupervised — worked best. When they played the results through a vocoder, which synthesizes human voices, for a group of 11 listeners, those individuals were able to correctly interpret the words 75 percent of the time.

The second paper, posted Nov. 27, 2018, relied on neural recordings from people undergoing surgery to remove brain tumors. As the patients read single-syllable words out loud, the researchers recorded both the sounds coming out of the participants' mouths and the neurons firing in the speech-producing regions of their brains. Instead of training computers deeply on each patient, these researchers taught an artificial neural network to convert the neural recordings into audio, showing that the results were at least reasonably intelligible and similar to the recordings made by the microphones.

The third paper, posted Aug. 9, 2018, relied on recording the part of the brain that converts specific words that a person decides to speak into muscle movements. While no recording from this experiment is available online, the researchers reported that they were able to reconstruct entire sentences (also recorded during brain surgery on patients with epilepsy) and that people who listened to the sentences were able to correctly interpret them on a multiple choice test (out of 10 choices) 83 percent of the time. That experiment's method relied on identifying the patterns involved in producing individual syllables, rather than whole words.

The goal in all of these experiments is to one day make it possible for people who've lost the ability to speak (due to amyotrophic lateral sclerosis or similar conditions) to speak through a computer-to-brain interface. However, the science for that application isn't there yet.

Interpreting the neural patterns of a person just imagining speech is more complicated than interpreting the patterns of someone listening to or producing speech, Science reported. (However, the authors of the second paper said that interpreting the brain activity of someone imagining speech may be possible.)

It's also important to keep in mind that these are small studies. The first paper relied on data taken from just five patients, while the second looked at six patients and the third only three. And none of the neural recordings lasted more than an hour.

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An Airplane With No Moving Parts

Sakshi Uttam Ugare - S. Y. (AIDS)

MIT researchers have flown the first airplane that has no moving parts. The aircraft, packed with lithium-ion batteries, used an ion thruster to fly the 60 meters that were available in the indoor flight area.

"This was the simplest possible plane we could design that could prove the concept that an ion plane could fly," said Steven Barrett, associate professor of aeronautics and astronautics at MIT. "It's still some way away from an aircraft that could perform a useful mission. It needs to be more efficient, fly for longer, and fly outside."

The plane weighs a little over 2 kilograms (5 pounds), and its engine has a thrust-to-weight ratio roughly comparable to that of a jet engine. Its lithium-ion batteries put out about 500 watts.

Ion drive was first demonstrated 101 years ago by famed rocketeer Robert Goddard, and it's now routinely used in space, for instance to reposition satellites. Space applications are natural because of the great thrust that can be generated while using a very small amount of propellant, always in short supply up in orbit.

"For every kilogram [of propellant] you take up in space you have to have more propellant in the launch vehicle," Barrett said, in a press conference run by the journal Nature, which today published the study. "So you use the propellant as efficiently as you can, throwing it behind you as fast as you can. In our application it's sort of the opposite: You want a large volume of air, and the ion wind is a good way of achieving that objective."

The researchers produce that wind by running 40,000 volts through a number of thin electrodes at the front of the plane's 5-meter wingspan. That strips electrons off nitrogen molecules in the air, leaving behind positively charged ions. The ions then shoot toward a second electrode at the back; on the way, they collide with millions of air molecules, pushing them along as well—hence the large volume of air.

There's a lot of electrodes sticking out, and one of the group's next goals is to hide them away in the wing. While they're at it, the researchers may want to lay on photovoltaic cells, which could recharge the batteries for use in high-flying applications where the plane functions like a relay station or a surveillance post. Such "pseudosatellites," which would fly for extended periods on automatic pilot, could benefit from the great potential reliability of a system with no moving parts.

One more possibility cannot have escaped the notice of the military: Ion thrusters make no noise and are therefore stealthy, at least to the human ear.

Don't look for them in people-moving aircraft anytime soon. Barrett speaks of "a low number of decades, not in five years or anything like that."

People living near airports can hardly wait for the silence.

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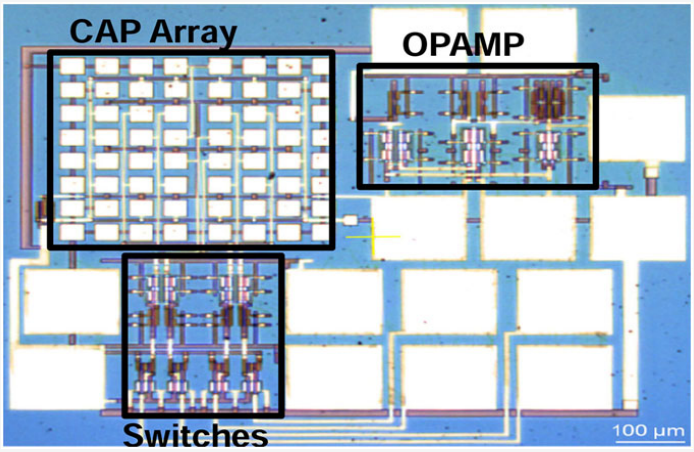
First Carbon-Nanotube Mixed-Signal ICs

Shreya Neminath Patil - S. Y. Electrical



RRAM 3D integration and a self-healing technique remove metallic nanotubes that poison analog circuits

All the amazing carbon-nanotube logic circuits we've heard about over the years have a dirty secret: Some of those nanotubes are metallic rather than the semiconducting type that's wanted. This tiny fraction of bad tubes is no big deal for logic circuits. They add a bit of noise, but nothing the digital nature of logic can't deal with. The problem has been analog circuits.

For analog, that stray metallic nanotube may as well be basilisk venom. "A single metallic [carbon nanotube] causes a complete circuit failure in a simple amplifier," Aya G. Amer explained to engineers at the IEEE International Solid-State Circuits Conference last week in San Francisco. Amer and her colleagues in the MIT laboratory of Max Shulaker have found a way to solve that problem, creating the first carbon-nanotube mixed-signal ICs .

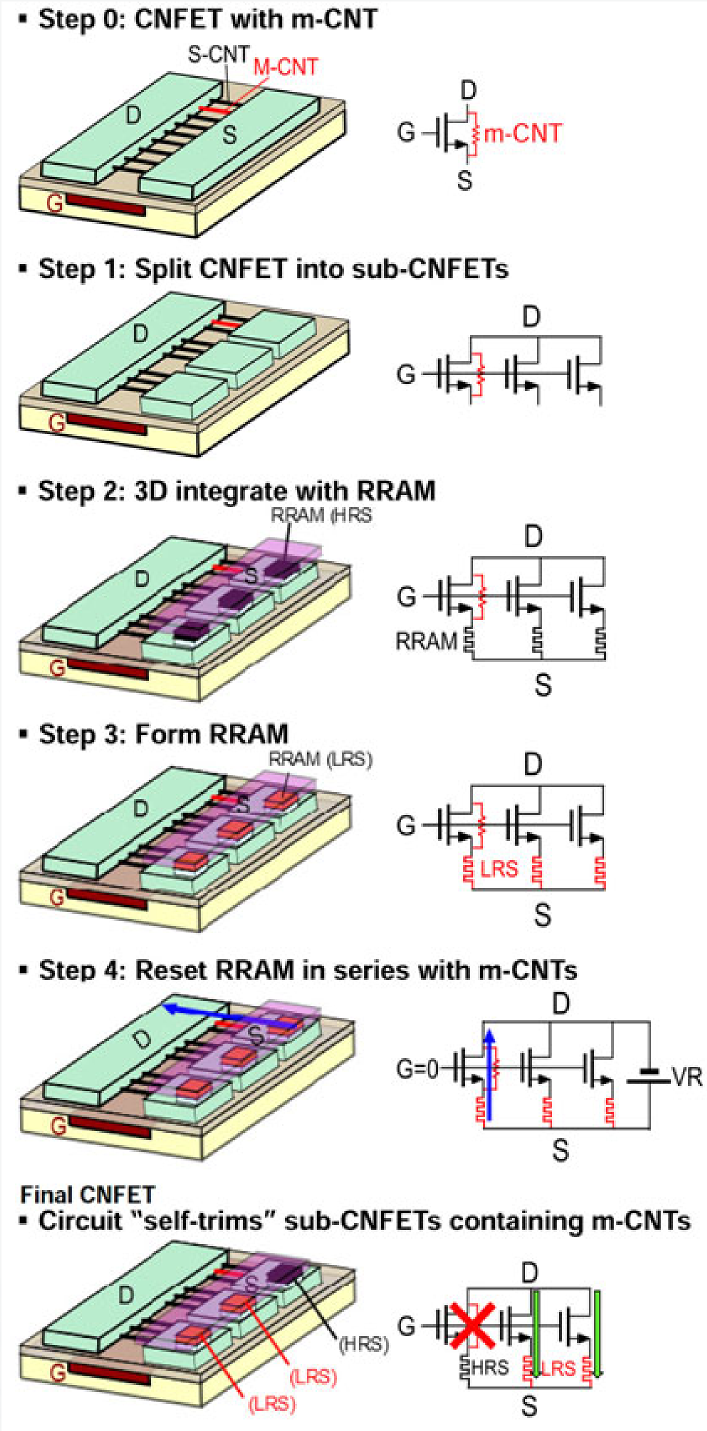
Their solution hinges on the 3D integration of carbon-nanotube field-effect transistors (CNTFETs) and resistive RAM memory (RRAM), a technology Shulaker helped pioneer with H.-S. Philip Wong and SubhasishMitra while at Stanford University.

The process involves depositing carbon nanotubes on a layer of already produced silicon circuits, processing these to form transistors and their interconnections, and then building RRAM atop this stack. This is not something that can be done using layers of silicon electronics, because the process temperatures involved would destroy the metal interconnects. Even stacking preprocessed silicon chips can't match it, because those chips have a limited ability to make vertical connections. The vertical interconnects in the Stanford/MIT method can be made thousands of times as dense, boosting interlayer bandwidth.

The U.S. Defense Advanced Research Projects Agency is so keen on the technology that it's pouring US $61 million into an effort to develop the manufacturing process at SkyWater Technology Foundry, in Bloomington, Minn

The analog process starts by building essentially the same style of CNTFET needed for logic. That's basically a metal gate buried beneath a channel made of many horizontally aligned carbon nanotubes that stretch between a source and drain electrode. At least one of these nanotubes is likely to be metallic; the trick is to isolate it and take it out of any future circuit. To do that, Shulaker's team broke the source electrode into three pieces. Statistically, only one of these would be connected to a metallic electrode.

In order to determine which one and remove it from the circuit, they integrated a RRAM cell atop each of the drain electrodes. RRAM holds data in the form of resistance. Flow current in one direction and the resistance increases. Flow it in the other direction and it decreases. So they applied a voltage across the circuit comprising the RRAMs and the nanotubes. For the two with semiconducting connections, this had no effect; no current could flow because the transistor's gate was not energized. But for the one hiding the metallic nanotube, things were quite different. The metallic nanotube acted as a short circuit across the transistor, pouring current through it and its attached RRAM cell. That caused the RRAM cell's resistance to leap to a value so high that it effectively cut off the path containing the metallic nanotube. So when the transistor is actually used in a circuit, only the semiconducting pathways count.



Amer and Shulaker call the process "self-healing analog with RRAM and CNFETs" (SHARC); it's self-healing in that the transistor removes its own flaws. The team built two mixed-signal circuits that used SHARC in the analog parts, a 4-bit digital-to-analog converter and 4-bit analog-to-digital converter. With 306 CNFETs, the latter is the largest CMOS carbon-nanotube circuit reported to date.

The SHARC technology "ties in nicely with a bunch of things we're doing," including the SkyWater project, says Shulaker. "The DARPA program is about computing, and there's more to computing than just" digital logic.

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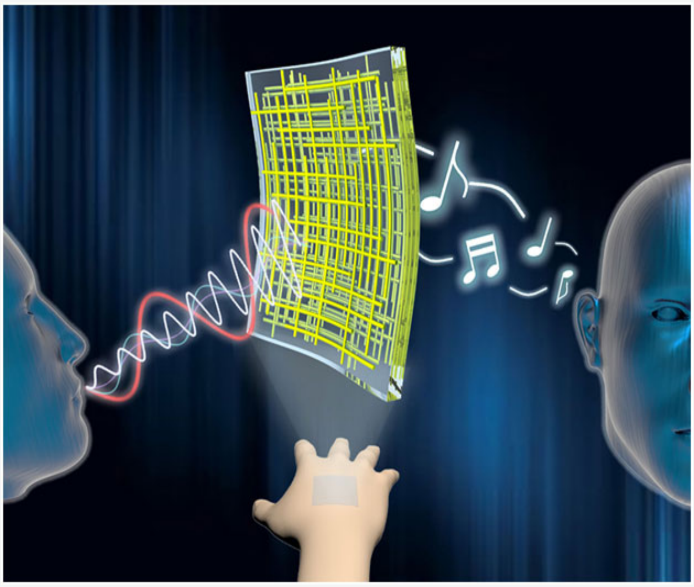
Flexible Loudspeaker

Ajay Jogeshwar Singh - S. Y. Mechanical



A variety of nanomaterials have been used over the years in loudspeakers and microphones. Nanoparticles have replaced permanent magnets in loudspeakers and a thin film of carbon nanotubes has done pretty much the same. And, of course, someone tried to use graphene to reproduce sound for microphones.

Now researchers at Ulsan National Institute of Science and Technology (UNIST) in South Korea have made a nanomembrane out of silver nanowires to serve as flexible loudspeakers or microphones. The researchers even went so far as to demonstrate their nanomembrane by making it into a loudspeaker that could be attached to skin and used it to play the final movement of a violin concerto—namely, La Campanella.

In research described in the journal Science Advances, the Korean researchers embedded a silver nanowire network within a polymer-based nanomembrane. The decision to use silver nanowires rather than the other types of nanomaterials that have been used in the past was based on the comparative ease of hybridizing the nanowires into the polymer.

In addition, the researchers opted for nanowires because the other materials like graphene and carbon nanotubes are not as mechanically strong at nanometer-scale thickness when in freestanding form, according to Hyunhyub Ko, an associate professor at UNIST and coauthor of the research. It is this thickness that is the critical element of the material.

"The biggest breakthrough of our research is the development of ultrathin, transparent, and conductive hybrid nanomembranes with nanoscale thickness, less than 100 nanometers," said Ko. "These outstanding optical, electrical, and mechanical properties of nanomembranes enable the demonstration of skin-attachable and imperceptible loudspeaker and microphone."

The nanomembrane loudspeaker operates by emitting thermoacoustic sound through the oscillation of the surrounding air brought on by temperature differences. The periodic Joule heating that occurs when an electric current passes through a conductor and produces heat leads to these temperature oscillations.

For the operation of the microphone, the hybrid nanomembrane is sandwiched between elastic films with tiny patterns. In this way, the nanomembrane can precisely detect the sound and the vibration of the vocal cords based on a triboelectric voltage that results from the contact with the elastic films. In these loudspeakers and microphones, the silver nanowires enable both the electrical conductivity and give the nanomembranes their freestanding strength.

While the researchers demonstrated the technology by applying a thin film of the nanomembrane on skin, this may not turn out to be a practical application of the technology, according to the researchers. This is because the performance of the thermoacoustic loudspeaker is proportional to the speaker size and temperature change of the speaker.

If it were directly attached to the skin, the input power level per unit area would increase too much for the generation of a large sound.

Floating Solar Power Plants

Vinit Sanjay Patil - S. Y. Mechanical

Siam Cement Group hopes to win the first contract to install a 45-megawatt floating solar farm at Thailand's Sirindhorn Dam

Solar farms take up land, which is especially precious in areas with dense populations—and those areas need renewable power most. To solve this paradox, populous countries short on land have started to turn to solar farms that float on reservoirs and dams. Of the world's 1.1 gigawatts of floating solar capacity, 450 megawatts exists in China, Japan, India, and South Korea.

Thailand now wants in, and an unlikely player is vying to get a big share of that market. Thailand's Siam Cement Group (SCG), one of Southeast Asia's largest building-material companies, has developed floating solar modules that it will build, install, and maintain. As the only large Thai company making floating panels, it hopes to land contracts to build at least some of the 1 GW of floating solar capacity that state-run Electricity Generating Authority of Thailand (EGAT) plans to install across eight dams over the next two decades.

EGAT announced in January that installation of the first project, a 45-MW farm at the Sirindhorn Dam on the country's eastern border, would begin in April, with four others following soon after. But the utility still hasn't picked a supplier. "Right now, EGAT is in a competitive bidding process, and we're trying to be one of the winners," says ChatreeKettong, energy development manager at SCG Chemicals Co., a subsidiary of Siam Cement Group.

Floating solar is part of the petrochemical producer's goals to diversify its business, Kettong says. SCG makes the mounting platforms for its floating solar farms from durable and recyclable high-density polyethylene. The pontoons should last 50 years, twice the expected life-span of the encapsulated, water-resistant silicon solar panels that SCG buys from various suppliers. Each module generates 100 kilowatts, and they can be easily bolted together. Their design is also more streamlined, he says: A 1-MW floating plant takes 10 percent less space than competitors' plants.

The company has already installed 5 MW of floating solar projects in eastern and southern Thailand, mostly at factories. And the company is starting to sell to clients in other Southeast Asian countries.

The French company Ciel& Terre could give the Thai firm some stiff competition. The firm, which pioneered the floating solar concept in 2006, already has projects under way in Thailand. It opened a floating solar-equipment-manufacturing facility there last year that customizes a product for the country, where a major requirement is low cost. "Pontoons are the more expensive part of floating solar, and Ciel& Terre has a monopoly on this," says Jordan Macknick, the lead energy-water-land analyst at the United States' National Renewable Energy Laboratory.

But plastics are SCG's specialty, and its ability to produce pontoons in-house should keep costs down. In fact, the company has teamed up with EGAT to conduct R&D for floating buoy materials at a pilot plant in the ThaThung Na Dam, according to the Bangkok Post.

Thailand today gets 12 percent of its energy from renewables and hydropower. The government aims to increase the country's renewables share to 37 percent by 2036, with solar providing 17 GW. Half of that, or 6 percent of the country's total power, could in principle come from floating solar farms, according to the Thai law firm Pugnatorius.

Floating solar is attractive in Thailand, and the country's several hydropower plants offer ideal staging waters. "Hydropower and floating solar make a lot of sense together because the grid infrastructure is already built," Macknick says. Hydropower can balance out solar's variable output, he adds, and "floating systems on reservoirs could reduce evaporation from those reservoirs, which means more fuel for hydropower systems."

Solar farms are also easier to set afloat on water than to install on land, which can require clearing, excavation, and grading, says Kettong. The two remaining challenges facing floating solar in the country are the complicated permit process (which can take three to six months) and building credibility. "This is a new product, and a new concept, for Thai companies," he says.

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U. R. Rao - The man behind The first satellite launched by India

Aryabhatta, the name given to the satellite, was an indigenously designed space-worthy satellite that set up tracking and transmitting systems in the orbital sphere. U.R. Rao,

the chairman of ISRO at the time was the man behind the launch in 1975 that put India on the world map in terms of space research.

Great Electrical Discovery: Turkey Tenderization

Manisha Shrikant Yanape - S. Y. ECE

Parlor tricks based on electricity were all the rage in mid-18th-century Europe. One of the most famous demonstrations, popularized by the electricity pioneer Stephen Gray, was the "Flying Boy" [PDF], which featured a young boy suspended from the ceiling by silk ropes. Thus insulated from the ground, he was subjected to an electrical charge and then was able to do apparent magic, such as turning the pages of a book just by passing his hands over them. The grand finale had a noninsulated audience member touch the boy's nose to create a spark and shock. History is silent on how the boy felt about this painful turn of events.

U.S. founding father Benjamin Franklin wanted to understand the phenomenon behind these clever tricks. Along with Ebenezer Kinnersley, Thomas Hopkinson, and Philip Syng Jr., he undertook a systematic investigation into electricity. Peter Collinson, a fellow of the Royal Society, in London, provided some of their instruments.

Starting in 1746, the group conducted a series of experiments in Philadelphia, which Franklin described in letters to Collinson. Collinson read the reports to the Royal Society, and then published the letters in an 86-page pamphlet that was quickly translated into French, German, and Italian. Franklin introduced the terms plus and minus and positive and negative to describe electrical states and charging and discharging to describe the actions of a Leyden jar, which was essentially a capacitor that stored charge for later use.

Electricians, as some early experimenters called themselves, charged a Leyden jar using machines such as the one pictured below. A user rotated the glass plate, which built up static electricity as it rubbed against the leather pads. The electricity was then drawn off by conductors (missing on this machine) to the Leyden jar.

Capacitance was measured by the number of Leyden jars, but the jars varied in size and the thickness of the glass, so this was not a precise measurement. It would be anachronistic to apply modern units of measurement to the early experimenters' jars—such units had not yet been invented or standardized, and the mathematical relationships of energy, capacitance, and voltage difference had not yet been discovered. But according to one modern source, a typical pint-size Leyden jar (roughly half a liter) would likely have had a capacitance of about 1 nanofarad and the energy of about 1 joule.

Spinning Wheel: To charge a Leyden jar, the user would rotate the glass plate. Friction between the glass and the leather pads produced static electricity, which was then stored in the Leyden jar.

Franklin also constructed an electrical battery by linking Leyden jars together in series, such as the one shown at top, which Joseph Hopkinson, Thomas's son, donated to the American Philosophical Society in 1836. The battery's 35 jars increased the amount of electricity Franklin could use in an experiment.

Franklin's fascination with electricity spilled over to more elaborate parlor tricks. In the summer of 1749 he hosted an electrical feast, which began with Franklin electrocuting a turkey and then roasting it on a spit that was turned by an electrically powered jack. Guests sipped wine from electrically charged glasses, which gave a small shock when brought to the lips. He invented a game called Treason, which featured an electrified portrait of the King of England wearing a removable gilt crown. Players got shocked if they were holding the frame while they attempted to steal the crown.

Franklin's experiments occasionally went awry. In some of his first attempts at turkey electrocution, the birds were merely stunned, arising a few minutes later after regaining consciousness. In his third letter to Collinson, Franklin noted the importance of grounding when charging and discharging the jars—a lesson he'd learned the hard way. On one memorable occasion, he electrocuted himself instead of the bird. Witnesses to the event claimed to have seen a great spark and heard a loud crack similar to the sound of a pistol.

In a letter dated 25 December 1750, Franklin described the unfortunate episode: "I have lately made an experiment in electricity that I desire never to repeat. Two nights ago, being about to kill a Turkey by the Shock from two large Glass Jars, containing as much electrical fire as forty common Phials, I inadvertently took the whole thro' my own Arms & Body, by receiving the fire from the united Top Wires with one hand, while the other held a chain connected with the outsides of both Jars."

Although Franklin never lost consciousness, his arm tingled with numbness for the remainder of the evening, and his chest felt sore for the next few days.

He pleaded with the letter's recipient—presumably his brother John—not to spread the story. "Do not make it morPublick, for I am Ashamed to have been Guilty of so Notorious A Blunder." Franklin did give permission to relate the cautionary tale to James Bowdoin II, a fellow experimenter in electricity. Bowdoin not only read the letter but made a copy of it. And thanks to the digitized version of that copy available from the Massachusetts Historical Society, we can all share a laugh at Franklin's expense.

Franklin continued his explorations in pursuit of a practical use for electricity. In particular, he theorized that electricity could be used to tenderize meat. By 1773 Franklin had not only a hypothesis but specific instructions.

In a letter to Jacques Barbeu-Dubourg and Thomas-François Dalibard, Franklin explained his theory by comparing it to a tree being struck by lightning. Just as lightning vaporizes the moisture contained in a tree, separating the fibers into fine splinters, so too could electricity forcibly separate the particles of meat to make them tender.

Franklin recommended a battery of six large glass Leyden jars to electrocute and tenderize a 10-pound turkey or a lamb. Each jar held 20 to 24 pints (9 to 11 liters). Having learned from his own mistakes, he ended his letter with a warning: "The one who does the operation must be very aware, lest it happen to him, accidentally or inadvertently, to mortify his own flesh instead of that of his hen."

More than 200 years later, researchers continued to investigate how electrical stimulation could be used to tenderize meat. A 1981 review of the field by S.C. Seideman and H.R. Cross of the U.S. Department of Agriculture cited dozens of contemporary studies on the theory and mechanics of electricity as a meat tenderizer.

Compared with practices in Franklin's day, the modern field of animal science is much more sophisticated. Experts have devised, for instance, specific measurements of meat tenderness, in kilograms of force needed for a steel blade to slice through the core of cooked meat. Meat requiring less than 4.6 kilograms to cut is reliably tender, while that requiring more force is deemed chewy and unpalatable.

By rendering tough cuts of meat more tender, electrical stimulation allows more of the animal to be used. It's also potentially cheaper to electrically tenderize meat than to tenderize it by aging it in a refrigerator for several weeks. Still, electricity changes the color and moisture of meat in ways that are considered undesirable.

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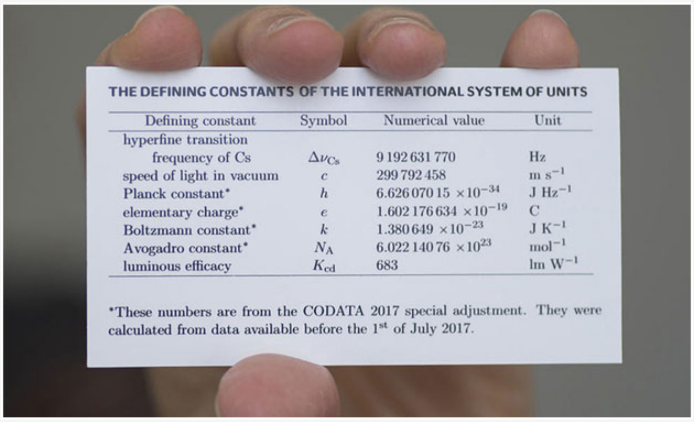
Historic SI Unit Overhaul Redefines Kilogram, Ampere, and More

Ajay Maruti Kumbhar - S. Y. ECE

The International Bureau of Weights and Measures will redefine four base units in terms of fundamental constants in nature



THE DEFINING CONSTANTS OF THE INTERNATIONAL SYSTEM OF UNITS

Defining constant	Symbol	Numerical value	Unit
hyperfine transition frequency of Cs	$\Delta\nu_{Cs}$	9 192 631 770	Hz
speed of light in vacuum	c	299 792 458	$m\ s^{-1}$
Planck constant*	h	$6.626\,070\,15 \times 10^{-34}$	$J\ Hz^{-1}$
elementary charge*	e	$1.602\,176\,634 \times 10^{-19}$	C
Boltzmann constant*	k	$1.380\,649 \times 10^{-23}$	$J\ K^{-1}$
Avogadro constant*	N_A	$6.022\,140\,76 \times 10^{23}$	mol^{-1}
luminous efficacy	K_{cd}	683	$lm\ W^{-1}$

*These numbers are from the CODATA 2017 special adjustment. They were calculated from data available before the 1st of July 2017.

Fig 1:- This wallet card displays the fundamental constants and other physical values that will define a revised international system of units.

Our standards of measurement seem, well, standard. A meter is a meter. A second is a second. The units by which we measure our world simply are—they feel as immutable as an ocean wave.

But these longtime standards are set to change. A governing body unanimously voted Friday for the biggest ever overhaul of the international system of units (SI), which will redefine four base units: the ampere, kelvin, kilogram, and mole.

"It's a moment of quite major significance in our obsessive little world of metrology," says Jon Pratt, chief of the National Institute of Standards and Technology (NIST)'s Quantum Measurement Division of the Physical Measurement Laboratory, who managed a team that has worked for eight years on equipment and projects related to the SI unit overhaul.

"We're achieving the completion of an arc that started when the French were first thinking up the metric system," Pratt adds. "They were striving for a universal measurement system. And now we are basing units on the fabric of the universe."

The vote of the International Bureau of Weights and Measures (BIPM, based on the group's French initials) at a Versailles conference was an inevitability, the culmination of decades of discussion and debate. Pratt credits "a complex mix of metrology funding and the progress of science"—namely, agreement on the measurement of Planck's constant—for finally making the vote, and the redefinition, a reality. More than 50 BIPM member-states voted for the redefinitions.

The overhauled system, which will take effect in May 2019, links every unit to a fixed figure: a fundamental constant in nature. And many of the units' definitions will reference one another.

As BIPM put it in a statement before the vote, "for the first time, all the definitions will be separate from their realizations: instead of definitions becoming outdated as we find better ways to realize units, definitions will remain constant and future-proof."

Perhaps the biggest—and certainly the buzziest—change is to the kilogram, the last base unit to be defined by a physical artifact. The International Prototype Kilogram, or Le Grand K as it is affectionately known, is a cylinder made of platinum and iridium, housed in a trio of bell jars in Paris and held under lock and key. It's taken out only to measure against official replicas of the kilogram, in an intensely careful process.

In a keynote speech Friday ahead of the vote, Nobel laureate Bill Phillips of NIST's Gaithersburg, Md., group highlighted the limitations of this setup as he held up a kilogram replica to the assembled crowd.

"If this were the real kilogram that I were holding in my hands, the fingerprints I put on this kilogram would increase the mass," Phillips said. "But of course it can't increase the mass, because by definition this is a kilogram. So you would all lose weight!"

With the revamp, the kilogram will now be defined in terms of the Planck constant—which itself will be given a fixed numerical value—and can then be realized by methods like the Kibble (watt) balance or the Avogadro constant.

Perhaps the most notable change for EEs is that of the ampere. The amp, currently defined as the magnetic force between two infinitely long wires at a certain distance apart that carry the same charge, will now be defined in terms of the elementary charge. But BIPM noted in a statement [PDF] that "for the vast majority of measurement users, no action need be taken as the volt will change by about 0.1 parts per million and the ohm will change by even less."

To measure temperature, the redefined kelvin will depend on the Boltzmann constant, and the mole will be defined in terms of the Avogadro constant.

Outside of the "obsessive little world of metrology," as NIST's Pratt put it, on a practical level these SI unit changes may seem minor. But as BIPM notes, "for the first time in history, [we will] base the whole of the international system of measurement on invariant constants of nature, ensuring its long-term stability and providing universal access to the SI base units."

Pratt sees that last point as the most important. The redefinitions will serve to "democratize the system," he says. "Now for the first time in the history of this endeavor, anyone can theoretically create their own primary reference of mass. It takes a lot of know-how, like knowing quantum electrical standards, but in principle anyone can make it."

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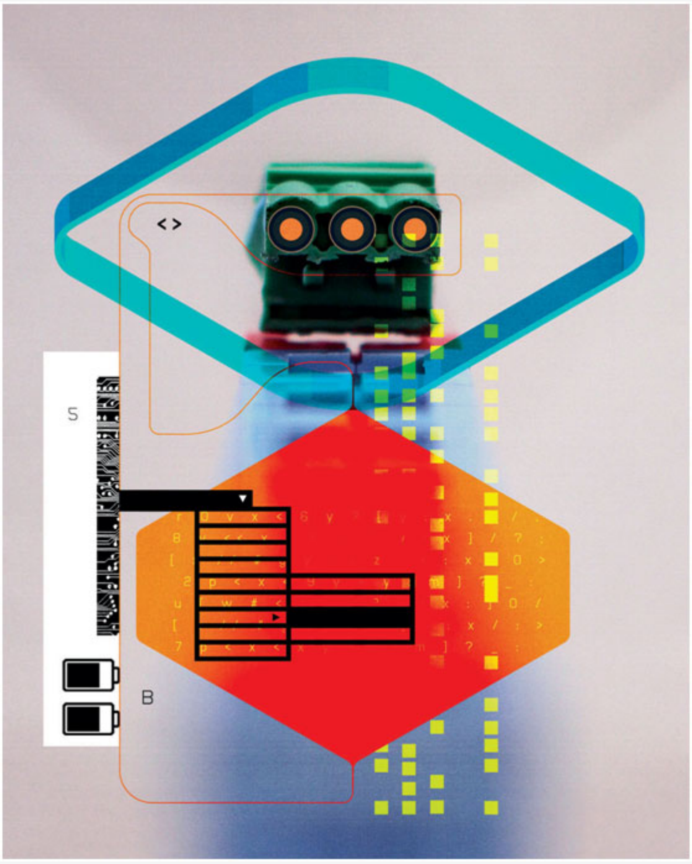
SubhashMukhopadhyay - Gave life to India's first and the world's second IVF baby

The 3rd of October 1978 saw Subhash performing India's first In vitro fertilisation which resulted in the birth of baby Durga. Tragically, Subhash was only given a posthumous recognition of his achievements in 1986 as the West Bengal Government refused to support his 'unethical' methods.

Internet of Things (IoT)

Riya Shafin Pinjari - S. Y. CSE

1. IoT Cameras



November's Internet of Everything column discussed the need to rethink cameras for an era of always-on operation at every corner. We'll also have to rethink the way those cameras see.

Today, computer vision can track cars, faces, and production processes as accurately as most people can. When there's a lot of data to sift through, computer-vision models are better than people.

But there are limits. Computers still need more time than a human to recognize a person or action. They can't follow a person or object between multiple video cameras. They can be fooled easily. They can't assign meaning to what they see. These are the limits engineers must overcome to make cameras more useful in manufacturing and in smart cities.

Today's cameras can typically perform inference—using algorithms to match incoming images against a predefined model—at roughly 30 frames per second. The speed depends on the complexity of those computer-vision algorithms.

All inference is basically a trade-off among the variables of cost, speed, memory, and accuracy. A camera that can quickly infer what something is might sacrifice accuracy. Or it might need more memory, resulting in a higher device cost.

Thirty frames per second is fine for finding a face in a concert crowd after the fact. However, when it comes to more complicated computer-vision tasks, such as determining errors in a manufacturing process, computers need to speed up their capabilities or risk slowing down production lines, says Sophie Lebrecht, the director of operations at Xnor.ai, a company building software to improve computer vision. Xnor.ai's goal is to track images at 60 frames per second.

Speeding up the frame rate at which computers can process images is just the first step. The next is to build software that can track an object between cameras in a network. For example, finding a person on one surveillance camera would allow the network to track that person as they walked in front of other cameras, automatically and in real time.

For that, we need fast image processing of complex models, plus software that will run across the camera network and can pick up the image. The goal would be to find a way to do this on a single network without sending data to the cloud. It would require an algorithm to recognize the person and another to track that person through physical space. It might also require a software overlay on the cameras or new communications protocols.

Cameras will also need to avoid "adversarial attacks," which are a brand new area of research. Just as humans can be fooled by optical illusions, a computer's vision may be deceived by various tricks that can distort an otherwise normal image, causing a program to perceive something that's not there.

Perhaps the most difficult task is creating software that allows computers to ascribe meaning to what they see. It's one thing to recognize a person is crawling; it's another for a camera to infer that a person crawling across the floor needs help or is trying to avoid detection.

From there, the cameras—and their software—will need to decide what to do next. We're a long way off from that, but researchers at Alphabet have already done impressive work trying to teach computer-vision algorithms to find meaning. It's possible that one day, computers may see even better than we do, and will harness what they see for our benefit.

2. IoT Devices and Then Prod Users to Smarten Up

National Institute of Information and Communications Technology (NICT) will begin testing the security of Internet-connected devices that belong to citizens and businesses. Without notifying owners, the agency will use default credentials to try to log in to possibly millions of gadgets across the country as part of a nationwide cybersecurity experiment due to end in 2022.

The project will be conducted in cooperation with the country's major Internet Service Providers (ISPs). The aim is to root out Internet of Things (IoT) devices with weak security. Then, ISPs will warn owners that their devices are vulnerable to cyberattacks.

The government recognized poor IoT security as a threat to national security in a paper on cybersecurity [PDF] published in 2015. And with the 2020 Summer Olympics to be held in Tokyo, the eyes of the world will soon focus on Japan, placing the country's ability to hold a trouble-free Olympics under international scrutiny.

Consequently, the government has come up with the NICT IoT security-test project in an attempt to proactively address security concerns. The project is officially named the National Operation Towards IoT Clean Environment, or NOTICE, and was authorized by Japan's Ministry of Internal Affairs and Communications.

Hiroyuki Sato, associate professor at the University of Tokyo's Information Technology Center, says that while he understands the motivation for such testing, it is nevertheless being conducted without the public's consent.

Sato points out that last year, the government had to revise an existing NICT regulation—the so-called NICT Law—in order to avoid the project conflicting with a general law prohibiting unauthorized computer access. "This indicates that this device testing still has several problems concerning civil rights," he says. "I'm concerned this decision by the government is a hasty one."

He also says the government could have done a better job explaining to the public and the business sector how the collected data will strengthen security, or whether the data will be used for other purposes.

"The explanation given so far is not sufficient," says Sato. "Which is an all-too-common way of Japanese governing. A more detailed account is necessary."

In an effort to reassure the public that NOTICE will not lead to the disclosure of private content, NICT issued a press release on 1 February explaining the "investigation is to check whether the password set in each IoT device is easily guessed (e.g. 123456, 00000000, etc.)."

The announcement says there will be no intrusion into devices or acquisition of "information other than that required for the investigation. As for information obtained by the investigation, strict control measures will be taken in accordance with NICT's work implementation plan approved by the Minister for Internal Affairs and Communications."

Sato does not doubt the ability of NICT to properly carry out NOTICE. He says NICT has experience in conducting IT tests and surveys. He also believes such testing is indispensable for ISPs to understand the status of their network security. However, he does question how effective the practical results will turn out to be. Ordinary people, he says, won't know how to react when told their devices are vulnerable.

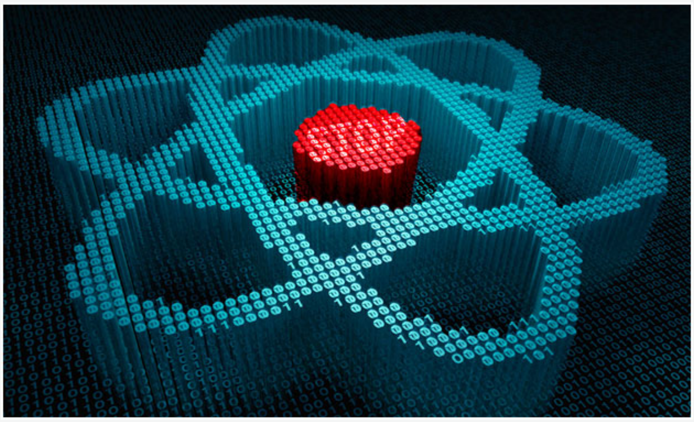
"Most people don't know the account information of old devices and don't know how to patch for any security failings," he says. "So I expect effective results will be limited."

A better approach, he believes, would have involved ISPs carrying out less drastic testing in advance of the NOTICE tests. This would have better prepared the nation for NICT's intrusive program, he says.

Going forward, Sato expects the ISPs to update their firmware to help strengthen network security. And he thinks device manufacturers will be strongly advised by the government to take responsibility for security when releasing new models.

Meanwhile, the rest of the IT world will look on with keen interest to see how NOTICE proceeds and how users whose devices are targeted will react.

3. Circuit Secures the IoT Against Quantum Attack



One of the most frequently mentioned fears about future quantum computers is that they will someday crack our encryption codes and lay all our digital secrets bare. Despite it being a truly far-off possibility, cryptographers are already taking the threat very seriously.

The solution seems to be to develop one or more classes of encryption schemes that classical computers can use but quantum computers can't crack. Less than two weeks ago, the U.S. National Institute of Standards and Technology reported that its search for quantum-proof algorithms had reached the semifinals stage. Following a year-long evaluation, the agency has narrowed the field down to 26 algorithms, most of which fall into three broad families.

Now, at the IEEE International Solid-State Circuits Conference on Monday in San Francisco, engineers from MIT have reported the creation of an encryption system that performs one of these schemes on a chip small enough and energy-efficient enough to guard battery-powered nodes on the Internet of Things from future quantum attack.

The MIT engineers focused on one family of post-quantum algorithms, called lattice-based cryptography. The name comes from a way to picture the problems that would need to be solved to crack this kind of encryption. Imagine a two-dimensional grid with points scattered around it. It might not seem too difficult to find the shortest vector between a random spot on the lattice and the nearest point, but expand the grid into three dimensions, and then 1,000, and then 10,000, and it becomes enough to occupy today's computers for years.

"Lattice-based cryptography is a promising candidate because of its small public key and signature sizes," MIT doctoral student Utsav Banerjee told engineers at the conference. The problem that computers must solve in order to crack the encryption is called the learning with error problem. Encryption using that problem requires the generation of matrices of numbers that each have certain characteristics. Banerjee says that generating those numbers was the biggest computational constraint, while storing the vectors for the key exchange computations took up the most area on the chip.

In order to reduce the computational load, the MIT group first implemented an efficient pseudo random number generator, using the SHA-3 hash function, that was two to three times as energy efficient as two other candidates. To fit the encryption algorithm, the random numbers must fit certain statistical properties. That required three different algorithms designed to reject numbers that didn't fit. The team chose algorithms that produced significant energy savings when implemented in silicon. One proved to use merely 1/16th the energy of a competing algorithm.

Solving the key exchange equation was only 30 percent of the computation, but took up more than 75 percent of the chip area, mostly as banks of SRAM memory. It could have been worse. By redesigning the connections among the memory banks (and proving that this action wouldn't compromise security and efficiency), Banerjee and his colleagues were able cut about 124,000 logic gates from the total.

The MIT team, which includes Abhishek Pathak and dean of engineering Anantha P. Chandrakasan, tested their silicon with four of NIST's candidate algorithms—Kyber, NewHope, R-EMBLEM, and LIMA. The chip was 28 times as energy efficient running Kyber as an ARM Cortex-M4 doing the same algorithm in software. For NewHope it was 37 times as efficient. On NewHope, it consumed an average of only 516 microwatts.

Banerjee's next goal is to ensure that the chip is immune to what are called side-channel attacks. These are ways to steal data indirectly through things such as changes in a chip's power consumption, how it radiates energy, or how long certain actions take. He's already shown that key parts of the system produce their results at a constant rate, so it should be immune to timing attacks. However, he hasn't tested it yet for power and electromagnetic radiation.

4. Internet of Things Will Manage the Chaos in India's Booming Cities

The 20 million residents of Mumbai slog through monstrous traffic jams during monsoon season. The heavy rains that last from June until August frequently choke off the flow of traffic through India's most populous city, leaving millions of Mumbaikars seething in their cars after a workday.

Though it's particularly bad during monsoon season, Mumbai's traffic is awful even on sunny days. And meanwhile, the number of vehicles in the city continues to grow. In 2012, there were just 2 million cars, scooters, and auto-rickshaws in Mumbai. Four years later, at the end of 2016 (the most recent year for which data is available), there were 3 million.

City planners are struggling to keep up. The city's total road length—about 2,000 kilometers—has remained stagnant over the years. More vehicles, crowded onto the same length of road, means that there are now more than 1,500 vehicles per kilometer of road. That's even worse than Los Angeles—infamous for its bad traffic—which, despite having far more cars (almost 6.5 million), has only about 600 vehicles per kilometer.

Mumbai has seen its population more than double since the early 1990s. The rapidly urbanizing city needs new ways to manage its traffic but also to cope with energy usage, waste management, and the other effects of escalating urbanization. For all of these problems, the Internet of Things (IoT) is a tool of great promise and potential power.

To be effective in such applications, the IoT would have to be deployed at a scale larger than any seen so far. And for that to happen, a country like India would first need a robust infrastructure backbone that could support such a vast rollout of machine-to-machine communications. That's why Tata Communications (at which I am a senior vice president and head of the IoT division) has built a superlow-power, secure, bidirectional network specifically for massive IoT communications. It is now the world's largest IoT network, connecting over 400 million people in India's 44 largest cities as well as hundreds of villages along 12 national highways. Our goal was to offer a simple, energy-efficient way for any organization to provide large-scale IoT applications to ease the growing pains faced by India—and potentially by other developing countries as well.

Mumbai is one of many cities rushing to implement networks of connected devices and sensors to increase the efficiency of public services, reduce pollution, and improve quality of life in other ways, while also keeping costs under control. Local governments around the world are exploring smart-city systems as a way to address a variety of municipal crises. These projects are a cornerstone of efforts to create smart cities. There isn't any universal agreement about what the term smart city means, though it now implies that a city is using IoT to make its municipal services more efficient by some metric. Analysts at the technology analysis firm IHS Markit project that there will be at least 88 smart cities globally by 2025—up from just 21 in 2013.

This fourfold boom in smart cities is one of the reasons the advisory company Gartner predicts that there will be more than 20 billion IoT nodes, or connected "things," by 2020. You may not be able to feel their impact while you're walking down the street today, but you will in some cities within a couple of years.

We're already seeing how connected devices can improve services in more developed economies. For example, some cities in Europe now have connected garbage trucks and garbage bins. Using IoT-enabled sensors, the bins can tell sanitation workers when they are full or nearly so, so that they can be collected. This approach is more energy efficient and cost effective than sticking to a set schedule, because trash accumulation varies widely: It's heaviest during holiday periods such as Christmas, and lowest when many households are away on vacation, for example during the summer. Such a flexible schedule also helps to ease the flow of waste into landfill and recycling facilities, and to improve air quality by reducing pollution. City planners in many developed regions are also exploring how systems of IoT nodes can enable more interactive and responsive city administration, create safer public spaces, and meet the needs of aging populations.

In developing countries, smart devices have the potential to truly transform people's quality of life by completely changing the way in which services are delivered. For India especially, the Make in India program—the government's recent plan to turn the country into a leading global manufacturing hub—is just the sort of ambitious project that can benefit from large-scale IoT networks.

Launched in 2014, Make in India has prioritized upgrading infrastructure, supporting innovation, and developing skills in the country across 25 sectors of the economy, including railways, mining, and pharmaceuticals. The program has been criticized by some industry leaders who feel it has failed to develop the policies and skilled workers needed to achieve significant results. Nevertheless, it has attracted investment into India from such large electronic systems manufacturers as Huawei, Lenovo, and Samsung.

If this effort succeeds, industrial facilities could become smarter and better connected than ever, accruing substantial savings and even environmental benefits. For example, with data from sensors directly connected to a building's control system, management could adjust light and heating levels based on how many people are in the building.

There's even good news for individuals. Remember those beleaguered drivers on the congested streets of Mumbai? Think about the collective time that millions of Mumbaikars could save if traffic lights could adjust to conditions on the road ahead and redirect vehicles before traffic ever had the opportunity to explode into rush hour chaos. In addition, with data collected from IoT sensors connected to a citywide traffic-management system, gridlocked Mumbaikars could use more-accurate route-mapping apps, get real-time notifications of parking spaces available, and even check predictive analytics to see which parking spots will most likely be available when they arrive at their destinations. The days of driving around the block endlessly to find a spot or risking a ticket for double parking will be long gone.

This bright urban future won't happen unless we can overcome a significant barrier: Different IoT devices and applications rely on different standards and technologies. Because of this incompatibility, engineers must often coax devices to work together in order to connect people, smartphones, and sensors.

This was one of the key challenges we at Tata Communications wanted to address four years ago as we started to build our IoT-focused network in India. By building our new network from the ground up, we could be sure that our engineers wouldn't get headaches

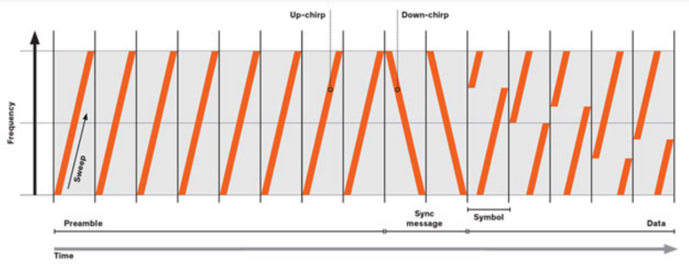
trying to make devices communicate with one another later on. The end result is a uniform IoT-focused network that cities or companies can easily tap into for their own projects.

For example, in one use of the network, we deployed 300 smart streetlights in the city of Jamshedpur for Jamshedpur Utilities and Services Co. (JUSCO). We hope the project can reduce electricity consumption by switching the lights on and off or dimming them remotely from a central command center based on the amount of traffic on any given street. If the system works in Jamshedpur, we plan to install thousands more of these streetlights in cities across India.

In Mumbai, we partnered with Mahanagar Gas Limited (MGL) to deploy 5,000 smart gas meters in the city. MGL can monitor these meters to analyze each building's gas usage in finer detail, which will allow the company to deliver natural gas more effectively.

Building a single network for a country as expansive as India without breaking the bank or sucking too much power is a major challenge. To make it possible, we're using long-range low-power (LoRa) wireless communications in the 865-to-867-megahertz range. LoRa is a communication technology patented by wireless semiconductor manufacturer Cycleo (now owned by semiconductor supplier Semtech). It doesn't require the ravenous power consumption of wireless options that would otherwise make large-scale networks challenging.

LoRa keeps power consumption low by using a signal's chirp—its change in frequency—to send information. Chirps come in two varieties: up-chirps, in which the signal's frequency increases, and down-chirps, in which it decreases. LoRa modulates these up-chirps and down-chirps to encode data. This technique uses less power at the cost of requiring a wider frequency band for communication. The power usage is so low that the battery in an IoT device connected to our network could last for more than a decade without replacement.



Listening for Chirps: Long-range low-power, or LoRa, communication sends information through a signal's change in frequency—that is, its chirp. The eight up-chirp preamble catches the receiver's attention in a noisy environment, and then two down-chirps sync the message. Then come the symbols—up-chirps starting at specific frequencies, with each frequency signifying a specific string of bits. LoRa's chirps make the method more resistant to interference.

This chirp modulation is an example of a technique called spread spectrum. Spread-spectrum methods take advantage of a larger bandwidth than other types of signals, whether by a transmitter shifting the signal to different frequencies or deliberately filling other frequencies in the band with interference. Regardless of the method, the goal of any spread-spectrum technique is to prevent interference from other signals or provide more secure communications. LoRa's resistance to interference works by "sweeping" the signal across a 125-, 250-, or 500-kilohertz-wide band assigned to the network.

Any LoRa signal starts with eight up-chirps—in which the signal sweeps across the entire band each time—to give a receiver a heads-up that it needs to start listening for a message, as shown in the illustration above. This alert is critical, as all the IoT devices in a network are using that same frequency band. Without the use of a "preamble" to grab a receiver's attention, the subsequent message could easily be missed. Two down-chirps follow, to sync the receiver as it receives the message.

The message itself is composed of symbols. Each symbol represents a predetermined string of bits and corresponds to the point in the band where the chirp begins. As the signal moves to the next symbol in the message, it jumps to a new frequency and completes a sweep across the band, ending at the same frequency where it began. Each subsequent symbol denotes another jump in the frequency before the next sweep. To decode the message, the receiver just needs to note the point in the band where each chirp started and match it to the corresponding symbol.

The network has impressive reach because an antenna receiving information is listening only for the frequency at which the next chirp starts. That's much easier for an antenna to hear than information that has been encoded through other methods, like frequency or amplitude modulation. Signals can easily travel more than 15 kilometers and can penetrate a concrete wall—or three plaster walls. Such penetration means the system can be used to monitor trains coming and going in metro stations, the number of cars in an underground parking lot, the water level in a reservoir—all sites that are difficult or impossible for traditional wireless systems. Compared with traditional wireless technologies—such as Bluetooth, LTE, Wi-Fi, or ZigBee—LoRa allows networks to reach farther, with less power and cost.

Even with the capabilities of LoRa, building a network that can function well across India's vast geographical disparity and for its huge population was still a significant challenge. The trickiest part is that the frequencies from 865 to 867 MHz are unlicensed spectrum in India. So, when designing the network, we had to consider that others might be using the same band at the same time for other applications. Because LoRa signals sweep across an entire band, they are somewhat impervious to interference caused by other signals transmitting on a specific frequency in that band. Even so, enough other traffic on the same frequencies could still interfere with LoRa signals and prevent them from reaching their destination.

In 2018, the network's first command center opened in the city of Jamshedpur. In this center, JUSCO is using over 100,000 sensors to digitize 15 elements of its infrastructure, including streetlights, utilities, and parking meters, all connected to India's first IoT network. The command center will allow JUSCO to reduce the city's energy use, increase waste-management efficiency, make construction sites safer, and alleviate rush-hour traffic.

While this IoT network will connect more people than ever before, there are other, similar projects in the country planned to help make cities and communities better connected: Kochi in the state of Kerala, Coimbatore in Tamil Nadu, and Bhubaneswar in Odisha have ambitions to become smart cities, and there is a smart-city project already under way near Ahmedabad, in the western state of Gujarat, called Gujarat International Finance Tec-City(GIFT).

Its developers hope GIFT becomes not only the country's first full-fledged smart city but also a rival for Hong Kong, London, New York City, and Singapore as a major global financial services center. The Bombay Stock Exchange has already set up an international exchange in GIFT, and the data-center and connectivity infrastructure to underpin the smart systems of the city is being deployed now.

But the most promising development is that India's smart ambitions aren't confined to cities. The state of Rajasthan, for example, has plans to develop more than 3,000 smart villages with connected utility systems to provide access to clean drinking water, widespread Wi-Fi connectivity, e-libraries, smart streetlights, and telehealth facilities.

From Mumbai and Jamshedpur in India to the rest of Asia and beyond, smart cities are being built using large-scale IoT networks. These always-connected communities will transform the lives of hundreds of millions of people. We are just at the beginning of this journey, but nowhere will the positive outcomes be greater than in the cities of India.

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Narinder Singh Kapany - The creator Fiber optics

The process to transfer information freely and almost instantaneously was made possible by the pioneering work of NarinderKalpany. Fiber optics have revolutionised the way we communicate, offering high speed data transfers as well as helping in medical procesdures such as endoscopy and laser surgeries.

MWC Barcelona 2019: 5G Isn't About the Smartphone

Sanjivani Babaso Kokane - S. Y. ESE

So you've been hearing about 5G. It's a new generation of wireless communications, you've probably heard. You may have even heard that it will do flashy things like empower the Internet of Things or usher in self-driving cars. But in all that, you haven't heard much about what it's going to do for you, personally. In your frustration, you may ask yourself, what the gosh-darn heck is the point of 5G?

Last week, I spent four days at MWC Barcelona 2019 (formerly called Mobile World Congress) trying to answer that question. As it turns out, those in the industry have a lot of ideas about how 5G will be used, and when we'll see those applications emerge. Depending on who I talked with, they were excited about robots or virtual reality, the Internet of Things or autonomous vehicles.

However, those specific use cases might not be the real reason to be jazzed about 5G. In a sense, 5G is just another generation of wireless technologies. But it's also the first time that the smartphone will no longer be our primary gateway into the wireless world.

Every new generation of cellular technology has brought more features to our phones. "2G was digital voice," says Ignacio Contreras, director for 5G marketing at Qualcomm. "3G was the first data services, 4G [was] mobile broadband, but always very centered on the phone. In 5G, one of the key differences [is], it's designed to serve all sorts of new different segments."

In fact, the potential of 5G seems far more open-ended than previous generations of wireless. And by shifting emphasis from the phone, the focus is already changing from selling a certain number of devices to thinking about complete wireless ecosystems.

"If you look at 2G, 3G, 4G, it's all about selling a SIM card," says Jane Rygaard, head of marketing for mobile networks at Nokia. "You might have sold a SIM card to a device, a sensor or something like that, but you still sold a SIM card." But Rygaard thinks this approach makes no sense for 5G.

"If we truly want to use 5G to its full potential," she says, "we need to stop selling SIM cards, stop selling the mindset of a subscription and start thinking, 'I'm selling a solution for creating the connectivity in a certain thing.'"

So what does that mean, that 5G is about creating connectivity in things?

After four days at MWC Barcelona 2019, my big takeaway is that 5G is a new solution to the last-mile problem. Building communications backbones—such as laying big fiber optic cables to move terabytes of data—is expensive but relatively straightforward. It's when providers have to think about how to connect every house, every apartment, and every store to that backbone that the expenses really balloon.

And houses and apartments are relatively straightforward, compared to something like a factory. "A factory actually deploys multiple communications systems for each and every use case," says Erik Josefsson, Ericsson's head of advanced industries. "I have factory owners coming and saying, 'It feels like the roof is coming down. I have kilometers of cabling. I have LoRa, Bluetooth, Zigbee, Wi-Fi.' It's getting tough. And that's where the vision with 5G comes in."

With 5G, Josefsson hopes that factories of the future would require little, if any, human interference—instead, robots and conveyor belts inside would communicate with one another, shifting positions and making their own adjustments based on the factory's needs at the time. "I think the industry has high hopes," Josefsson adds, "that this can help simplify complex environments."

So yes, when you upgrade your smartphone in the next year, or two years, or whenever, you'll likely end up with a 5G smartphone. But the key promise is a new way to connect more devices—and more types of devices—without requiring an overwhelming variety of communications technologies. Your smartphone will connect to networks via 5G, and your smart appliances will connect via 5G. So will air quality sensors on streetlamps, manufacturing robots in factories, and VR headsets for museum exhibits. In the years to come, perhaps self-driving cars will navigate city streets with 5G. And all of this means, ideally, that previously unconnected aspects of our lives might work together cohesively, without any hassle.

Of course, it remains to be seen how much of this technological future will come to pass. Service providers around the world are rolling out 5G networks now, but they are very much still a work in progress. It will take time until we see new devices and applications that can tap into these networks once they're finished. When that happens, though, there may be a lot more to be excited about than for any previous wireless generation. Just don't get hung up on the smartphone.

In a demonstration at MWC Barcelona 2019 (formerly called Mobile World Congress), I overcame my anxiety and successfully drove a truck through a modest obstacle course in a parking lot in Götenberg, Sweden, while I sat surrounded by monitors in a conference hall in southern Spain.

Thankfully, Einride, the company behind the truck I was driving, took precautions to make sure I didn't set a new world record for "Instigating a Traffic Accident from the Greatest Distance Away." Those precautions included limiting the top speed of the truck, called a T-pod, to five kilometers per hour regardless of how hard I stepped on the gas, and having an Einride employee on site in Götenberg with a kill switch at the ready.

With a 4G network, driving a truck from half a continent away would be tricky, to say the least. There would be too much latency in the network, forcing you to proceed in fits and starts as you wait for the latest information to arrive each time you step on the gas or turn the wheel.

But now 5G is here. With the 5G network Ericsson provided for Einride's demonstration, the majority of the (barely perceptible) delay came from the time it took for signals to physically travel from Barcelona to Götenberg, and vice versa.

Providers are deploying 5G networks across the globe, and promising more data throughput, lower latency, and higher reliability than ever before. With that in mind, I spent my time at MWC Barcelona 2019 looking at how companies think 5G will impact different industries.

We've heard promises of self-driving cars for years now, and despite having a lot of potential opportunities to connect to and possibly even run on 5G networks, we'll need to wait several more years, at least, to see the full picture of how these two technologies converge. In the immediate future, we can expect 5G's impact on the automotive industry to bolster a human driver's abilities through developments in vehicle-to-vehicle and vehicle-to-environment communications.

Of course, engineers began working on autonomous vehicles long before 5G. There are plenty of self-driving technologies that don't require a vehicle to communicate with its environment. Instead, a vehicle can process all of its data onboard. But according to Erik Josefsson, the head of advanced industries at Ericsson, which sponsored the semi-truck demonstration, this approach doesn't really make sense in the long run. "Why should you have all this computing power on the actual device? It makes it heavier, it makes it more expensive. So the wish is, maybe we dumb down this one and put more in the cloud."

5G can offer high data throughput and low latency to move at least some real-time data processing out of the vehicle itself, just like Josefsson argues. The natural progression, argues Josefsson and Alexander Lautz, Deutsche Telekom's senior vice president for 5G, goes something like this: First, vehicles will communicate with their surroundings over 5G and begin to receive immediate updates from nearby sensors and other IoT devices. Next, vehicles will start supplying data to their surroundings, as well as to other vehicles.

Both steps will bring new ways to improve the human driver's skills. And eventually, the entire network of vehicles, infrastructure, and sensors could become robust enough to move humans to the passenger seat.

When all is said and done, the connected car might be 5G's grandest legacy. "What will be the device that, 10 years from now, we'll look back at as the device of the 5G era?" asks Lautz. "Many think it will be the car. Because the car needs so many elements from the new technologies."

Imagine you're driving toward a red traffic light. Naturally, you'd brake. But what if your car could communicate with the traffic light itself? Cellular vehicle-to-everything (C-V2X) is the concept of connecting a car to other smart devices over cellular networks, as opposed to through other wireless technologies such as dedicated short range communications. If the traffic light could tell you how much time you had before it switched to green, your vehicle could calculate how fast you should go. Rather than braking completely, you might be able drop your speed to 20 kilometers per hour and cruise through intersection as the light turns green.

Of course, you could still be in trouble if a driver decides to try to speed through their red light. That's where vehicle-to-vehicle communications comes in. If the vehicles are also communicating with each other, your car can warn you—perhaps as an alarm or on a head's up display—of unexpected cross traffic. At Qualcomm's booth, this scenario was demonstrated in videos of four C-V2X-equipped vehicles negotiating a four-way stop sign.

The IoT could benefit immensely from large 5G networks with low latency and reliable communications. In fact, as cars become connected, you could think of them as more devices—albeit large ones—in the wider IoT. With enough processing in the cloud, and extremely low-latency signals to and from the vehicle, they could become fully autonomous.

But as Einride and their T-pods demonstrate, even an autonomous vehicle might still need a human operator. The T-pods are capable of autonomous driving in many situations, such as driving down a highway. But remote human operators can also step in to help the truck navigate thornier situations, like unexpected roadwork. In fact, even the best self-driving vehicles may always need humans in the picture.

Like other applications I've looked into this week, it will still take some time before we see the first stages of this autonomous future. Like the rest of the nebulous IoT, as well as augmented and virtual reality, many technical specifications that will impact automobiles are not yet fully laid out. That won't happen until telecom industry association 3GPP publishes Release 16 later this year, which will tackle all the tricky, non-traditional—read, "non-cell phone"—devices that will connect to 5G networks.

Even so, it's hard not to feel like we've turned a corner when it comes to autonomous vehicles. And it's quite possible that, as vehicles gain more and more autonomy, it will fundamentally change how we use our roads.

At one point in our conversation, Deutsche Telekom's Lautz suggested that as cars become autonomous, we'll no longer plot our commutes based on the shortest time or most direct route. Instead, we'll find routes with the best cellular coverage.

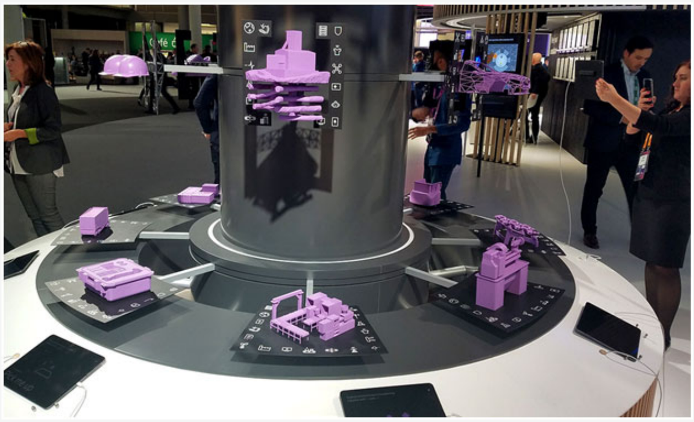
Maybe that won't be the case, but it's hard to deny that, while C-V2X automobiles are still quite far away, they're speeding toward us, fast. Much faster than I drove that T-pod from half a continent away, at least.

Imagine: You're in the back of an ambulance. You have some serious stomach pain. You don't know if it's a burst appendix or just a bug—either way, it hurts.

Because seconds can matter, the emergency room doctor doesn't want to wait until you arrive to start figuring out what's going on. Luckily for you, the ambulance is connected to a 5G network. The EMT on board dons a haptic glove, and at the hospital, the doctor puts her hand on a joystick.

Just like that, the EMT is putting various amounts of pressure on different points on your abdomen with his gloved hand, guided by joystick movements from the doctor. Thanks to this connection, the doctor can figure out the best treatments for you well before you arrive at the hospital.

Today, ambulances aren't connected directly to the Internet. But, if you slap some antennas on one, you can turn it into a node in a 5G network and make any



ambulance part of the Internet of Things (IoT). Specifically, it would become one "thing" in the emerging, 5G-enabled IoT.

5G networks are now being deployed in countries around the world, often with promises of ultrareliable networks and ultralow latencies. This week at MWC Barcelona 2019 (formerly called Mobile World Congress), I wanted to know what these 5G networks will bring to the IoT that 4G, Wi-Fi, and other wireless technologies can't provide.

The answer, as it turns out, is a lot, if you're willing to wait a while longer. And even when the 5G-enabled IoT is here, you'll probably barely notice it.

Before I go any further, I should probably acknowledge that the IoT is such an astoundingly broad term that it can feel practically useless. Or, as Marianne Laurent, head of marketing for Acklio, a company that builds software for IoT networks, told me, the IoT is more or less a "Wild West."

Within that Wild West, however, we can stake out some general regions of interest. Acklio, for example, primarily builds software for low-power, wide-area networks. LPWA networks, as they're called, work best for nodes (or devices) spread over a large geographic area that cannot be easily recharged or supplied with power from the grid, like using ear tags to keep track of cattle.

5G is probably not the best option for LPWA networks for a few reasons. First, because it partly relies on frequencies that don't travel very far, like millimeter waves. And 5G's emphasis on low latency isn't really that important for things like tracking cattle herds, where you only need an update every 10 minutes or so, if that.

It could, however, work for networks that are relatively compact—geographically speaking—or that require low latency or high reliability. In fact, one of the biggest potential opportunities for the 5G-enabled IoT is the smart city (another term that often feels as vague as IoT).

Mike Zeto, the general manager of AT&T Smart Cities, says his definition of a smart city, which has changed over time, includes using data proactively. That could mean analyzing feeds from cameras to improve safety in public spaces or keeping an eye on traffic to clear the way for an ambulance with someone who may have a burst appendix.

Regardless of the particular use, the idea is to use large amounts of datagathered by cameras and sensors to make a city's operations more efficient, without us even being aware of it. You probably won't notice if you only wait 5 seconds for a green light instead of 10 as these 5G-enabled IoT applications operate in the background.

It will still take some time for these applications to appear, though. Not only do citywide 5G networks need to be in place—which is currently true only for a very small handful of cities—the specifics of the devices themselves need to be sorted out.

Much like augmented and virtual reality, many IoT applications for 5G will need to wait for subsequent releases of the specifications that the telecom industry association 3GPP publishes. Release 15 was the latest to be published, in June 2018, and it covered 5G for smartphones and traditional cellular networks. We'll have to wait for Release 16—set to be published later this year—and Release 17 for more details about how to approach 5G for all the esoteric devices and applications the IoT can encompass.

But if you want a glimpse of what kinds of things could be possible once those releases are, well…released, here's one example that highlights what the future might hold.

While at MWC Barcelona 2019, I spoke with Ignacio Contreras, director of 5G marketing, and Danny Tseng, 5G and LTE technical marketing manager, both at Qualcomm, as well as Jane Rygaard, head of marketing for mobile networks at Nokia, and Erik Josefsson, the head of advanced industries at Ericsson.

One thing they were all excited about, without fail, was 5G in factories and manufacturing. Keep in mind, one robot is just a robot. But dozens of robots, working on a factory's assembly lines? That becomes IoT. (I've written separately about how 5G will affect the robotics industry.)

In a factory, reliable connections are incredibly important. The last thing you want is a manufacturing robot to make a mistake on an assembly line due to a missed software update. It would delay production, costing countless dollars while the issue is sorted out. Qualcomm's Contreras and Tseng stressed that one of the most important aspects of 5G will be its ultrareliability—the goal is for 99.9999 percent reliability. (And no, that's not arbitrary. The target is actually, genuinely, honestly six 9s.)

The first ultrareliable connections in factories will be support the wireless communications between more and more sensors. "That is what I would say comes first," says Ericsson's Josefsson. "This is the discussion that's ongoing: How can I get one sensor per square meter? It's unrealistic to put cable to all that."

Then, we could expect factory floors will become more modular, as 5G IoT networks reduce the need for any cabling at all. "Imagine you can just move around your robots and just reconfigure your whole production line," says Nokia's Rygaard. "Imagine one day you're making one product, and you need to change something, you don't need to wait three months for recabling."

The final result, years and years away of course, is what Josefsson calls "black factories." "You're never going to turn on a light in a factory in the future," he says, because the manufacturing robots and conveyor belts will arrange themselves.

Long before we reach that point, however, and regardless of what IoT devices are doing on 5G networks, it seems clear that the goal of 5G-enabled IoT projects will always be efficiency, whether that applies to a city's rush hour traffic or a factory's assembly process. We probably won't even notice many of these incremental changes, even as the world around us runs more smoothly.

"The biggest revolutions," Josefsson says, "you didn't know them. You just saw them when you looked back.

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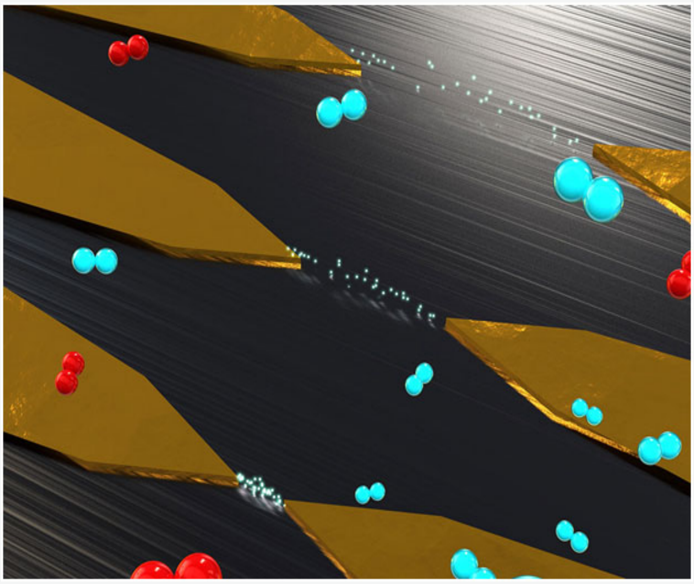
WHAT TO GIVE & TAKE

If you want give,
then give happiness to others,
If you want to take,
then take blessings of others,
If you want to write,
then write to glories of great peoples,
If you want to kil,
then kill overproudness,
If you want to see,
then see own mistakes,
If you want to win,
then win heart of others,
If you want to help,
then help poor & needy peples,
If you want to talk,
then talk sweet to others,
And...
If you want to worship,
Then worship your Mother & Father...

New Metal-Air Transistor Replaces Semiconductors

Pratiksha Anandrao Mane - S. Y. CSE



It is widely predicted that the doubling of silicon transistors per unit area every two years will come to an end around 2025 as the technology reaches its physical limits. But researchers at RMIT University in Melbourne, Australia, believe a metal-based field emission air channel transistor (ACT) they have developed could maintain transistor doubling for another two decades.

The ACT device eliminates the need for semiconductors. Instead, it uses two in-plane symmetric metal electrodes (source and drain) separated by an air gap of less than 35 nanometers, and a bottom metal gate to tune the field emission. The nanoscale air gap is less than the mean-free path of electrons in air, hence electrons can travel through air under room temperature without scattering.

"Unlike conventional transistors that have to sit in silicon bulk, our device is a bottom-to-top fabrication approach starting with a substrate. This enables us to build fully 3D transistor networks, if we can define optimum air gaps," says ShrutiNirantar, lead author of a paper on the new transistor published this month in Nano Letters. "This means we can stop pursuing miniaturization, and instead focus on compact 3D architecture, allowing more transistors per unit volume."

Using metal and air in place of semiconductors for the main components of the transistor has a number of other advantages, says Nirantar, a Ph.D. candidate in RMIT's Functional Materials and Microsystems Research Group. Fabrication becomes essentially a single-step process of laying down the emitter and collector and defining the air gap. And though standard silicon fabrication processes are employed in producing ACTs, the number of processing steps are far fewer, given that doping, thermal processing, oxidation, and silicide formation are unnecessary. Consequently, production costs should be cut significantly.

In addition, replacing silicon with metal means these ACT devices can be fabricated on any dielectric surface, provided the underlying substrate allows effective modulation of emission current from source to drain with a bottom-gate field.

"Devices can be built on ultrathin glass, plastics, and elastomers," says Nirantar. "So they could be used in flexible and wearable technologies."

Replacing the solid-channel transistors in space circuitry is another potential application. Because the electrons flow between the electrodes just as well in a vacuum (think vacuum tube) as in air, radiation will not modulate channel properties, making ACT devices suitable for use in extreme radiation environments and space.

Now that the researchers have proof of concept, the next step is to enhance stability and improve component efficiency by testing different source and drain configurations and using more tolerant materials. In fabricating the prototype ACTs, the researchers used electron-beam lithography and thin-film deposition, while tungsten, gold, and platinum were evaluated as metals of choice.

"We also need to optimize the operating voltage as the electrode metal tips are experiencing localized melting due to concentrated electric fields," notes Nirantar. "This decreases their sharpness and emission efficiency. So we're looking at designs that will increase collector efficiency to decrease stress on the emitter." She believes this can be accomplished over the next two years.

Looking further ahead, she points out that the theoretical speed of an ACT is in the terahertz range, some 10 thousand times as fast as the speed at which current semiconductor devices work. "So further research is needed to find and demonstrate the operational limits," she adds.

As for commercialization, Nirantar says access to industrial fabrication facilities and support from industry to scale up to 3D networks of the transistors will be necessary. "With such help and sufficient research funding, there is the potential to develop commercial-grade field emission air-channel transistors within the next decade—and that's a generous timeline. With the right partners, this could happen more quickly."

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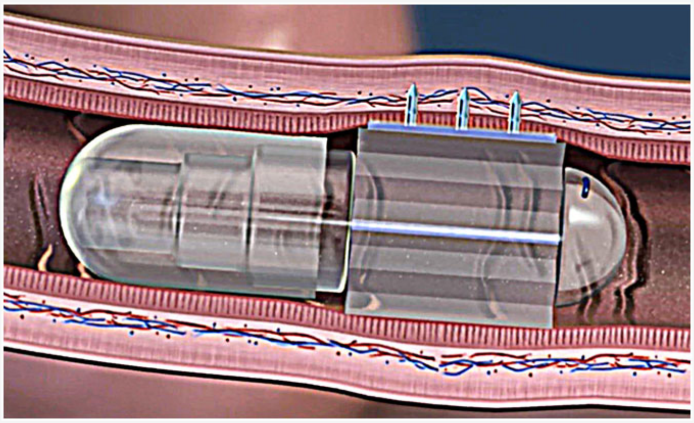
Dr. A. SivathanuPillai - Oversaw the creation of Indigenously developed missile systems

India's self sustaining missile developing programme is called **BrahMOS**. Dr. Pillai developed the concept of the joint venture BrahMOS, which makes India one of the few countries to develop it's own ballistic missiles as well as produce and supply missiles in other key areas of the world. The onset of BrahMOS led to the negation of the absolute power held by Western countries.

Robotic Pills

Arpita Annappa Pujari - S. Y. Electrical



An average person with type 1 diabetes and no insulin pump sticks a needle into their abdomen between 700 and 1,000 times per year. A person with the hormone disorder acromegaly travels to a doctor's office to receive a painful injection into the muscles of the butt once a month. Someone with multiple sclerosis may inject the disease-slowing interferon beta drug three times per week, varying the injection site among the arms, legs and back.

The RaniPill capsule works like a miniature Rube Goldberg device: Once swallowed, the capsule travels to the intestines where the shell dissolves to mix two chemicals to inflate a balloon to push out a needle to pierce the intestinal wall to deliver a drug into the bloodstream.

It may not be simple, but so far, it's working: Imran's company, San Jose-based Rani Therapeutics, just announced the successful completion of the first human study of the pill—a 20-person trial that showed a drug-free version of the capsule (roughly the size of a fish oil pill) was well-tolerated, easy-to-swallow, and passed safely through the stomach and intestines.

"There were no issues in swallowing the capsule, in passing it out, and, most importantly, no sensation when the balloon inflated and deflated," says Imran, Rani's chairman and CEO.

The human trial follows more than 100 animal studies testing over 1,000 capsules filled with all types of large-molecule drugs, such as insulin and Humira, according to the company.

Working from the outside in, the RaniPill consists of a special coating that protects the pill from the stomach's acidic juices. Then, as the pill is pushed into the intestines and pH levels rise to about 6.5, the coating dissolves to reveal a deflated biocompatible polymer balloon.

Upon exposure to the intestinal environment, a tiny pinch point made of sugar inside the balloon dissolves, causing two chemicals trapped on either side of the pinch point to mix and produce carbon dioxide. That gas inflates the balloon, and the pressure of the inflating balloon pushes a dissolvable microneedle filled with a drug of choice into the wall of the intestines. Human intestines lack sharp pain receptors, so the micro-shot is painless.

The intestinal wall does, however, have lots and lots of blood vessels, so the drug is quickly taken up into the bloodstream, according to the company's animal studies. The needle itself dissolves.

The recent human study did not include a drug-filled needle, but the next one, scheduled to begin this year, will include a needle filled with a drug called octreotide for individuals with the hormone disorder acromegaly.

The current study included 10 individuals who ate prior to swallowing the capsule and 10 that fasted. After swallowing the capsule, participants were free to walk around and behave normally, and they paused every 30 minutes to have an X-ray taken to track the progress of the capsule.

Subjects said the pill was easy to swallow, according to Imran, who says he has personally swallowed "quite a few," including without water. Food did not seem to impact the pill's performance other than taking a little longer to get through the stomach of the individuals who had eaten. Participants passed the remnants of the balloon within 1-4 days.

Imran calls the device a robot though it has no electrical parts and no metal. "Even though it has no brains and no electronics, it [works through] an interplay between material science and the chemistry of the body," says Imran. "It performs a single mechanical function autonomously."

For the next version of the RaniPill capsule, Imran and his team are developing tiny wireless sensors for the part of the balloon that pushes the microneedle into the intestinal wall. When applied, the sensors could send a wireless signal that the drug has been delivered, allowing doctors to monitor patient compliance and patients to receive a text message if they miss a dose.

Rani Therapeutics has partnerships with Novartis and Shire, just acquired by Takeda Pharmaceuticals, to test the delivery of various drugs using the platform.

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Dr. HomiJehangirBhabha - The father of the Indian Nuclear Research Programme

India achieved nuclear capability thanks to the efforts of Homi, thereby avoiding certain conflict simply through non aggression treaties. This also made us one of the few nations to have atomic power as a source of energy as well as a way to weaponise.

What's in a Blockchain?

Komal Raju Patil - S. Y. Electrical

As the intrigue of blockchains settles to a quiet simmer, it's time to ask: How far has the technology advanced? Hundreds of new coin species have been minted. Billions of dollars have been raised. And tales have been spun of an encroaching technological revolution.

So, what has it changed? Who is using cryptocurrencies, and how often? How many coins are there? How are they being used? How secure are they? Which networks are thriving and which have withered?

These are questions best asked of data. However, for a technology that promises to bring transparency to the business of moving money, blockchain networks are remarkably opaque. On blockchains like Ethereum and Bitcoin, the complete historical records of financial transactions are out there for anyone to see. But getting your hands on an up-to-date version of them is far from trivial. As is the task of running any kind of analysis.

Recently, a handful of new projects have set out to make it much easier to access and query blockchain data. And by doing so, they may shed light on how far cryptocurrency projects have come and how far they still have to go.

Google is certainly the biggest player to enter the blockchain search field. This month, the company announced that it has made available, through its BigQuery cloud platform, the full data sets from eight of the most active blockchain networks: Bitcoin, Bitcoin Cash, Ethereum, Ethereum Classic, Zcash, Dash, Litecoin, and Dogecoin.

The transactional data for each of these cryotocurrencies is already public, but Google is now providing it in a form that is easily accessible to data scientists.

In the past, if researchers wanted a glimpse into these blockchains, they would need to first spin up a node on the peer-to-peer networks that run them and use that connection to download and parse raw data passed onto them from other nodes in the network.

"For your average data scientist, they don't have the time to run their own node or write their own tools to parse that node to get that data out…and even if they did do that, they'd have to do it every day, just to get the latest data," explains YazKhoury, the director of developer relations for the Ethereum Classic Cooperative, a nonprofit that funds development and outreach in support of the Ethereum Classic network. "They shouldn't have to suffer by setting up all that data engineering infrastructure."

For those lacking the time and resources to download their own copy of a blockchain, there is also the option of browsing a service called an explorer, a primitive search engine that publishes block data online. Multiple explorers are now available for all the major cryptocurrencies, but they come with their own restrictions. On these websites, the data is not presented in a form that is easy to analyze. And though some provide charts visualizing the most basic economic trends, the insights they offer are mostly only of interest to the website owners.

Google is now positioning itself as the place to go if you want to run an analysis without the hassle. By accessing BigQuery, researchers get remote access to blockchains structured in a relational database, updated daily to Google's cloud. Presented in this form, it's then possible to run an analysis with Standard Query Language (SQL), a domain-specific language commonly used by data scientists.

"We converted the blockchain into a database that you can query. That opens it up to a lot of people who never would have touched the blockchain as a structure," says Khoury, who collaborated with Google to bring the Ethereum Classic blockchain data to BigQuery.

With cryptocurrencies like Bitcoin and Litecoin, in which the main function of the network is simply to move value around, this may be enough. However, analysis gets a lot trickier with more complex blockchains like Ethereum.

In addition to standard transactions, blockchains like Ethereum also run smart contracts, code that remotely executes complex applications, called Dapps. However, before any analysis can be performed on these functions, the applications must be decompiled to their source code, a service that BigQuery does not provide.

Developers are now making such tools available outside of the BigQuery platform. Tomasz Kolinko, a developer working on the Ethereumblockchain, has created his own decompiler, called Eveem, which he has been using to load data from contracts back onto BigQuery, where they can then be used for basic analysis.

In this way, BigQuery is functioning as a repository for sharing data beyond what Google itself has to offer.

Kolinko says combining decompiled data from Ethereum, together with BigQuery's search capabilities, will especially empower researchers who want to inspect the security of the Ethereum network.

This year, he has used the two tools in tandem to search for security bugs known to exist in certain contracts and measure their prevalence across the entire network. When the results are pushed into the cloud, he says, it is much more likely that auditors will find vulnerabilities before they cause massive damage to users.

"If there are many more eyes looking at this data…perhaps we can find the contracts that are affected before they gain in size," says Kolinko.

BigQuery, however, is only practical for inspecting data on public blockchains. During the blockchain frenzy of the last two years, much of the innovation has come from private blockchains, networks where participation is restricted to a pool of vetted users.

While you won't find any of these blockchain data sets on Google's BigQuery platform, another company, Hacera, is pushing to make them at least partially transparent.

In a project called Unbounded, Hacera provides a registry where the administrators of private blockchains can list their networks along with a description of what functions they provide. Administrators of private blockchains can also use Unbounded, which is itself a blockchain built on Hyperledger's Fabric, to selectively publish details about their networks, pushing operating data into the public that would otherwise be visible only to a closed group of participants.

There are many reasons to build a private blockchain. Most are run by businesses who have regulatory obligations to keep their client data out of the public view. With Hacera, these companies can choose to publish portions of their data, such as the total transaction volume or the number of participants on their network. Doing so provides some indication of their rate of adoption without running afoul of regulators.

According to Jonathan Levi, the founder and CEO of Hacera, even this small level of transparency will help people in the industry get a better sense of which technologies are available and how they are functioning. In the long run, they may even inspire collaboration, which has been one of the central goals of blockchain enthusiasts from the beginning.

"At the moment, everyone is just trying to create another chain," says Levi. "We're trying to say—let's use what's out there."

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