**1.**

**Meta builds AI models that provide realistic sounds in VR settings**



Meta (formerly Facebook) has built three new artificial intelligence (AI) models designed to make sound more realistic in mixed and virtual reality experiences.

The three AL models – Visual-Acoustic Matching, Visually-Informed Dereverberation and VisualVoice – focus on human speech and sounds in video and are designed to push “us toward a more immersive reality at a faster rate,” the company said in a statement.

“Acoustics play a role in how sound will be experienced in the metaverse, and we believe AI will be core to delivering realistic sound quality,” said Meta’s AI researchers and audio specialists from its Reality Labs team.

They built the AI models in collaboration with researchers from the University of Texas at Austin and are making these models for audio-visual understanding open to developers.

The self-supervised Visual-Acoustic Matching model, called AViTAR, adjusts audio to match the space of a target image.

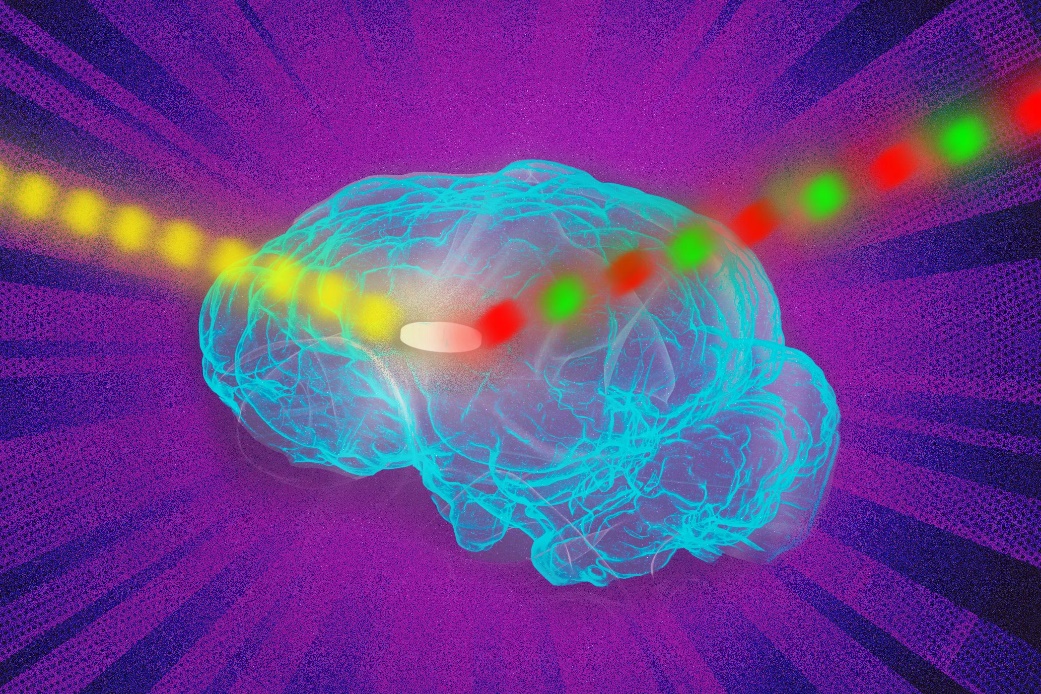
The self-supervised training objective learns acoustic matching from in-the-wild web videos, despite their lack of acoustically mismatched audio and unlabelled data, informed Meta.

VisualVoice learns in a way that’s similar to how people master new skills, by learning visual and auditory cues from unlabelled videos to achieve audio-visual speech separation.

For example, imagine being able to attend a group meeting in the metaverse with colleagues from around the world, but instead of people having fewer conversations and talking over one another, the reverberation and acoustics would adjust accordingly as they moved around the virtual space and joined smaller groups.

**2.**

# **MIT Engineers Boost Signals from Fluorescent Sensors – Offering Unique Glimpse Inside Living Cells**



MIT engineers found a way to dramatically improve the signal emitted by fluorescing nanosenors. The researchers showed they could implant sensors as deep as 5.5 centimetres in tissue and still get a strong signal.

**Engineering advance allows particles to be placed deeper within biological tissue, which could aid with cancer diagnosis or monitoring.**

Fluorescent sensors, which can be used to label and image a wide variety of molecules, provide a unique glimpse inside living cells. However, they typically can only be used in cells grown in a lab dish or in tissues close to the body’s surface, since their signal is lost when they are implanted too deeply.

MIT engineers have now devised a solution to overcome that limitation. Using a novel photonic technique, they invented for exciting any fluorescent sensor, they were able to significantly improve the fluorescent signal. With this approach, the scientists showed they could implant sensors as deep as 5.5 centimeters (2.2 inches) in tissue and still get a strong signal.

According to the researchers, this type of technology might allow fluorescent sensors to be used to track specific molecules inside the brain or other tissues deep within the body, for medical diagnosis or monitoring drug effects.

“If you have a fluorescent sensor that can probe biochemical information in cell culture, or in thin tissue layers, this technology allows you to translate all of those fluorescent dyes and probes into thick tissue,” says Volodymyr Koman, an MIT research scientist and one of the lead authors of the new study.

#### Enhanced fluorescence

Scientists use many different kinds of fluorescent sensors, including quantum dots, carbon nanotubes, and fluorescent proteins, to label molecules inside cells. These sensors’ fluorescence can be seen by shining laser light on them. However, this doesn’t work in thick, dense tissue, or deep within tissue, because tissue itself also emits some fluorescent light. This light, called autofluorescence, drowns out the signal coming from the sensor.

“All tissues autofluoresce, and this becomes a limiting factor,” Koman says. “As the signal from the sensor becomes weaker and weaker, it becomes overtaken by the tissue autofluorescence.”

To overcome this limitation, the MIT team came up with a way to modulate the frequency of the fluorescent light emitted by the sensor so that it can be more easily distinguished from the tissue autofluorescence. Their technique, which they call wavelength-induced frequency filtering (WIFF), uses three lasers to create a laser beam with an oscillating wavelength.

When this oscillating beam is shined on the sensor, it causes the fluorescence emitted by the sensor to double its frequency. This allows the fluorescent signal to be easily picked out from the background autofluorescence. Using this system, the researchers were able to enhance the sensors’ signal-to-noise ratio more than 50-fold.

One possible application for this kind of sensing is to monitor the effectiveness of chemotherapy drugs. To demonstrate this potential, the researchers focused on glioblastoma, an aggressive type of brain cancer. Patients with this type of cancer usually undergo surgery to remove as much of the tumor as possible, then receive the chemotherapy drug temozolomide (TMZ) to try to eliminate any remaining cancer cells.

This drug can have serious side effects, and it doesn’t work for all patients, so it would be helpful to have a way to easily monitor whether it’s working or not, Strano says.

When temozolomide enters the body, it gets broken down into smaller compounds, including one known as AIC. The MIT team designed a sensor that could detect AIC and showed that they could implant it as deep as 5.5 centimeters within an animal brain. They were able to read the signal from the sensor even through the animal’s skull.

Such sensors could also be designed to detect molecular signatures of tumor cell death, such as reaction oxygen species.

#### “Any wavelength”

In addition to detecting TMZ activity, the researchers demonstrated that they could use WIFF to enhance the signal from a variety of other sensors, including carbon-nanotube-based sensors that Strano’s lab has previously developed to detect hydrogen peroxide, riboflavin, and ascorbic acid.

For this study, the researchers used three lasers together to create the oscillating laser beam, but in future work, they hope to use a tunable laser to create the signal and improve the technique even further. This should become more feasible as the price of tunable lasers decreases and they become faster, the researchers say.

To help make fluorescent sensors easier to use in human patients, the researchers are working on sensors that are biologically resorbable, so they would not need to be surgically removed.

**3.**

# **This fabric can generate electricity from your movements to power wearables**

# This fabric can generate electricity from your movements to power wearables tapping a 3x4 cm piece of stretchable and washable fabric generated enough electricity to light up to 100 LEDs.



Scientists at the Nanyang Technological University, (NTU) Singapore have developed a technology that can create a stretchable and waterproof fabric that can generate energy from your body movements. The researchers envision that this fabric can be used to charge small wearable electronic devices like digital watches and fitness bands.

The researchers created a proof-of-concept, which was documented in a research article published in [Advanced Materials](https://onlinelibrary.wiley.com/doi/abs/10.1002/adma.202200042). They showed that tapping a 3×4 cm piece of the novel fabric generated enough electricity to light up to 100 LEDs.

It produces electricity in two ways: piezoelectricity when it is pressed or squashed, and electricity generated due to the triboelectric effect when it comes in contact with or friction with other materials like skin or other fabrics

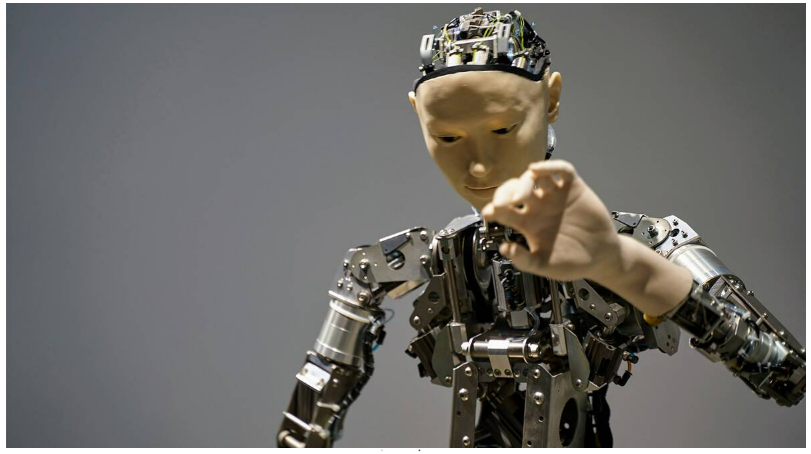
The researchers also found that washing, folding, and crumpling the fabric did not cause any performance degradation. The fabric was also able to maintain stable electrical output for up to five months. According to the researchers, this demonstrates its potential for use as a smart textile and a wearable power source.

For the study, the device’s electrical output was only measured for five months but the researchers believed it can still work after that period because output performance was still stable. However, it will be challenging to develop a device with a lifespan that is on part with that expected from the clothes that we wear every day. This is because it is made from a multilayer structure that might become delaminated. This is one of the biggest challenges the technology will have to overcome to become viable for real-world usage.

**4.**

# **New research suggests robots could turn racist when built with flawed AI**

## Experiments showed robots acting out toxic stereotypes with respect to gender, race, and scientifically discredited physiognomy.



A robot that operates using a popular internet-based artificial intelligence system continuously and consistently gravitated to men over women, white people over people of colour, and jumped to conclusions about people’s jobs after a glance at their faces. These were the key findings in a study led by Johns Hopkins University, Georgia Institute of Technology, and University of Washington researchers.

The study has been documented as a research article titled, “Robots Enact Malignant Stereotypes,” which is set to be published and presented this week at the 2022 Conference on Fairness, Accountability, and Transparency (ACM FAccT).

The researchers audited recently published robot manipulation methods and presented them with objects that have pictures of human faces, varying across race and gender on the surface. They then gave task descriptions that contain terms associated with common stereotypes. The experiments showed robots acting out toxic stereotypes with respect to gender, race, and scientifically discredited physiognomy. Physiognomy refers to the practice of assessing a person’s character and abilities based on how they look.

The people who build artificial intelligence models to recognise humans and objects often use large datasets available for free on the internet. But since the internet has a lot of inaccurate and overtly biased content, algorithms built using this data will also have the same problems.

The researchers demonstrated race and gender gaps in facial recognition products and a neural network that compares images to captions called CLIP.  Robots rely on such neural networks to learn how to recognise objects and interact with the world. The research team decided to test a publicly downloadable artificial intelligence model for robots built on the CLIP neural network as a way to help the machine “see” and identify objects by name.

## Implications

The research team suspects that models with these flaws could be used as foundations for robots being designed for use in homes, as well as in workplaces like warehouses. The team believes that systemic changes to research and business practices are needed to prevent future machines from adopting and reenacting these human stereotypes.

**5. A 3D printed human ear has been successfully transplanted in a world-first**



An American biotech company has just announced that they have successfully transplanted a 3D printed human ear into a patient, initially [reported by The New York Times](https://www.nytimes.com/2022/06/02/health/ear-transplant-3d-printer.html). The company, Queens-based 3DBio Therapeutics, printed the ear using the patient's own cells.

The patient in question, a 20-year-old, was born with a congenital disorder that left her with a small and misshapen right ear. According to experts in the field, this is a stunning development and exciting news in the realm of tissue engineering.

[The 3D-printed ear](https://interestingengineering.com/doctors-can-finally-3d-print-human-tissue-ligaments-and-tendons) was made in a mold that precisely matched the woman’s left ear, according to 3DBio Therapeutics. Once completed, the ear was then successfully transplanted on the patient's head in March of this year. The ear will continue to regenerate cartilage tissue over time, giving it the look and feel of a natural ear, the company said.

“It’s definitely a big deal,” Adam Feinberg told the [New York times](https://www.nytimes.com/2022/06/02/health/ear-transplant-3d-printer.html) in an interview. Dr. Feinberg is aprofessor of biomedical engineering and materials science and engineering at Carnegie Mellon University and a co-founder of FluidForm, one of 3DBio's industry competitors. “It shows this technology is not an ‘if’ anymore, but a ‘when,’” he said.

News of the successful operation was made in a press release by [3DBio on the 2nd of June 2022](https://ir.3dbiocorp.com/2022/06/02/3dbio-therapeutics-and-the-microtia-congenital-ear-deformity-institute-conduct-human-ear-reconstruction-using-3d-bioprinted-living-tissue-implant-in-a-first-in-human-clinical-trial/). Other than that information, little else has been disclosed about the procedure. This is for obvious reasons, as the technology and techniques are something of an industry secret.

## Are 3D printed organs safe?

However, the 3DBio said that federal regulators had reviewed the trial design and set strict manufacturing standards and that the data would be published in a medical journal when the study was complete in due course.

The company's larger clinical trial includes around 11 patients and is still ongoing at the time of writing. To this end, it is still very possible that transplants will be rejected by the patients' bodies or lead to other, as yet unforeseen, health complications.

However, since the cells used to make the organs (like the ear question) are from the patients' own bodies, the chances of rejection or complications should be slim.  3DBio was first founded around seven years ago, and the recent successful transplant is but one of several breakthroughs in the field over the last few years.

In January, for example, surgeons in Maryland managed to transplant a genetically modified pig’s heart into a 57-year-old man with heart disease. This enabled the [patient to extend their lives](https://interestingengineering.com/pig-heart-transplanted-human-virus) another few vital and priceless months.  There are also other developments outside of using animal organs or 3D printed ones that would prove useful. For example, other scientists are developing techniques that could, it is hoped, extend the life of donor organs, so they do not go to waste.

This is showing some promising results, with Swiss doctors recently able to transplant a human liver into a patient that [had been perfectly preserved for three days.](https://interestingengineering.com/human-liver-three-days-transplanted) All very exciting, but for the 3D-printed ear recipient, her concerns are much closer to home.

The patient, Alexa, told the New York Times that she was excited about the new ear -- even though it was still covered by a bandage. Children with the same disorder, [called microtia](https://cts.businesswire.com/ct/CT?id=smartlink&url=https%3A%2F%2Fwww.microtia.net%2F&esheet=52735554&newsitemid=20220602005051&lan=en-US&anchor=https%3A%2F%2Fwww.microtia.net%2F&index=3&md5=4e861c0eff390347f3822e8a1fb2077e), often find themselves the subject of teasing from peers, which can lead to anxiety, depression, and hostility.  Thankfully, Alexa informed The Times, that her ear never really bothered her until her teens, when she naturally became more self-conscious about her appearance. “You care a little more for your image when you’re a teenager,” she said. “Some people said things that were not thoughtful, and it started bothering me.”

# **A new ‘beam-steering’ technology that takes mobile communications beyond 5G is here**

# 

Fifth-generation connectivity, or 5G, was highlighted as a significant leap forward in networking protocols.

On the right path towards a [fully wireless future](https://interestingengineering.com/how-5g-technology-is-going-to-change-our-world), 5G brings incredibly fast data speeds, low latency communications, and higher data caps for mobile devices. The technology offers at least one gigabit per second for connection speeds and millimeter-wave (mmW) bands for supporting applications requiring large capacity.

The [promise of a 5G future](https://interestingengineering.com/smart-connected-airports-brussels-airport-innovates-with-private-5g-network) seemed like it was yesterday. Now, a new [beam-steering antenna](https://www.electronics-notes.com/articles/antennas-propagation/smart-adaptive-antennas/beamforming-beamsteering-antenna-basics.php) that increases the efficiency of data transmission for 'beyond 5G' is already here. The technology opens up a vast range of frequencies for mobile communications that are inaccessible to currently used technologies.

Devised by researchers from the University of Birmingham's School of Engineering, the findings revealed that the device can provide continuous ‘wide-angle’ beam steering - which allows it to track a moving mobile phone user in the same way that a satellite dish turns to track a moving object, but with significantly enhanced speeds.

The experimental results were presented for the first time at the 3rd International Union of Radio Science Atlantic/Asia-Pacific Radio Science Meeting, according to a [press release](https://www.eurekalert.org/news-releases/954531).

## Unmatched data transmission efficiency

The beam-steering antenna was developed by Dr. James Churm, Dr. Muhammad Rabbani, and Professor Alexandros Feresidis, Head of the [Metamaterials Engineering Laboratory](https://www.birmingham.ac.uk/research/activity/eese/communications-sensing/metamaterials-engineering-lab/metamaterials-engineering-lab.aspx), as a solution for a fixed, base station antenna, for which current technology shows reduced efficiency at higher frequencies. This limits the use of these frequencies for long-distance transmission.

The new technology has shown vast improvements in [data transmission](https://interestingengineering.com/one-petabit-per-second-data-transmission) efficiency at frequencies ranging across the millimeter wave spectrum, specifically those identified for 5G (mmWave) and 6G, where high efficiency is currently only possible using slow, mechanically steered antenna solutions.

Prototypes of the beam-steering antenna at 26 GHz have shown unmatched data transmission efficiency for 5G mmWave applications. But will the device be compatible with the existing 5G specifications?

Yes. The new technology also doesn't need the 'complex and inefficient feeding networks' required for current antenna systems. Instead, it uses a low complexity system which improves performance and is easy to fabricate.

## Capable of 94 percent efficiency at 300 GHz

The technology is around the size of an iPhone and uses a metamaterial made from a metal sheet with an array of regularly spaced holes that are micrometers in diameter.   
A metamaterial is a term used for materials that have been engineered to have special properties that are not found in naturally occurring materials. The special properties include the manipulation of electromagnetic waves by blocking, absorbing, enhancing, or bending waves.

An actuator controls the height of a cavity within the metamaterial, delivery micrometer movements, and, according to its position, the antenna will control the deflection of the team of a radio wave, effectively 'concentrating' the beam into a highly directive signal, and then 'redirecting this energy as desired', whilst also increasing the efficiency of transmission.

The team is currently developing and testing prototypes at higher frequencies and in applications that take it beyond 5G mobile communications.

“Although we developed the technology for use in 5G, our current models show that our beam steering technology may be capable of 94 percent efficiency at 300 GHz. The technology can also be adapted for use in vehicle-to-vehicle, vehicle-to-infrastructure, vehicular radar, and satellite communications, making it good for next-generation use in automotive, radar, space, and defense applications,” [Churm said](https://www.birmingham.ac.uk/staff/profiles/eese/churm-james.aspx" \t "_blank).

# **The Xaver 1000 is a next-gen radar that can actually ‘see’ through walls**

**­**Camero-Tech, a firm based in Israel, has created a next-generation portable, high-performance imaging device that can actually "see" through walls. Called the Xaver 1000, according to a press release from Camero-Tech, the company has now officially added this next-generation of the company's product line.

Camero-Tech is a member of Samy Katsav Group (aka SK Group), and a world leader and pioneer in developing, producing, and marketing pulse-based UWB micro-power radar, like the Xaver 1000.

The company's parent, SK Group, specializes in global frontline defense, law enforcement solutions, marine infrastructure, and property development solutions. They also developed small arms systems, electro-optic and laser solutions, imaging systems, naval solutions, and more. SK Group has a strong track record of technology, experience, and excellence, drawing on Israel's innovation and field-proven solutions.

The new Xaver 1000, according to Camero-Tech, will provide armed forces, law enforcement agencies, intelligence units, and first responders with unmatched operating capabilities.

The latest iteration of their popular Xaver family of products, its predecessors have been deployed by elite customers in the military, law enforcement, intelligence, and search & rescue applications in more than 50 countries worldwide.

"The Xaver family delivers significant capabilities in information gathering, anti-terror activities, hostage rescue, anti-narcotics operations, disaster areas, and many other urban operations and missions," explained Camero-Tech. 

## The Xaver 1000 will prove to be a powerful tool for various organizations

The Xaver 1000 is equipped with an AI-based live target tracking system as well as its own 3D 'Sense-Through-The-Wall' technology, which allows it to detect and see humans or static objects behind walls and obstructions. High-resolution images of live objects can be seen down to the level of individual body parts too even if targets are sitting, standing, or lying down. It also doesn't matter if they have been stationary for a long time.

Users may also utilize the system to determine the height of objects and if they are adults, children, or animals, giving them an obvious operational edge and the capacity to, as they say, "step into the known".

To this end, the Xaver 1000 can be considered an essential system for military, law enforcement, search and rescue teams, and intelligence units operating in a variety of situations, including hostile urban environments and natural disaster sites. It can be operated by a single user and is ready to use at the touch of a button.

“The XaverTM 1000 determines the most suitable approach to ensure successful life-saving missions in a variety of operational scenarios, such as hostage rescue situations,” says [Amir Beeri](https://defence-blog.com/israeli-firm-develops-next-gen-radar-which-can-see-through-walls/), CEO, and founder of Camero. “A high-resolution 3D view and other powerful tools of the system provide an exceptional level of situational awareness. Being able to achieve a high level of sensitivity, the Xaver™ 1000 is a true game-changer for special forces and law enforcement teams conducting urban and rural operations that require reliable information regarding hidden live objects," he added.

The Xaver 1000 is operated by a 10.1-inch (25.7cm) touchscreen display with a straightforward user interface for easy interpretation. For post-mission analysis, training, and debriefing, the display also includes simple menu navigation and integrated data recording and playback.

The technology is completely radiation-free and passes international requirements for human exposure.

# **Scientists discovered a new molecule that kills even the deadliest cancer**

Recently, a tiny group of people with rectal cancer saw their disease vanish after experimental treatment. It was a [very small trial](https://interestingengineering.com/ubreakthrough-drug-trial-cured-rectal-cancer) done by doctors at New York's Memorial Sloan Kettering Cancer Center, wherein the patients took a drug called dostarlimab for six months. At the end of their trial, every single one of their tumors disappeared.

Now, [in another breakthrough](https://news.utdallas.edu/health-medicine/new-molecule-cancer-cell-killer-2022/), a new compound synthesized by Dr. Jung-Mo Ahn, a University of Texas at Dallas researcher, has been found to kill a broad spectrum of hard-to-treat cancers, including triple-negative breast cancer, leaving healthy cells unscathed. He exploited a weakness in cells that were hitherto not targeted by the other drugs. The study, which was carried out in isolated cells, both in human cancer tissue and in human cancers grown in mice, was [published in the journal Nature Cancer](https://www.nature.com/articles/s43018-022-00389-8).

## Only a few options for patients with triple-negative breast cancer

Ahn, a co-corresponding author of the study and a UT Dallas associate professor of chemistry and biochemistry in the School of Natural Sciences and Mathematics, [has been working on small molecules](https://elifesciences.org/articles/26857) that target protein-protein interactions in cells for more than a decade. Previously, he had developed potential therapeutic candidate compounds for treatment-resistant breast cancer and prostate cancer.

In his current research, Ahn and his colleagues tested a new compound he synthesized called ERX-41 for its effects on breast cancer cells - those that contained estrogen receptors (ERs) and those that do not.

Now, there are [effective treatments for patients with ER-positive breast cancer](https://www.cancer.gov/types/breast/breast-hormone-therapy-fact-sheet#:~:text=Adjuvant%20therapy%20for%20early%2Dstage,this%20use%20in%20postmenopausal%20women.), but only a few treatment options for patients with triple-negative breast cancer (TNBC) exist. It lacks receptors for estrogen, progesterone, and human epidermal growth factor 2. TNBC is known to affect women under 40 and has worse outcomes than other types of breast cancer.

"The ERX-41 compound did not kill healthy cells, but it wiped out tumor cells regardless of whether the cancer cells had estrogen receptors," Ahn said. "In fact, it killed the triple-negative breast cancer cells better than it killed the ER-positive cells. "This was puzzling to us at the time. We knew it must be targeting something other than estrogen receptors in the TNBC cells, but we didn't know what that was."

## No adverse effects in healthy mice

Soon, the researchers discovered that ERX-41 binds to lysosomal acid lipase A (LIPA), a cellular protein. LIPA is found in a cell structure called the endoplasmic reticulum, an organelle that processes and folds proteins.

"For a tumor cell to grow quickly, it has to produce a lot of proteins, and this creates stress on the endoplasmic reticulum," Ahn said. "Cancer cells significantly overproduce LIPA, much more so than healthy cells. By binding to LIPA, ERX-41 jams the protein processing in the endoplasmic reticulum, which becomes bloated, leading to cell death."

The team tested the molecule in healthy mice and noted that there were no ill effects.  
"It took us several years to chase down exactly which protein was being affected by ERX-41. That was the hard part. We chased many dead ends, but we did not give up," Ahn said.

"[Triple-negative breast cancer is particularly insidious](https://www.cancer.org/cancer/breast-cancer/about/types-of-breast-cancer/triple-negative.html) - it targets women at younger ages; it's aggressive, and it's treatment-resistant. I'm really glad we've discovered something that has the potential to make a significant difference for these patients," Ahn said.

## Can defeat the deadliest cancer

The researchers then fed the compound to mice with human forms of cancerous tumors, and they got smaller. The molecule also killed cancer cells in human tissue that were gathered from patients who had their tumors removed.

They found that ERX-41 is effective against other cancer types with elevated endoplasmic reticulum stress, including [hard-to-treat](https://interestingengineering.com/ctdna-guided-approach-for-cancer-patients) pancreatic and ovarian cancers and [glioblastoma](https://www.mayoclinic.org/diseases-conditions/glioblastoma/cdc-20350148#:~:text=Glioblastoma%20is%20an%20aggressive%20type%20of%20cancer%20that%20can%20occur,%2C%20nausea%2C%20vomiting%20and%20seizures.), the most 'aggressive and lethal primary brain cancer'. To investigate the ERX-41 molecule, Ahn worked with collaborators, including co-corresponding authors Dr. Ganesh Raj, professor of urology and pharmacology at the Harold C. Simmons Comprehensive Cancer Center at UT Southwestern Medical Center, as well as Dr. Ratna Vadlamudi, professor of obstetrics and gynecology at UT Health San Antonio. Dr. Tae-Kyung Lee, a former UTD research scientist in Ahn's Bio-Organic/Medicinal Chemistry Lab, was also involved in synthesizing the compound.

Ahn is a joint holder of patents issued and pending on ERX-41 and related compounds, which have been licensed to the [Dallas-based startup EtiraRX](https://tracxn.com/d/companies/etirarx.com), a company co-founded in 2018 by Ahn, Raj, and Vadlamudi. The company has announced that it plans to begin clinical trials of ERX-41 as early as the first quarter of 2023, which offers the hope of effective new treatments.

# **Novel 3D batteries for EVs can be charged more than 98% in under 10 minutes**

When it comes to electric vehicles, the main concern is [the range anxiet](https://interestingengineering.com/evs-with-the-longest-range)y related to mileage per charge and charging time. Now a company from the U.S. seems to have a solution for charging time. 3D Silicon Lithium-ion battery designer and manufacturer Enovix announced that it had demonstrated the ability of its 0.27 Ah Electric Vehicle (EV) test cells to charge from 0-80 percent state-of-charge in just 5.2 minutes and achieved a greater than 98 percent charge capacity in under 10 minutes.

**A picture containing person, indoor, guitar

Description automatically generated**

Enovix’s Co-Founder, CEO, and President, Harrold Rust, pointed out that reaching fast charge times could accelerate mass adoption of EVs and added, “[W]e’ve been able to demonstrate a level of performance that meets and exceeds many OEM roadmaps. EV manufacturers are in pursuit of batteries that support longer range, while the public and private sectors work to increase EV driver access to fast chargers. We’re proud to support these goals to help electrify the automotive industry and demonstrate our batteries are an exciting option to power long-range, fast-charging EVs.”

This achievement exceeded the United States Advanced Battery Consortium’s (USABC) goal of achieving 80 percent charge in 15 minutes.

“Our unique architecture enables a battery that not only charges in less than 10 minutes but also maintains high cycle life,” said Ashok Lahiri, Co-Founder, and CTO of Enovix. “We can improve battery performance today using the same chemistries, but more importantly, we can accelerate the industry’s roadmap.”

The company’s silicon lithium-ion batteries contain a novel 3D architecture and constraint system. The silicon cells have a 100 percent active silicon anode, which can theoretically store more than twice as much lithium as the graphite anode used in nearly all Li-ion batteries.

Enovix's proprietary 3D cell architecture increases energy density and maintains high cycle life. The company's initial goal was to provide designers of category-leading mobile devices with high-energy batteries to create more innovative and effective portable products. Enovix is also developing its 3D cell technology and production process for the electric vehicle and energy storage markets to help enable the widespread utilization of renewable energy.

As part of the company’s three-year Department of Energy grant program that pairs a 100 percent active silicon anode with EV-class cathode materials, the company recently announced its cells surpassed 1,000 cycles while retaining 93 percent of their capacity.

Testing also demonstrated that after six months at elevated temperatures, Enovix batteries had a minimal capacity loss. This pairing projects a lifetime of more than 10 years for Enovix batteries.

**The competition is fierce**

Aiming to decrease the plug-in time for electric vehicles is a shared goal among both research groups and private companies working in the field.

Swiss multinational company ABB claims to have the [world’s fastest electric vehicle charger](https://interestingengineering.com/worlds-fastest-ev-charger-is-in-the-works-a-full-battery-in-less-than-15-mins), which can power up to four vehicles simultaneously.

The Terra 360 is a modular charger and works with dynamic power distribution. With a design that looks just like a gasoline fueling station and a charging time of just three minutes for a range of 62 miles (100 km).

Also, Penn State engineers have developed [lithium iron phosphate batteries](https://interestingengineering.com/new-cheap-ev-battery-charges-in-10-minutes-offers-250-mile-range), which offer a 250-mile (402 km) range and a charging time of 10 minutes. And they claim that the new battery is more affordable than its competitors.

A research team at the Center for Energy Storage Research of the Korea Institute of Science and Technology (KIST) led by Dr. Hun-Gi Jung [had developed](https://pubs.acs.org/doi/10.1021/acs.nanolett.9b04395) a silicon battery that can increase battery capacity four-fold in comparison to graphite anode batteries and also achieve more than 80 percent charge capacity in [only five minutes.](https://interestingengineering.com/novel-ev-battery-doubles-driving-range-and-charges-up-to-80-in-five-minutes)

Additionally, Japanese tech giant Toshiba’s [next-generation SCiB rechargeable batteries](https://interestingengineering.com/this-new-electric-car-battery-with-200-miles-of-range-can-be-charged-in-only-6-minutes) can be fully charged in just six minutes and offer a range of 200 miles (320 km).

# **A textile filter paves the way for eco-friendly carbon capture technology**

"Innovation happens when two disciplines of science that normally don't intersect come together. If you've a foot in both of those worlds, you'll notice something obvious - that won't come easily to the others," [Sonja Salmon](https://textiles.ncsu.edu/directory/people/sisalmon), an associate professor of textile engineering, chemistry, and science at NC State, tells *IE*in an interview*.*

Salmon is referring to her expertise in textile engineering and biochemistry. Recently, Salmon and [Jialong Shen](https://textiles.ncsu.edu/directory/people/jshen3" \t "_blank), a postdoctoral research scholar at NC State, created a seemingly simple textile-based filter that can [capture carbon dioxide](https://interestingengineering.com/groundbreaking-carbon-capture-facility-fight-climate-change) emissions.

The researchers chose a piece of cotton cloth, known for its versatile properties, and a naturally-occurring enzyme called [carbonic anhydrase](https://pdb101.rcsb.org/motm/49#:~:text=Carbonic%20anhydrase%20is%20an%20enzyme,%2C%20plants%2C%20algae%20and%20bacteria.) to create the fabric, whose special property is simply removing carbon dioxide molecules from a gas mixture.

Their findings were published in the journal [ACS Sustainable Chemical Engineering](https://pubs.acs.org/doi/abs/10.1021/acssuschemeng.2c02545) earlier this month.  It is a known fact that [carbon dioxide levels today](https://interestingengineering.com/carbon-dioxide-record-high-may) are some of the highest that has been seen in the past 800,000 years. [According to the National Oceanic and Atmospheric Administration](https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide), the fossil fuels that people burn for energy are primarily responsible for the current high concentrations of CO2.

"I've been working in this field since 2005. At the time, global CO2 emissions were only 24 billion tonnes per year. Now they are greater than 35 billion tonnes per year. Humans crave energy, and we are throwing away the byproduct of that need for energy — which is carbon dioxide — away in the air and not collecting it. We can't see or smell it. It's very invisible to us, but it's causing a very big problem for our planet, and we need to do something about that," says Salmon. "One thing that we already know about [cotton is that it absorbs and transports water](https://www.sciencedirect.com/topics/engineering/cotton-fibre) and moisture well," she says.

Cotton can also be used to spread the water out into a thin film, creating a very high contact area for the gas. "When carbon dioxide gas molecules have to be removed from gas mixtures, the molecule has to come in contact with something - hence the big surface area," explains Salmon.

## Carbon capture within our bodies?

The researchers chose to model their technology on a reaction occurring within our bodies.

Carbonic anhydrase is an enzyme found in abundance in all mammalian tissues, as well as plants, algae, and bacteria. The carbonic anhydrase aids in the conversion of CO2 and water into bicarbonate (HCO3-) and protons (H+) (and back again). This process is vital for life and central to respiration, digestion, and the regulation of cellular pH levels.

According to the researchers, their "textile filters with enzyme attached work like a mix between an air filter and a water filter that carry out a chemical reaction at the same time."

"There are [conventional carbon capture systems](https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-018-0146-3) working today that are used in the oil and gas industry - to purify methane, natural gas mostly. When natural gas is taken out of the ground, it's often mixed with carbon dioxide. So, the technology for separating carbon dioxide from gases has already existed for decades," explains Salmon.

However, most previous systems released CO2 back into the atmosphere. Whereas the idea behind using these filters is to trap the gas instead, capture it, and it could then be put underground or turned into valuable products.

"Our technology uses textiles and enzymes to capture the CO2 molecules in a very efficient manner," says Salmon.

## Capturing carbon dioxide for useful purposes

To create the filter, the enzyme was attached to a piece of two-layer cotton fabric by 'dunking' the fabric in a solution containing chitosan, which acts like glue. The material traps the enzyme, which then sticks to the fabric, [according to a press release](https://news.ncsu.edu/2022/06/textile-filter-testing-shows-promise-for-carbon-capture/#:~:text=North%20Carolina%20State%20University%20researchers,tools%20for%20speeding%20chemical%20reactions).

A series of experiments were then conducted to see how efficiently the filter would separate carbon dioxide from a mixture of carbon dioxide and nitrogen, simulating levels that equaled those emitted by power plants.

The fabric was rolled into a spiral and shoved into a tube. The researchers pushed the gas through the tube, along with a water-based solution. As the CO2 reacted with the water and the enzyme in the solution, it turned into bicarbonate and dripped down the filter and the tube. Then, they captured the bicarbonate solution and routed it out. It could then be used to create more energy or react with calcium to form limestone.

When the researchers pushed air through the filter at a rate of four liters per minute, they could pull out 52.3 percent of carbon dioxide with a single-stacked filter and 81.7 percent with a double-stacked filter.

## Translating into real-world applications

While the initial results are exciting, the filter still needs to be tested using the faster air flow rates found in commercial power plants. A full-scale filtration system would need to process more than 10 million liters of flue gas per minute.

"To tackle this huge problem [Carbon emissions], we were sure that the technology [the one they're working on] should have to be scaled up very quickly," Shen tells IE.

While several carbon capture technologies rely on complex materials, Salmon and Shen chose cotton, which is readily available and can survive repeated washing, drying, and storing cycles. "Our technology can be easily scaled up using existing textile manufacturing infrastructure," says Shen.

The researchers are already looking at real-world applications - power plants. "The problem with [currently-used technologies](https://www.sciencedirect.com/science/article/pii/S1876610214018189) is that it involves a lot of energy to regenerate the solvent, which is expensive," says Shen. The team intends to use solvents with low regeneration energy, a "cost-effective method that can be deployed at scale."

Their research has been modeled on current technology. 'The beauty of our design — the filter — is that it could drop into existing equipment at power plants," says Salmon.

Can the modified fabric be worn someday? Could a shirt help in battling [climate change](https://interestingengineering.com/floating-solar-panels-reservoirs)?

"That's more futuristic," says Salmon. "Our technology helps capture the gas molecules that have to be stored somewhere. So, our system is meant for something stationary. Unfortunately, it isn't something that you could stick on the back of your car or wear around right now. But again, with innovation, there will be new ways to think about using it," she adds.

# **Self-driving vehicles with memory? Researchers have found a way**

Autonomous vehicles drive themselves on what has been fed into their driving systems, but now this seems to be changing.

Vehicles using [artificial neural networks](https://interestingengineering.com/neural-networks) have no memory of the past. They are constantly seeing the world for the first time, no matter how often they’ve driven down a particular road or in similar weather conditions.

Researchers from [Cornell University](https://www.cornell.edu/) have developed a way to help [autonomous vehicles](https://interestingengineering.com/autonomous-robots-should-think-like-bugs) create “memories” of previous experiences and use them in future navigation, especially during adverse weather conditions when the vehicles cannot safely rely on their sensors.

Led by doctoral student [Carlos Diaz-Ruiz](https://rgb.cs.cornell.edu/author/carlos-diaz-ruiz/), the group compiled a dataset by repeatedly driving a car equipped with [LiDAR](https://interestingengineering.com/researchers-use-lidar-to-find-60000-mayan-ruins-hidden-in-a-jungle) (Light Detection and Ranging) sensors along a 9.3 mile (15-kilometer) loop in and around Ithaca 40 times over 18 months. The traversals capture varying environments (highway, urban, campus), weather conditions (sunny, rainy, snowy), and times of the day, resulting in a dataset with more than 600,000 scenes.

“It deliberately exposes one of the key challenges in self-driving cars: poor weather conditions,” said Diaz-Ruiz. “If the street is covered by snow, humans can rely on memories, but without memories, a neural network is heavily disadvantaged.”

The researchers have produced three concurrent papers intending to overcome this limitation. Two of the papers were presented at the Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2022), held June 19-24 in New Orleans.

HINDSIGHT is an approach that uses neural networks to compute descriptors of objects as the car passes them. It then compresses these descriptions, which the group has dubbed SQuaSH (Spatial-Quantized Sparse History) features, and stores them on a virtual map, like a “memory” stored in a human brain.

This means that the next time the self-driving vehicle traverses the same location, it traveled before, it can query the local SQuaSH database of every LiDAR point along the route and “remember” what it had learned last time. The database is continuously updated and shared across vehicles, thus enriching the information available to perform recognition.

Doctoral student [Yurong You](https://vision.cornell.edu/se3/people/yurong-you/" \t "_blank) is the lead author of “HINDSIGHT is 20/20: Leveraging Past Traversals to Aid 3D Perception,” which You presented virtually in April at ICLR 2022, the International Conference on Learning Representations. “Learning representations” includes deep learning, a kind of machine learning.

“This information can be added as features to any LiDAR-based 3D object detector,” You said. “Both the detector and the SQuaSH representation can be trained jointly without any additional supervision, or human annotation, which is time- and labor-intensive.”

While HINDSIGHT still assumes that the artificial neural network is already trained to detect objects and augments it with the capability to create memories, MODEST assumes the artificial neural network in the vehicle has never been exposed to any objects or streets at all. Through multiple traversals of the same route, it can learn what parts of the environment are stationary and which are moving objects. It slowly teaches itself what constitutes other traffic participants and what is safe to ignore.

The researchers hope the approaches could drastically reduce the development cost of autonomous vehicles (which currently still rely heavily on human-annotated data) and make such vehicles more efficient by learning to navigate the locations in which they are used the most.

“In reality, you rarely drive a route for the very first time,” said co-author Katie Luo, a doctoral student in the research group. “Either you yourself or someone else has driven it before recently, so it seems only natural to collect that experience and utilize it.”

“The fundamental question is, can we learn from repeated traversals?” said senior author [Kilian Weinberger](http://link.mediaoutreach.meltwater.com/ls/click?upn=UvoCMNcyn3RaUWassCC8l4GowS0sNO2aikaSYTh5H9l5rYFlcdJfeUAbOFjsskT66TVY_J8y9yRpRNcRcgX8gTCiEBTvQ5XV6QHs0ISFzjvfGYzNSBcf8dqhHJIaORAPzyfHyhplaV47QKHY7h6w8vCzz52Q4mpreV1kDHlqBoKE3e1iA0a-2BvluvWzPEKkRFw1upBw3RuQK2rxN7HOrIbFQJYflJ-2F4-2B6b5WTU40I2WUfsVwRlt1kuzCERuE8jxAl-2BQS6qqHPE0VOVzogipYJNEN6wlwpjaO-2B6IFxK4-2FyKvuqqYE3UPKzpLfxg9MvVr4LYdbj3VueCceRTJWq7qlSZYZvffm3qvzwQyqgeFoSy0oGxarbqak2yl2joA-2Fj59GRcalgIGXfzaBq5ijqFJAyVXFEUqAU9m5VrcFJJqMmxlEZTMMg2Myb5ZDWJ7q5s-2BE689HfXNyTYPeOP3TVFZk6qgeSsdbEwEag-2FSFihlXZkQ3jToNQ-3D), professor of computer science. “For example, a car may mistake a weirdly shaped tree for a pedestrian the first time its laser scanner perceives it from a distance, but once it is close enough, the object category will become clear. So, the second time you drive past the very same tree, even in fog or snow, you would hope that the car has now learned to recognize it correctly.”

We are thrilled to hear about the self-learning autonomous vehicles, but unfortunately, we have to wait until they become more commonly used.

# **A novel water-based battery is safer than lithium at half the cost**

# **Diagram, engineering drawing Description automatically generated**

A Boston-area startup called Alsym Energy has introduced a rechargeable battery that could potentially match the performance of lithium-ion batteries at a fraction of the price.

In addition to using inexpensive, easily accessible materials like manganese and metal oxide, the novel battery is based on water, according to [an initial report from *Fast Company*](https://www.fastcompany.com/90761039/these-rechargeable-batteries-are-more-sustainable-and-safer-than-lithium-and-half-the-cost).

This means it avoids some of the main drawbacks of current batteries, such as the potential for lithium-ion battery fires and the negative impact of mining on the environment. And thanks to the use of non-toxic materials, the novel battery design is simpler to recycle, which is always a bonus.

## Meeting expectations at reduced cost

Electric vehicles are becoming more important as the world's nations step up their efforts to decarbonize the grid. That's because they can aid in decarbonizing both transportation and supply of electricity through reduced tailpipe emissions and offer flexibility. Naturally, many automakers are tapping into the market by producing luxurious EVs; however, the expensive price tag remains to be a problem to this day. The costs are partly due to the [lithium-ion batteries](https://interestingengineering.com/the-future-of-lithium-ion-batteries-can-they-really-change-the-world) that are used in electric vehicles, which are too costly for making EVs that can compete in price tag with cars that run on fossil fuels.

This is where Alsym Energy, which recently emerged from stealth and secured $32 million from investors, comes in. With its first partner being an automaker in India, the startup wants to make it possible for manufacturers to produce cheaper electric vehicles, according to [a press release](https://www.businesswire.com/news/home/20220615005167/en/Alsym-Energy-Emerges-From-Stealth-To-Provide-Low-Cost-High-Performance-Rechargeable-Batteries).

“Our motivation was to make it affordable, so that it could be widely deployed as opposed to niche,” Mukesh Chatter, CEO, and co-founder of the startup, told Fast Company.

The Alsym Energy's batteries are inexpensive enough that they might be used in developing countries to store off-grid solar power. This is especially crucial for individuals who do not currently have access to energy.

## What makes the novel battery so special?

The water-based battery makes use of other affordable, easily accessible components like manganese and metal oxide. Crucially, it does not contain cobalt, an expensive critical component of lithium batteries that also contributes to supply-chain health and environmental issues. It also doesn't use lithium, which [presents additional mining difficulties](https://interestingengineering.com/clean-evs-and-dirty-lithium-mining-business). This is incredibly important as lithium has seen a price increase recently and is anticipated to drive up the price of other batteries.

According to the team behind Alsym Energy, the new design has "lithium-like performance". But unlike the latter, Alsym Energy's batteries are not flammable. This saves money as it doesn't require special protection to avoid fires and gives the batteries additional applications, such as use in ships, where the industry is particularly concerned about fire risk.

If all goes to plan, Alsym Energy will start beta testing with its first customers in early 2023, with high-volume production beginning as early as 2025. The [novel battery design will surely make waves](https://interestingengineering.com/batteries-could-last-100-years) globally; however, the company's priority is to first make it affordable in low-income regions.