SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

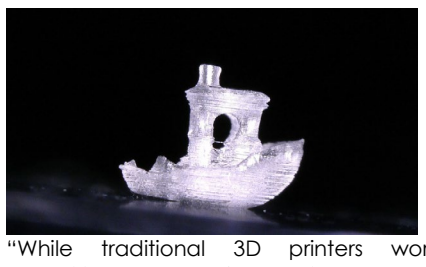
Weekly Discovery

We SHARE to inspire and ignite ideas!

17 Feb – 21 Feb 2025

3D PRINTING

Holograms boost 3D printing efficiency and resolution



"While traditional 3D printers work by depositing layers of material, tomographic volumetric additive manufacturing (TVAM) involves shining laser light at a rotating vial of resin until it hardens where accumulated energy exceeds a certain threshold. An advantage of TVAM is that it can produce objects in a matter of seconds, compared to around 10 minutes for layer-based 3D printing. But a disadvantage is that it is very inefficient, because only around 1% of the encoded light reaches the resin to produce the desired shape.

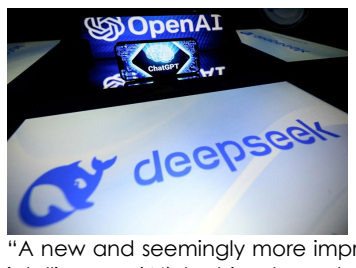
Researchers from EPFL's Laboratory of Applied Photonic Devices, led by Christophe Moser, and from the University of Southern Denmark Centre for Photonics Engineering, led by Jesper Glückstad, have reported a TVAM method in Nature Communications that significantly reduces the amount of energy required to fabricate objects, while simultaneously boosting resolution. The technique involves projecting a three-dimensional hologram of a shape onto the spinning vial of resin. Unlike traditional TVAM, which encodes information in the amplitude (height) of projected light waves, the holographic method takes advantage of their phase, or position.

This small change has a big impact. "All pixel inputs are contributing to the holographic image in all planes, which gives us more light efficiency as well as better spatial resolution in the final 3D object, as the projected patterns can be controlled in the projection depth," Moser summarizes."

Source: EPFL (17 Feb 2025)

AI

What are the best AI tools for research? Nature's guide



"A new and seemingly more impressive artificial intelligence (AI) tool is released almost weekly, and researchers are flocking to try them out. Whether they are looking to edit manuscripts, write code or generate hypotheses, researchers have more generative AI tools to choose from than ever before.

Each large language model (LLM) is suited to different tasks. Some are available through free chatbots, whereas others use a paid-for application programming interface (API) that means they can be integrated with other software. A few can also be downloaded, allowing researchers to build their own custom models.

Although LLMs produce human-like responses, they all remain too error-prone to be used on their own, says Carrie Wright, a data scientist at the Fred Hutchinson Cancer Center, headquartered in Seattle, Washington.

So which LLM is best for what task? Here, researchers share their current favourites with Nature to help guide those in need."

Source: Nature (17 Feb 2025)

AI & CONSERVATION

Can artificial intelligence save the Great Barrier Reef?

"Australian researchers are designing a global real-time monitoring system to help save the world's coral reefs from further decline, primarily due to bleaching caused by global warming.

Coral reefs worldwide are dying at an alarming rate, with 75% of reefs experiencing bleaching-level heat stress in the past two years.

The World Heritage-listed Great Barrier Reef (GBR), considered the jewel in the crown of coral reefs worldwide and one of Australia's most significant ecological and tourism assets, has been decimated by severe bleaching events since 2016, exacerbated by ongoing crown-of-thorns starfish outbreaks and coastal development.

A collaborative project led by the University of South Australia (UniSA), with input from Queensland and Victorian researchers, is integrating remote sensing technologies with machine learning, artificial intelligence and Geographic Information Systems (GIS) to monitor and hopefully stall the damage to the world's most fragile marine ecosystems.

A multimodal platform will distil all research data relating to coral reefs, including underwater videos and photographs, satellite images, text files and time-sensor readings, onto a central dashboard for real-time global monitoring.

UniSA data analyst and lead researcher Dr Abdullahi Chowdhury says that a single centralised model will integrate all factors affecting coral reefs and provide environmental scientists with real-time predictions."

Source: UNISA (13 Feb 2025)

AI & MATERIALS

Research Uses AI to Make Infrastructure More Resilient, Sustainable

""We're trying to optimize the use of recycled materials, industrial by-products, renewable resources and alternative sustainable materials in construction while reducing not only physical cost, but labor costs, energy costs, environmental impact costs and lifecycle maintenance expense as well."

In one of his most recent publications, Behnood and Abolfazl Afshin, an Ole Miss doctoral student in civil engineering from Zahedan, Iran, tested different artificial intelligence algorithms' abilities to predict how well asphalt pavements with reclaimed asphalt pavement materials could withstand moisture.

When water seeps into asphalt, it can break the bonds that hold the materials together. In its weakened state, the asphalt is more likely to crack or otherwise fail, Afshin said.

"We focused on moisture damage, which is one of the most critical issues in asphalt pavements, particularly for wet and cold regions, because it results in a variety of distresses like stripping, potholes and cracking," he said. "We evaluated the effectiveness of four different artificial intelligence algorithms in predicting moisture damage in asphalt mixtures containing (reclaimed asphalt pavement) materials.

"What we found was that these algorithms are able to effectively predict moisture damage in asphalt mixtures with high accuracy. Based on these results, we can optimize material selection and predict failure probability in the pavement's life cycle."

Source: OLEMISS(15 Feb 2025)

AI AGENTS

Are You Ready to Let an AI Agent Use Your Computer? AI agents from OpenAI, Anthropic, and Google want to lighten your load

"Two years after the generative AI boom really began with the launch of ChatGPT, it no longer seems that exciting to have a phenomenally helpful AI assistant hanging around in your web browser or phone, just waiting for you to ask it questions. The next big push in AI is for AI agents that can take action on your behalf. But while agentic AI has already arrived for power users like coders, everyday consumers don't yet have these kinds of AI assistants.

That will soon change. Anthropic, Google DeepMind, and OpenAI have all recently unveiled experimental models that can use computers the way people do—searching the web for information, filling out forms, and clicking buttons. With a little guidance from the human user, they can do thinks like order groceries, call an Uber, hunt for the best price for a product, or find a flight for your next vacation. And while these early models have limited abilities and aren't yet widely available, they show the direction that AI is going.

"This is just the AI clicking around," said OpenAI CEO Sam Altman in a demo video as he watched the OpenAI agent, called Operator, navigate to OpenTable, look up a San Francisco restaurant, and check for a table for two at 7pm.

Zachary Lipton, an associate professor of machine learning at Carnegie Mellon University, notes that AI agents are already being embedded in specialized software for different types of enterprise customers such as salespeople, doctors, and lawyers. But until now, we haven't seen AI agents that can "do routine stuff on your laptop," he says. "What's intriguing here is the possibility of people starting to hand over the keys.""

AIR QUALITY

Air inside your home may be more polluted than outside due to everyday chemical products

"WEST LAFAYETTE, Ind. — When you walk through a pine forest, the crisp, fresh scent is one of the first things you notice.

But bringing that pine scent or other aromas indoors with the help of chemical products — yes, air fresheners, wax melts, floor cleaners, deodorants and others — rapidly fills the air with nanoscale particles that are small enough to get deep into your lungs, Purdue University engineers have found over a series of studies.

These nanoparticles form when fragrances interact with ozone, which enters buildings through ventilation systems, triggering chemical transformations that create new airborne pollutants.

"A forest is a pristine environment, but if you're using cleaning and aromatherapy products full of chemically manufactured scents to recreate a forest in your home, you're actually creating a tremendous amount of indoor air pollution that you shouldn't be breathing in," said Nusrat Jung, an assistant professor in Purdue's Lyles School of Civil and Construction Engineering.

Nanoparticles just a few nanometers in size can penetrate deep into the respiratory system and spread to other organs. Jung and fellow civil engineering professor Brandon Boor have been the first to study nanoscale airborne particle formation indoors and compare it to outdoor atmospheric processes."

ARCHITECTURE

The Timeless Appeal of Modernism in Technology and Digital Architecture

"Modernism, a movement that sought to break away from traditional forms and embrace the future, laid the groundwork for many technological and digital advancements in contemporary architecture. As the Industrial Revolution brought about mass production, new materials, and technological innovation, architects like Le Corbusier, Walter Gropius, and Mies van der Rohe championed the ethos of "form follows function" and a rational approach to design. Their principles resonate in the digital age, where computational design and high-tech materials redefine form and construction.

The 20th century's modernist ideals — efficiency, simplicity, and functionality — created a foundation for architects to experiment with structural clarity and material honesty. High-tech architecture, which emerged in the late 20th century, evolved from these principles, merging modernism's clean lines with advanced engineering and technology. This paved the way for parametricism and algorithm-driven design processes, revolutionizing architecture and enabling complex forms previously thought impossible.

Today, digital tools, such as Building Information Modeling (BIM), parametric software, and 3D printing, are deeply rooted in modernist ideals. They streamline design and construction processes, reflecting modernism's pursuit of progress and technological integration. But how did these principles directly influence the digital turn in architecture?"

ARCHITECTURE

The Rise of Co-Living Spaces for Young Professionals in East Asia: 5 Projects Redefining Flexible Living

"Co-living in East Asia has been rising since 2020, rapidly expanding while remaining in its early stages. At the same time, it continues to fulfill a significant demand from young professionals working in major cities. A 2020 study by real estate services firm JLL highlighted the growing demand for co-living in China and Singapore, citing key advantages such as affordability compared to private studio apartments and a contemporary urban lifestyle that fosters openness and shared experiences. Much like other industries where ownership is becoming less relevant—such as streaming services for music, films, and television, or mobility solutions like car- and bike-sharing—co-living appeals to a similar demographic that values flexibility and access over long-term commitments.

Unlike co-living initiatives in Spain, which often focus on multigenerational shared spaces, East Asian co-living primarily targets young professionals with dynamic career paths. Often required to relocate every few years, these individuals prioritize convenience and adaptability over investing in a permanent home. For them, committing to a long-term residence may not be practical, making fully furnished, professionally managed co-living spaces with built-in amenities and hygiene services an attractive option. These environments cater to fast-paced urban lifestyles, where networking at professional events often precedes solitary downtime at home."

Source: IEEE Spectrum (13 Feb 2025)

DESIGN

Finger-waggling exoskeleton helps pianists play faster

"Japanese researchers have used a nimble robotic hand exoskeleton to train expert pianists to improve their performance, using a technique they believe could be applied to e-sports, surgery or even handicrafts.

The robotic exoskeleton is the work of researcher Shinichi Furuya and his team at the Sony Computer Science Laboratories (Sony CSL) in Tokyo, where they focus on using technology to enhance music practice.

The exoskeleton can independently move the wearer's fingers using a motor at the base of each digit.

Researchers found that after just one 30-minute session with the device, where the exoskeleton triggered a fast and complex movement pattern, participants in the study were able to play faster independently.

The effect was visible in both of the participants' hands – even though they had only worn the exoskeleton on the right – and persisted both immediately after the training and the next day.

Furuya, an accomplished pianist himself, was motivated to create the device to enable musicians to push past the plateau they usually hit after extensive training, also known as the "ceiling effect".

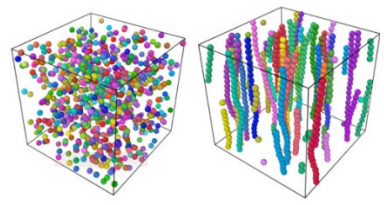
The ceiling effect means that no further improvement can be gained, no matter how much the musician may practice."

Source: Dezeen (11 Feb 2025)

Source: Eurekalert! (14 Feb 2025)

MATERIALS

Bristol scientists herald active matter breakthrough with creation of three-dimensional 'synthetic worms'



"Scientists have been investigating a new class of materials called 'active matter', which could be used for various applications from drug delivery to self-healing materials.

Compared to inanimate matter – the sort of motionless materials we come across in our lives every day such as plastic and wood – active matter can show fascinating life-like behaviour.

These materials are made of elements which are driven out of equilibrium by internal energy sources, allowing them to move independently.

Researchers from the University of Bristol, in collaboration with scientists in Paris and Leiden, carried out the experiment using special micron-sized (one millionth of a meter) particles called Janus colloids, which were suspended in a liquid mixture.

The team then made the material active by applying a strong electric field and observed the effects using a special kind of microscope which takes three-dimensional images.

Previous research in this field had used larger colloid particles – but by scaling the colloids to a third of their size the University of Bristol researchers were able to experiment in three-dimensions and found fascinating results.

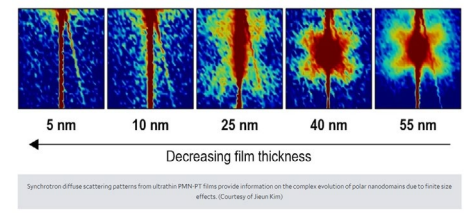
When the electric field was turned on, the scattered colloid particles would merge together to form worm-like structures – which creates a fully three-dimensional synthetic active matter system."

Source: BRISTOL (13 Feb 2025)

Source: Archdaily (13 Feb 2025)

NANOTECH

'Smaller and better': Rice research uncovers performance sweet spot for relaxor nanomaterial



Synchrotron diffuse scattering patterns from ultrathin PMN-PT films provide information on the complex evolution of polar nanodomains due to finite size effects. (Courtesy of Jieun Kim)

"A new study led by Rice University materials scientist Lane Martin sheds light on how the extreme miniaturization of thin films affects the behavior of relaxor ferroelectrics — materials with noteworthy energy-conversion properties used in sensors, actuators and nanoelectronics. The findings reveal that as the film shrinks to dimensions comparable to the materials' internal polarization structures, their fundamental properties can shift in unexpected ways.

The focus of the study published in Nature Nanotechnology is lead magnesium niobate-lead titanate, or PMN-PT, a widely used ceramic material found in applications ranging from medical imaging (ultrasounds) and energy harvesting to gas sensors and beyond. In their quest to shed light on how the internal polarization structure of PMN-PT evolves and acts at vanishingly small scales, the researchers made a surprising discovery: Before losing its special abilities, the material actually improved. This unexpected "sweet spot" could open the door to a new generation of nanoelectronic devices."

Source: RICE (11 Feb 2025)

Source: Archdaily(15 Feb 2025)

SENSORS

Scientists Develop Novel Self-Healing Electronic Skin for Health Monitoring

"Researchers have achieved a breakthrough in wearable health technology by developing a novel self-healing electronic skin (E-Skin) that repairs itself in seconds after damage. This could potentially transform the landscape of personal health monitoring.

In a study published in Science Advances, scientists demonstrate an unprecedented advancement in E-Skin technology that recovers over 80% of its functionality within 10 seconds of being damaged – a dramatic improvement over existing technologies that can take minutes or hours to heal.

The technology seamlessly combines ultra-rapid self-healing capabilities, reliable performance in extreme conditions, advanced artificial intelligence integration, and highly accurate health monitoring systems. This integration enables real-time fatigue detection and muscle strength assessment with remarkable precision.

"This self-healing technology represents a fundamental shift in wearable electronics," says Professor Yangzhi Zhu. "By achieving healing times of just seconds rather than minutes or hours, we've overcome one of the major barriers to practical, everyday use of electronic skin devices."

The technology shows particular promise in muscle strength monitoring and fatigue assessment, offering potential applications in athletics, rehabilitation, and general health monitoring. Its ability to function in various environmental conditions makes it particularly versatile for real-world use."

Source: TERASAKI (12 Feb 2025)

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