Weekly Discovery
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20 Jan – 24 Jan 2025

AI
AI Hallucinations Can't Be Stopped — But These Techniques Can Limit Their Damage
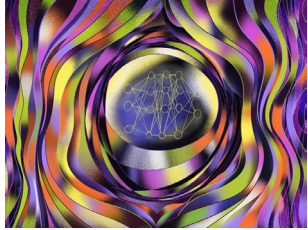
"When computer scientist Andy Zou researches artificial intelligence (AI), he often asks a chatbot to suggest background reading and references. But this doesn't always go well. "Most of the time, it gives me different authors than the ones it should, or maybe sometimes the paper doesn't exist at all," says Zou, a graduate student at Carnegie Mellon University in Pittsburgh, Pennsylvania.

It's well known that all kinds of generative AI, including the large language models (LLMs) behind AI chatbots, make things up. This is both a strength and a weakness. It's the reason for their celebrated inventive capacity, but it also means they sometimes blur truth and fiction, inserting incorrect details into apparently factual sentences. "They sound like politicians," says Santosh Vempala, a theoretical computer scientist at Georgia Institute of Technology in Atlanta. They tend to "make up stuff and be totally confident no matter what".

The particular problem of false scientific references is rife. In one 2024 study, various chatbots made mistakes between about 30% and 90% of the time on references, getting at least two of the paper's title, first author or year of publication wrong1. Chatbots come with warning labels telling users to double-check anything important. But if chatbot responses are taken at face value, their hallucinations can lead to serious problems, as in the 2023 case of a US lawyer, Steven Schwartz, who cited non-existent legal cases in a court filing after using ChatGPT."

Source: Nature (21 Jan 2025)

AI
KAIST Develops Neuromorphic Semiconductor Chip That Learns and Corrects Itself
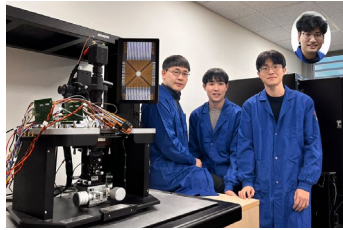
"Existing computer systems have separate data processing and storage devices, making them inefficient for processing complex data like AI. A KAIST research team has developed a memristor-based integrated system similar to the way our brain processes information. It is now ready for application in various devices including smart security cameras, allowing them to recognize suspicious activity immediately without having to rely on remote cloud servers, and medical devices with which it can help analyze health data in real time.

KAIST (President Kwang Hyung Lee) announced on the 17th of January that the joint research team of Professor Shinhyun Choi and Professor Young-Gyu Yoon of the School of Electrical Engineering has developed a next-generation neuromorphic semiconductor-based ultra-small computing chip that can learn and correct errors on its own.

What is special about this computing chip is that it can learn and correct errors that occur due to non-ideal characteristics that were difficult to solve in existing neuromorphic devices. For example, when processing a video stream, the chip learns to automatically separate a moving object from the background, and it becomes better at this task over time.

This self-learning ability has been proven by achieving accuracy comparable to ideal computer simulations in real-time image processing. The research team's main achievement is that it has completed a system that is both reliable and practical, beyond the development of brain-like components.

The research team has developed the world's first memristor-based integrated system that can adapt to immediate environmental changes and has presented an innovative solution that overcomes the limitations of existing technology."

Source: KAIST (17 Jan 2025)

ARCHITECTURE
How Did BIM Help Notre-Dame Rise from The Ashes?

"In many cultures, fire is a sacred element used in rituals of rebirth and renewal. It carries a dual symbolism, being both a creator and a destroyer—capable of illuminating paths or consuming everything in its wake. In Greek mythology, for example, Prometheus stole fire from the gods and gave it to humanity, marking it as a symbol of progress, knowledge, and creative power. However, fire also evokes destruction, as seen in biblical tales like that of Sodom and Gomorrah, where it was used as divine punishment. This duality was also evident in the 2019 fire at Notre-Dame Cathedral, which devastated its historic structure. The disaster sparked a wave of solidarity and led to unprecedented technological advancements, with restoration efforts utilizing digital tools such as laser scanning and Building Information Modeling (BIM) to recreate intricate details and preserve architectural heritage.

Even before firefighters fully extinguished the flames, a surge of donations flowed in for this symbol of Western civilization built in the 12th century. Among the restoration efforts, Autodesk played a pivotal role by contributing technology and expertise, providing its software, and creating detailed BIM models of the cathedral for reconstruction. These digital tools enabled precise planning and collaboration, ensuring that intricate structural details and historical authenticity were preserved while demonstrating how technology can be a powerful ally in efforts to conserve built heritage. We spoke with Nicolas Mangon, VP of AEC Industry Strategy at Autodesk, about this process and how BIM usage benefited the cathedral's reopening."

Source: Archdaily (21 Jan 2025)

BATTERY
KERI, Overcomes the Biggest Challenge of The Lithium–Sulfur Battery, The Core Of UAM

"Dr. Park Jun-woo's team at KERI's Next Generation Battery Research Center has overcome a major obstacle to the commercialization of next-generation lithium–sulfur batteries and successfully developed large-area, high-capacity prototypes.

The lithium–sulfur battery, composed of sulfur as the cathode (+) and lithium metal as the anode (-), has a theoretical energy density more than eight times that of lithium-ion batteries, demonstrating significant potential. Additionally, it uses abundant sulfur (S) instead of expensive rare earth elements, making it cost-effective and environmentally friendly. As a lightweight and long-lasting secondary battery, the lithium–sulfur battery is considered a key technological field to drive the era of urban air mobility (UAM).

However, the lithium–sulfur battery generates lithium polysulfides as intermediate substances during the charge and discharge processes. These substances shuttle between the cathode and anode, causing unnecessary chemical reactions that degrade the battery's lifespan and performance. This has been the biggest obstacle to the commercialization of lithium–sulfur batteries."

Source: Eurekalert! (20 Jan 2025)

BRAIN COMPUTER INTERFACE
Fine-Tuned Brain-Computer Interface Makes Prosthetic Limbs Feel More Real

"You can probably complete an amazing number of tasks with your hands without looking at them. But if you put on gloves that muffle your sense of touch, many of those simple tasks become frustrating. Take away proprioception — your ability to sense your body's relative position and movement — and you might even end up breaking an object or injuring yourself.

"Most people don't realize how often they rely on touch instead of vision — typing, walking, picking up a flimsy cup of water," said Charles Greenspon, PhD, a neuroscientist at the University of Chicago. "If you can't feel, you have to constantly watch your hand while doing anything, and you still risk spilling, crushing or dropping objects."

Greenspon and his research collaborators recently published papers in Nature Biomedical Engineering and Science documenting major progress on a technology designed to address precisely this problem: direct, carefully timed electrical stimulation of the brain that can recreate tactile feedback to give nuanced "feeling" to prosthetic hands."

Source: uchicagomedicine (15 Jan 2025)

BRAIN COMPUTER INTERFACE
'Unprecedented' Level of Control Allows Person Without Use of Limbs to Operate Virtual Quadcopter

"A brain-computer interface, surgically placed in a research participant with tetraplegia, paralysis in all four limbs, provided an unprecedented level of control over a virtual quadcopter—just by thinking about moving his unresponsive fingers.

The technology divides the hand into three parts: the thumb and two pairs of fingers (index and middle, ring and small). Each part can move both vertically and horizontally. As the participant thinks about moving the three groups, at times simultaneously, the virtual quadcopter responds, maneuvering through a virtual obstacle course.

It's an exciting next step in providing those with paralysis the chance to enjoy games with friends while also demonstrating the potential for performing remote work."

Source: UMich (20 Jan 2025)

CREATIVITY
A Team with Diverse Expertise Produces Novel Ideas – But Are They Practical?

"Contrary to the widespread belief that teams with diverse expertise are automatically more creative, a new study by a joint team of researchers from the University of Waterloo, Xiamen University and Texas Tech University reveals this isn't always the case.

The study, the first of its kind in the accounting field to explore team creativity with neuroimaging, shows that while teams with differing skill sets and perspectives bring fresh, unique ideas to the table, they often struggle to create practical, workable solutions — raising important questions for managers and businesses worldwide.

In an experiment, teams made up of members with different areas of expertise — engineers and accountants — were tasked with coming up with creative uses for an unused university space. The study found that teams with a mix of skills generated more unique proposals, but their ideas were often less useful compared to teams where everyone shared the same expertise.

"Our study challenges the trendy belief that teams with diverse expertise always boost creativity," said Adam Presslee, a professor from the School of Accounting and Finance at Waterloo. "While teams with differing skill sets and perspectives tend to come up with more original ideas, they also face friction when trying to turn those ideas into practical, implementable solutions.""

Source: UWaterloo (21 Jan 2025)

DESIGN
Leafypod Unveils AI-Powered Self-Watering Smart Planter At CES

"Technology brand Leafypod has unveiled an AI-powered smart planter at this year's Consumer Electronics Show (CES).

Made from durable plastic materials, the LeafyPod aims to address what the brand identifies as the four main causes of plant death: soil moisture, light, temperature, and humidity.

"The materials were chosen specifically for their resistance to water exposure and ability to maintain structural integrity over time", Cleo Song, co-founder of LeafyPod, told Dezeen.

The device has sensors that detect light, humidity, and temperature and relay the data to the LeafyPod app.

"Our AI-powered watering system automatically adapts to each plant's specific needs by monitoring environmental conditions and adjusting the watering schedule accordingly, ensuring optimal care regardless of the plant variety", Song said.

The LeafyPod app works alongside the plant, learning its routine over time and automatically adjusting the watering schedule for optimised care.

"The planter's clean, minimalistic design in classic white conceals its sophisticated technology – including multiple environmental sensors and watering systems", Song continued."

Source: Dezeen (17 Jan 2025)

Gaia Vest Gives Architects An "Extended Sensory System" To Feel the Health of a Site
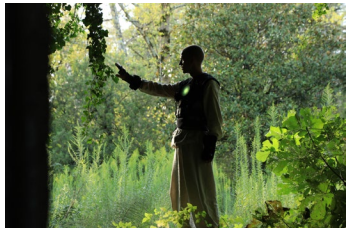
"Design studio Inxects has developed a wearable that translates environmental stress signals into physical sensations to let users feel humanity's impact on nature.

The Gaia Communication System (GCS) incorporates a sensor-laced vest and wrist sleeves that gather data about the health of plants, soil, air and ecosystems before translating these readings into haptic feedback in the form of vibrations.

Danish studio Inxects designed the system to give people an intuitive and visceral way of understanding the suffering of plants and animals due to pollution, climate change and habitat destruction.

The expectation is that this kind of sensory engagement will have a deeper impact on the human psyche than the mere reading of facts and data.

In particular, the studio envisions Gaia being used by architects, who could walk through project sites listening, testing and feeling the natural environment before they begin designing.

Inxects founder Pavels Hedström, an architect himself, said he was inspired to create Gaia while he was working in the corporate building industry, which he saw as prioritising human growth and industrial progress over concerns for other forms of life."

Source: Dezeen (21 Jan 2025)

Water As a Waste Management Source: SEOULTECH Researchers Revolutionize Catalytic Plastic Recycling
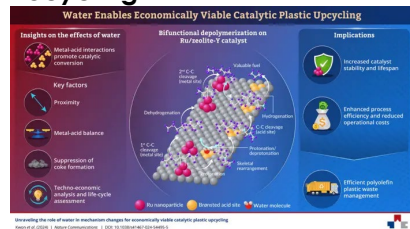
"Plastics are undeniably useful materials that have found their way into virtually all human activities. However, with yearly global plastic production exceeding 400 million tons, the environmental threat posed by increased plastic consumption and disposal, contributing to its pollution, is also bigger than ever. Considering that only one-tenth of all plastic waste is recycled, new technologies that can help tackle this growing problem are urgently required.

Catalytic recycling techniques, such as hydrogenolysis and hydrocracking, are emerging chemical processes that can break down plastic waste into simpler components using catalysts. Traditional recycling involves melting and remolding plastics into lower-quality materials, whereas catalytic recycling can convert plastics into valuable chemicals and fuels, enabling a more sustainable and efficient reuse. Though certainly promising, catalytic recycling methods need further refinements before they are ready for adoption on an industrial scale.

In a recent study published in Nature Communications online on 29 November, 2024, a research team led by Professor Insoo Ro of Seoul National University of Science and Technology, Korea, recently made a breakthrough discovery in the catalytic recycling of polyolefins, which comprise 55% of global plastic waste. As explained in their article, the researchers revealed the surprising benefits of adding water during polyolefin depolymerization when using ruthenium (Ru)-based catalysts."

Source: Eurekalert! (21 Jan 2025)

Global Trust in Science Remains Strong

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Source: uzh (20 Jan 2025)

Harnessing Electromagnetic Waves and Quantum Materials to Improve Wireless Communication Technologies
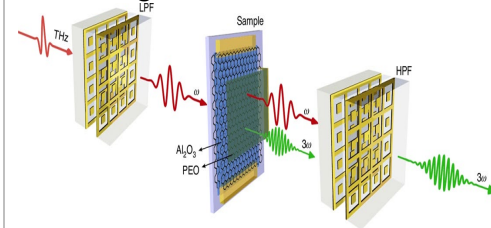
"THz waves, located in the far-infrared region of the electromagnetic spectrum, can be used to perform non-invasive imaging through opaque materials for security and quality control applications. Additionally, these waves hold great promise for wireless communication. Advances in THz nonlinear optics, which can be used to change the frequency of electromagnetic waves, are essential for the development of high-speed wireless communication and signal processing systems for 6G technologies and beyond.

THz technologies are rapidly evolving as they are poised to play a critical role in health, communication, security, and quality control. Jean-Michel Ménard, Associate Professor of Physics from the Faculty of Science and a team of researchers have paved the way for developing devices capable of upconverting electromagnetic signals to higher oscillation frequencies, effectively bridging the gap between GHz electronics and THz photonics.

These findings – published in Light: Science & Applicationsnorth_eastexternal link – demonstrate innovative strategies for enhancing THz nonlinearities in graphene-based devices. "The research marks a significant step forward in improving the efficiency of THz frequency converters, a critical aspect for multi-spectral THz applications and especially the future of communication systems, like 6G," says Professor Ménard, who collaborated on the project with fellow uOttawa researchers Ali Maleki and Robert W. Boyd, plus Moritz B. Heindl and Georg Herink from the University of Bayreuth (Germany)north_eastexternal link and Iridian Spectral Technologies.

This new research showcases methods to leverage the unique optical properties of graphene, an emerging quantum material made of a single layer of carbon atoms. This 2D material can be seamlessly integrated into devices, enabling new applications for signal processing and communication."

Source: UOttawa (21 Jan 2025)