SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

Weekly Discovery

We SHARE to inspire and ignite ideas!

24 June – 28 June 2024

3D PRINTING

Your Future Medications Could Be Personalized for You on a 3D Printer

"Chocolate-flavored pills for children who hate taking medicine.

Several drugs combined into one daily pill for seniors who have trouble remembering to take their medications.

Drugs printed at your local pharmacy at personalized dosages that best suit your health needs.

These are just a few potential advantages of 3D drug printing, a new system for manufacturing drugs and treatments on-site at pharmacies, health care facilities and other remote locations.

In 2015, the Food and Drug Administration approved the first 3D-printed drug, Spritam (levetiracetam), for epilepsy. Several other manufacturers and drug companies are developing their own ones.

But the widespread adoption of 3D drug printing will require stringent quality control measures to ensure that people get the right medication and dosage. Even a tiny mismeasurement of a drug's ingredient during the printing process could endanger a patient's health.

In a new research paper, NIST research scientist Thomas P. Forbes assesses various approaches to ensuring that 3D drug printers work as designed. The journal article applies a "quality by design" analysis to evaluate the best procedures and protocols to ensure that 3D printers produce drugs at the correct dosages and with the correct mix of chemicals."

Source: NIST (12 Jun 2024)

AI

Can AI Learn Like Us?

"It reads. It talks. It collates mountains of data and recommends business decisions. Today's artificial intelligence might seem more human than ever. However, AI still has several critical shortcomings. Cold Spring Harbor Laboratory (CSHL) NeuroAI Scholar Kyle Daruwalla explains:

Daruwalla has been searching for new, unconventional ways to design AI that can overcome such computational obstacles. And he might have just found one.

The key was moving data. Nowadays, most of modern computing's energy consumption comes from bouncing data around. In artificial neural networks, which are made up of billions of connections, data can have a very long way to go. So, to find a solution, Daruwalla looked for inspiration in one of the most computationally powerful and energy-efficient machines in existence—the human brain.

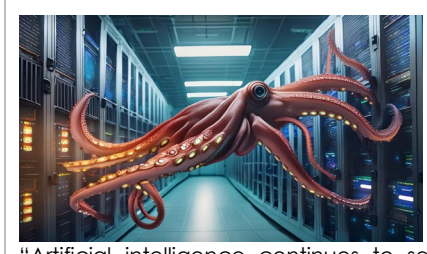
Daruwalla designed a new way for AI algorithms to move and process data much more efficiently, based on how our brains take in new information. The design allows individual AI "neurons" to receive feedback and adjust on the fly rather than wait for a whole circuit to update simultaneously. This way, data doesn't have to travel as far and gets processed in real time."

Watch the presentation

Source: CSHL (20 Jun 2024)

AI

SQUID Pries Open AI Black Box



"Artificial intelligence continues to squirm its way into many aspects of our lives. But what about biology, the study of life itself? AI can sift through hundreds of thousands of genome data points to identify potential new therapeutic targets. While these genomic insights may appear helpful, scientists aren't sure how today's AI models come to their conclusions in the first place. Now, a new system named SQUID arrives on the scene armed to pry open AI's black box of murky internal logic.

SQUID, short for Surrogate Quantitative Interpretability for Deepnets, is a computational tool created by Cold Spring Harbor Laboratory (CSHL) scientists. It's designed to help interpret how AI models analyze the genome. Compared with other analysis tools, SQUID is more consistent, reduces background noise, and can lead to more accurate predictions about the effects of genetic mutations.

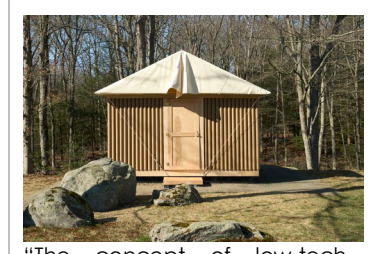
How does it work so much better? The key, CSHL Assistant Professor Peter Koo says, lies in SQUID's specialized training. Koo explains:

SQUID works by first generating a library of over 100,000 variant DNA sequences. It then analyzes the library of mutations and their effects using a program called MAVE-NN (Multiplex Assays of Variant Effects Neural Network). This tool allows scientists to perform thousands of virtual experiments simultaneously. In effect, they can "fish out" the algorithms behind a given AI's most accurate predictions. Their computational "catch" could set the stage for experiments that are more grounded in reality. CSHL Associate Professor Justin Kinney, a co-author of the study, explains."

Source: CSHL (21 Jun 2024)

ARCHITECTURE

What Is Low-Tech Architecture: Comparing Shigeru Ban and Yasmeen Lari's Approaches



"The concept of low-tech architecture recognizes the impact of carbon-intensive technologies and building practices and proposes an alternative: a rediscovery of practical, rational, locally adapted solutions that count on smart design strategies instead of energy-intensive devices to ensure a safe, comfortable living environment. Far from being a regressive approach, the term remains open to innovations but seeks to rebalance the industry's reliance on mechanization. It thus favors an architecture of fewer components, minimized dependence on high-tech solutions, and a preference for low-embodied carbon materials.

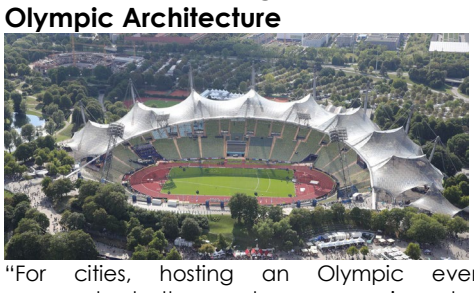
Across the world, architects are embracing this concept, recognizing its positive social, environmental, and ethical potential of it. Among them, two architects stand out for embodying these principles, though in different contexts. While continuing to be engaged with larger, more conventional projects, Shigeru Ban became internationally recognized for his humanitarian and disaster relief efforts, working with communities in crisis in the face of a scarcity of resources.

Similarly, Yasmeen Lari applies her architectural expertise to develop accessible and locally adapted solutions for communities across Pakistan. While her first interventions were also prompted by natural disasters such as the 2005 earthquake and subsequent floods in her home country, Lari works primarily with social infrastructures, probing the needs of at-risk communities and developing long-term solutions with them, often by adapting forgotten vernacular techniques."

Source: Archdaily (16 Jun 2024)

ARCHITECTURE

From White Elephants to Sustainable Venues: The Evolving Story of Olympic Architecture



"For cities, hosting an Olympic event represents both an honor, an important opportunity for growth, and a significant challenge. With over 200 nations taking part in the Games, the Olympics are the largest sporting competition in the world. Adapting the public and sporting infrastructure to accommodate this sudden influx of people and the scale of these events runs the risk of misunderstanding the cities' needs after the closing ceremony, often producing "white elephants" that struggle to adapt to the rhythm and necessities of everyday urban life. Urban transformations are often cited as an advantage of hosting the Olympic Games, as cities are incentivized to invest in their traffic infrastructure, housing, and public spaces. One such example is the city of Paris, which introduced its first metro line on the occasion of hosting the second edition of the Olympic Games in 1900.

When it comes to the venues, however, the issue of adaptive reuse becomes a pressing one, as the architecture is challenged to find solutions to transform, accommodating thousands of people during the Olympics, then scaling down to become a financially sustainable part of a city's sporting offering. Across the world, several Olympic venues have managed to extend their usability after the closing of the games, opening themselves to the local communities and welcoming a more diverse programming of sports and leisure events. While the high construction costs are often difficult to justify, these venues have become markers of local identity and attractive tourist attractions, extending their use decades after welcoming the Olympic crowds."

Source: Archdaily (20 Jun 2024)

AUTONOMOUS VEHICLES

Autonomous Vehicles Are Great at Driving Straight but Humans Still Do Better at Turns and In the Twilight

"Autonomous vehicles (AVs) have made headlines in recent months, though often for all the wrong reasons. Cruise, Waymo, and Tesla are all under U.S. federal investigation for a variety of accidents, some of which caused serious injury or death.

A new paper published in Nature puts numbers to the problem. Its authors analyzed over 37,000 accidents involving autonomous and human-driven vehicles to gauge risk across several accident scenarios. The paper reports AVs were generally less prone to accidents than those driven by humans, but significantly underperformed humans in some situations.

"The conclusion may not be surprising given the technological context," said Shengxuan Ding, an author on the paper. "However, challenges remain under specific conditions, necessitating advanced algorithms and sensors and updates to infrastructure to effectively support AV technology."

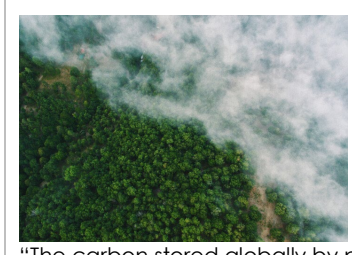
The paper, authored by two researchers at the University of Central Florida, analyzed data from 2,100 accidents involving advanced driving systems (SAE Level 4) and advanced driver-assistance systems (SAE Level 2) alongside 35,113 accidents involving human-driven vehicles. The study pulled from publicly available data on human-driven vehicle accidents in the state of California and the AVOID autonomous vehicle operation incident dataset, which the authors made public last year.

While the breadth of the paper's data is significant, the paper's "matched case-control analysis" is what sets it apart. Autonomous and human-driven vehicles tend to encounter different roads in different conditions, which can skew accident data. The paper categorizes risks by the variables surrounding the accident, such as whether the vehicle was moving straight or turning, and the conditions of the road and weather."

Source: IEEE Spectrum (18 Jun 2024)

CARBON EMISSIONS

Climate Models Underestimate Carbon Cycling Through Plants



"The carbon stored globally by plants is shorter-lived and more vulnerable to climate change than previously thought, according to a new study.

The findings have implications for our understanding of the role of nature in mitigating climate change, including the potential for nature-based carbon removal projects such as mass tree-planting.

The research, carried out by an international team led by Dr Heather Graven at Imperial College London and published today in Science, reveals that existing climate models underestimate the amount of carbon dioxide (CO_2) that is taken up by vegetation globally each year, while overestimating how long that carbon remains there.

Dr Graven, Reader in Climate Physics in Imperial's Department of Physics, said: "Plants across the world are actually more productive than we thought they were."

The findings also mean that while carbon is taken up by plants quicker than thought, the carbon is also locked up for a shorter time, meaning carbon from human activities will be released back into the atmosphere sooner than previously predicted.

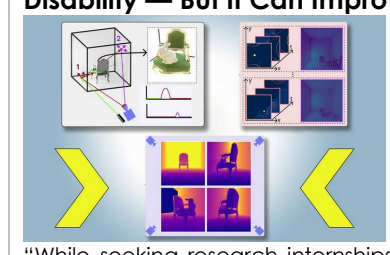
Dr Graven added: "Many of the strategies being developed by governments and corporations to address climate change rely on plants and forests to draw down planet-warming CO_2 and lock it away in the ecosystem.

"But our study suggests that carbon stored in living plants does not stay there as long as we thought. It emphasises that the potential for such nature-based carbon removal projects is limited, and fossil fuel emissions need to be ramped down quickly to minimise the impact of climate change."

Source: Imperial (20 Jun 2024)

CHATGPT

ChatGPT Is Biased Against Resumes with Credentials That Imply a Disability — But It Can Improve



"While seeking research internships last year, University of Washington graduate student Kate Glazko noticed recruiters posting online that they'd used OpenAI's ChatGPT and other artificial intelligence tools to summarize resumes and rank candidates. Automated screening has been commonplace in hiring for decades. Yet Glazko, a doctoral student in the UW's Paul G. Allen School of Computer Science & Engineering, studies how generative AI can replicate and amplify real-world biases — such as those against disabled people. How might such a system, she wondered, rank resumes that implied someone had a disability?

In a new study, UW researchers found that ChatGPT consistently ranked resumes with disability-related honors and credentials — such as the "Tom Wilson Disability Leadership Award" — lower than the same resumes without those honors and credentials. When asked to explain the rankings, the system spat out biased perceptions of disabled people. For instance, it claimed a resume with an autism leadership award had "less emphasis on leadership roles" — implying the stereotype that autistic people aren't good leaders.

But when researchers customized the tool with written instructions directing it not to be ableist, the tool reduced this bias for all but one of the disabilities tested. Five of the six implied disabilities — deafness, blindness, cerebral palsy, autism and the general term "disability" — improved, but only three ranked higher than resumes that didn't mention disability.

The team presented its findings June 5 at the 2024 ACM Conference on Fairness, Accountability, and Transparency in Rio de Janeiro."

Source: Eurekalert! (21 Jun 2024)

DESIGN

"Togetherness Aids Wellbeing" say Winners of Marmoleum Design Challenge

MEDTECH

Novel Blood-Powered Chip Offers Real-Time Health Monitoring

ROBOTICS

Getting To Grips with An Extra Thumb It's Easier Than You Might Think

ROBOTIC

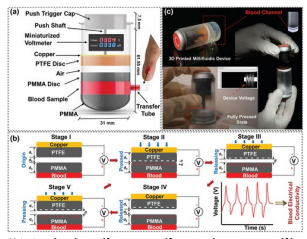
Robotic Exoskeleton Adapts to Its Wearer Through Simulated Training

"A pastel-toned break space with configurable partitions designed to foster social engagement and wellbeing has been named the winner of the Dezeen and Forbo Flooring's Marmoleum Design Challenge.

Finnish design studio Tuominen Patel has claimed the top prize with their adaptable break space called Breathe.

Along with a cash prize of £5,000, the designers will see their design brought to life in collaboration with Forbo Flooring. The completed project will be unveiled at a launch event in the Netherlands and featured on Dezeen in the coming weeks."

Source: Dezeen (21 Jun 2024)



"Metabolic disorders, like diabetes and osteoporosis, are burgeoning throughout the world, especially in developing countries.

The diagnosis for these disorders is typically a blood test, but because the existing healthcare infrastructure in remote areas is unable to support these tests, most individuals go undiagnosed and without treatment. Conventional methods also involve labor-intensive and invasive processes which tend to be time-consuming and make real-time monitoring unfeasible, particularly in real life settings and in country-side populations.

Researchers at the University of Pittsburgh and University of Pittsburgh Medical Center are proposing a new device that uses blood to generate electricity and measure its conductivity, opening doors to medical care in any location.

"As the fields of nanotechnology and microfluidics continue to advance, there is a growing opportunity to develop lab-on-a-chip devices capable of surrounding the constraints of modern medical care," said Amir Alavi, assistant professor of civil and environmental engineering at Pitt's Swanson School of Engineering. "These technologies could potentially transform healthcare by offering quick and convenient diagnostics, ultimately improving patient outcomes and the effectiveness of medical services."

Source: Wiley (30 May 2024)

"An emerging area of future technology is motor augmentation – using motorised wearable devices such as exoskeletons or extra robotic body parts to advance our motor capabilities beyond current biological limitations.

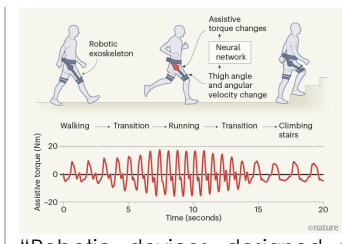
While such devices could improve the quality of life for healthy individuals who want to enhance their productivity, the same technologies can also provide people with disabilities new ways to interact with their environment.

Professor Tamar Makin from the Medical Research Council (MRC) Cognition and Brain Sciences Unit at the University of Cambridge said: "Technology is changing our very definition of what it means to be human, with machines increasingly becoming a part of our everyday lives, and even our minds and bodies.

"These technologies open up exciting new opportunities that can benefit society, but it's vital that we consider how they can help all people equally, especially marginalised communities who are often excluded from innovation research and development.

"To ensure everyone will have the opportunity to participate and benefit from these exciting advances, we need to explicitly integrate and measure inclusivity during the earliest possible stages of the research and development process."

Source: Cambridge (29 May 2024)



"Robotic devices designed to improve a person's gait can be worn on one or more joints of the leg, and usually have embedded motors that apply torques to either bend or extend the joint. This assistance — when applied properly — reduces the energy that the wearer expends when using their muscles. The device moves in sync with the joint, enabling the leg muscles to relax and allowing the device to assume their workload. However, for the device to offer optimal assistance and save maximum energy for the wearer, it must provide the right amount of assistive torque at the correct time. Failure to do so can make the user resist the assistance offered by the device, increasing their muscle activity and making movement more difficult.

Developing precise and adaptive control for these devices therefore remains a key challenge in exoskeleton research. It involves formulating control laws, which are sets of instructions that guide the device along a trajectory from one state to another. Controllers for lower-limb exoskeletons often follow pre-defined torque assistance profiles3,4 that stipulate how much torque to apply over the course of a single step. These profiles are adjusted manually, sometimes while the device is in use. This process can be cumbersome and subjective, often resulting in suboptimal assistance profiles."

Source: Nature (12 Jun 2024)