SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

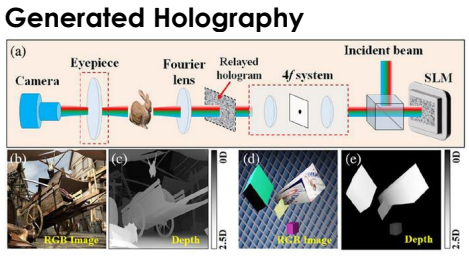
Weekly Discovery

We SHARE to inspire and ignite ideas!

8 Apr – 12 Apr 2024

3D PRINTING

Advancing Real-Time 3D Holographic Display: A Breakthrough in Computer-Generated Holography



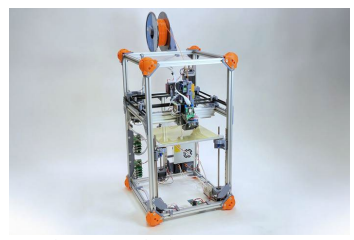
"Holographic displays offer a promising avenue for achieving lifelike 3D reproductions with continuous depth sensation, holding potential applications in fields such as entertainment, medical imaging, and virtual reality. However, the conventional methods for generating computer-generated holograms (CGHs) rely on repetitive computations, leading to increased computational complexity and impracticality for real-time applications.

To tackle this issue, researchers from the University of Shanghai for Science and Technology (China) have introduced a novel method for CGH generation that significantly reduces computational overhead while maintaining high-quality 3D visualization. As reported in Advanced Photonics Nexus, their approach leverages a split Lohmann lens-based diffraction model, enabling rapid synthesis of 3D holograms through a single-step backward propagation calculation. By incorporating a specially designed virtual digital phase modulation into the split Lohmann lens, their method achieves highly accurate reconstruction of 3D scenes with precise depth perception."

Source: Eurekalert! (8 Apr 2024)

3D PRINTING

This 3D Printer Can Figure Out How to Print with An Unknown Material



"While 3D printing has exploded in popularity, many of the plastic materials these printers use to create objects cannot be easily recycled. While new sustainable materials are emerging for use in 3D printing, they remain difficult to adopt because 3D printer settings need to be adjusted for each material, a process generally done by hand.

To print a new material from scratch, one must typically set up to 100 parameters in software that controls how the printer will extrude the material as it fabricates an object. Commonly used materials, like mass-manufactured polymers, have established sets of parameters that were perfected through tedious, trial-and-error processes.

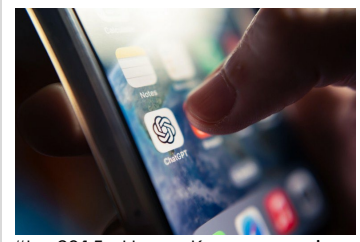
But the properties of renewable and recyclable materials can fluctuate widely based on their composition, so fixed parameter sets are nearly impossible to create. In this case, users must come up with all these parameters by hand.

Researchers tackled this problem by developing a 3D printer that can automatically identify the parameters of an unknown material on its own.

Source: Eurekalert! (8 Apr 2024)

AI

'Without These Tools, I'd Be Lost': How Generative AI Aids in Accessibility



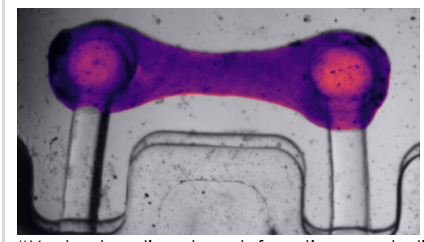
"In 2015, Hana Kang experienced a traumatic injury that damaged the left hemisphere of her brain, disrupting her facility for language and ability to process abstract thoughts. She spent the next six years rebuilding her memory, recovering basic mathematics skills and relearning Korean, Japanese and English. In 2022, she returned to finish her bachelor's degree in chemical biology at the University of California, Berkeley.

Today, Kang works as a junior specialist at the university's Center for Genetically Encoded Materials. She uses mobility aids and an oxygen concentrator to manage her chronic pain — physical tools that are essential to her well-being. But no less meaningful are the generative artificial intelligence (GAI) programs she turns to each day to manage her time, interact with peers and conduct research. Kang struggles to read social cues and uses chatbots to play out hypothetical conversations. These tools also help her on days when fatigue clouds her thinking — by transcribing and summarizing recordings of lectures she attends, gauging tone and grammar, and polishing her code. "Without these tools, I'd be very lost, and I don't think I could have done what I've managed to do," she says."

Source: Nature (8 Apr 2024)

AI

A Pulse of Innovation: AI At the Service of Heart Research



"Understanding heart function and disease, as well as testing new drugs for heart conditions, has long been a complex and time-consuming task. A promising way to study disease and test new drugs is to use cellular and engineered tissue models in a dish, but existing methods to study heart cell contraction and calcium handling require a good deal of manual work, are prone to errors, and need expensive specialized equipment. There clearly is a critical medical need for a more efficient, accurate, and accessible way to study heart function, using a methodology based on artificial intelligence (AI) and machine learning.

BeatProfiler, new tool to rapidly analyze heart cell function.

Researchers at Columbia Engineering unveiled a groundbreaking new tool today that addresses these challenges head-on. BeatProfiler is a comprehensive software that automates the analysis of heart cell function from video data and is the first system to integrate the analysis of different heart function indicators, such as contractility, calcium handling, and force output into one tool, speeding up the process significantly and reducing the chance for errors. BeatProfiler enabled the researchers to not only distinguish between different diseases and levels of their severity but also to rapidly and objectively test drugs that affect heart function. The study was published on April 8 in IEEE Open Journal of Engineering in Medicine and Biology."

Source: COLOMBIA (8 Apr 2024)

ARCHITECTURE

The "Miracle" Of Taiwan's Luxury Social Housing

With average house prices 22 times greater than annual incomes, Taiwan has some of the world's least affordable housing.

Since becoming a democracy in the late 1980s, the south-east Asian island has pursued a low-tax economy, with little in the way of a welfare state.

For two decades, housing policy here was almost exclusively focused on home ownership.

"Prior to 2010, Taiwan's housing policies primarily focused on providing loans to encourage home ownership, neglecting the importance of the rental market and lacking the construction of social housing," said Yang-Kae Peng, an architect and secretary general of Taiwan's Social Housing Advocacy Consortium.

A pre-2000 programme saw the government build some 165,000 homes – around two per cent of Taiwan's total housing stock – but these were all for sale.

Source: Dezeen (4 Apr 2024)

GLOBAL WARMING

How To Replace Air Conditioning? Passive Strategies for Addressing Global Warming

"Between now and 2050, worldwide installation of cooling appliances, like air conditioning, is projected to triple, resulting in a twofold increase in energy consumption. This reliance on such devices, often seen as exacerbating global warming, poses a paradox: how can we fight rising temperatures in cities while simultaneously contributing to them through our dependence on these solutions?

Using air conditioning extensively on scorching days not only strains the power grid but also contributes to raising a city's temperature by around 2°C. This happens because the process expels hot air. Moreover, access to cooling technologies, whether at home, work, or school, is limited and varies depending on people's financial circumstances.

Seen as a solution to combat heatwaves, air conditioning is selective and exacerbates discomfort for other residents. While it provides thermal comfort for some, it leads to discomfort for many others."

Source: Archdaily (7 Apr 2024)

HEALTH

Fans Are Not a Magic Bullet for Beating the Heat!

"A new study by researchers at the University of Ottawa throws cold water on the idea that fans can effectively cool you down during extremely hot weather events.

With severe heat waves becoming more frequent due to climate change, there's a growing need for safe and accessible ways to keep people cool, especially vulnerable populations like older adults. Fans are often recommended as cheap and easy solutions, but this study suggests they might not be as helpful as previously thought.

The research was led by post-doctoral fellow Robert Meade and was conducted at the Human and Environmental Physiology Research Unitnorth_eastexternal link at the University of Ottawa , a unit led by Dr. Glen Kenny, who is a professor of physiology at the Faculty of Health Sciences.

"Fans do improve sweat evaporation, but this effect is not strong enough to significantly lower your body's internal temperature when it's already really hot (above 33-35°C). In older adults, who may have a reduced ability to sweat, fans provide even less cooling benefits," explains Meade. "In fact, even in younger adults, fans only provide a small fraction of the cooling power of air conditioning.""

Source: OTTAWA (4 Apr 2024)

HEALTH TECH

Researchers developed new method for detecting heart failure with a smartphone

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Source: UTU (8 Apr 2024)

HUMAN-MACHINE

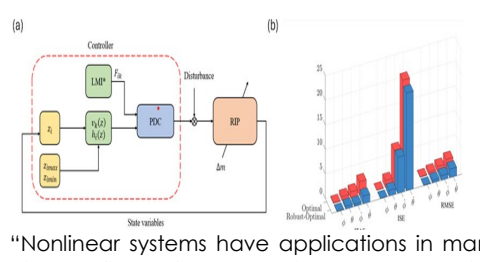
Universal Brain-Computer Interface Lets People Play Games with Just Their Thoughts

"Imagine playing a racing game like Mario Kart, using only your brain to execute the complex series of turns in a lap.

This is not a video game fantasy, but a real program that engineers at The University of Texas at Austin have created as part of research into brain-computer interfaces to help improve the lives of people with motor disabilities. More importantly, the researchers incorporated machine learning capabilities with their brain-computer interface, making it a one-size-fits-all solution.

NONLINEAR SYSTEMS

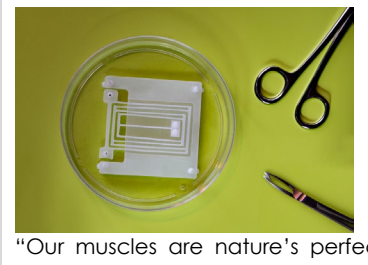
Novel Robust-Optimal Controllers Based on Fuzzy Descriptor System



"Nonlinear systems have applications in many diverse fields from robotics to economics. Unlike linear systems, the output is not proportional to the input is such systems. A classic example is the motion of a pendulum. Due to the inherent nature of nonlinear systems, their mathematical modelling and, consequently, control is difficult. In this context, the Takagi–Sugeno (T–S) fuzzy system emerges as a highly effective tool. This system leverages fuzzy logic to map input and output values to approximate a nonlinear system as multiple linear systems which are easier to model. Fuzzy

ROBOTICS

MIT Engineers Design Flexible "Skeletons" For Soft, Muscle-Powered Robots

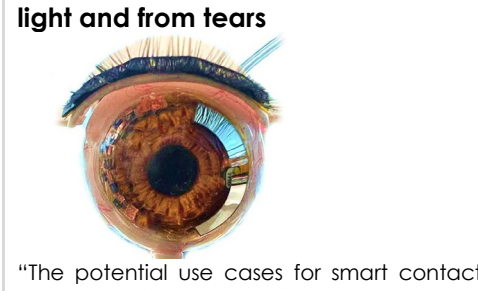


"Our muscles are nature's perfect actuators — devices that turn energy into motion. For their size, muscle fibers are more powerful and precise than most synthetic actuators. They can even heal from damage and grow stronger with exercise.

For these reasons, engineers are exploring ways to power robots with natural muscles. They've demonstrated a handful of "biohybrid" robots that use muscle-based actuators to power artificial skeletons that walk, swim, pump, and grip. But for every bot, there's a very different build, and no general blueprint for how to get the

SMART CONTACT LENS

Blink to Generate Power for Smart Contact Lenses: A dual-mode power pack harvests energy from light and from tears



"The potential use cases for smart contacts are compelling and varied. Pop a lens on your eye and monitor health metrics like glucose levels; receive targeted drug delivery for ocular diseases; experience augmented reality and read news updates with displays of information literally in your face.

But the eye is quite a challenge for electronics design: With one of the highest nerve densities of any human tissue, the cornea is 300 to 600 times as sensitive as our skin. Researchers have developed small, flexible chips, but power sources have

Typically, these devices require extensive calibration for each user — every brain is different, both for healthy and disabled users — and that has been a major hurdle to mainstream adoption. This new solution can quickly understand the needs of an individual subject and self-calibrate through repetition. That means multiple patients could use the device without needing to tune it to the individual.

"When we think about this in a clinical setting, this technology will make it so we won't need a specialized team to do this calibration process, which is long and tedious," said Satyam Kumar, a graduate student in the lab of José del R. Millán, a professor in the Cockrell School of Engineering's Chandra Family Department of Electrical and Computer Engineering and Dell Medical School's Department of Neurology. "It will be much faster to move from patient to patient."

The research on the calibration-free interface is published in PNAS Nexus."

Source: UTEXAS (29 Mar 2024)

logic is a form of mathematical logic in which, instead of requiring all statements to be true (1) or false (0), the truth values can be any value between 0 and 1. T–S fuzzy system has thus served as the foundation for several nonlinear control methods, with the Parallel Distributed Compensator (PDC) method being the most prominent.

Furthermore, scientists have developed an enhanced version of this system, known as the fuzzy descriptor system (FDS). It combines the T–S fuzzy system with the powerful space–state representation, which describes a physical system in terms of state variables, input variables, and output variables. Despite extensive research, optimal control strategies in the context of T–S FDSs are still largely unexplored. Additionally, while robust control methods, which protect against disturbances, have been explored for T–S FDS using methods like Linear Matrix Inequalities (LMI), these methods introduce additional complexity and optimization challenges.

To overcome these limitations, a group of researchers, led by Associate Professor Ngoc-Tam Bui from the Innovative Global Program of the College of Engineering at Shibaura Institute of Technology in Japan and including Thi-Van-Anh Nguyen, Quy-Thinh Dao, and Duc-Binh Pham, all from Hanoi University of Science and Technology, developed novel optimal and robust-optimal controllers based on the T–S fuzzy descriptor model. Their study was published in the journal Scientific Reports on March 07, 2024."

Source: SHIBAURA (8 Apr 2024)

most out of muscles for any given robot design.

Now, MIT engineers have developed a spring-like device that could be used as a basic skeleton-like module for almost any muscle-bound bot. The new spring, or "flexure," is designed to get the most work out of any attached muscle tissues. Like a leg press that's fit with just the right amount of weight, the device maximizes the amount of movement that a muscle can naturally produce.

The researchers found that when they fit a ring of muscle tissue onto the device, much like a rubber band stretched around two posts, the muscle pulled on the spring, reliably and repeatedly, and stretched it five times more, compared with other previous device designs.

The team sees the flexure design as a new building block that can be combined with other flexures to build any configuration of artificial skeletons. Engineers can then fit the skeletons with muscle tissues to power their movements.

"These flexures are like a skeleton that people can now use to turn muscle actuation into multiple degrees of freedom of motion in a very predictable way," says Ritu Raman, the Brit and Alex d'Arbeloff Career Development Professor in Engineering Design at MIT. "We are giving roboticists a new set of rules to make powerful and precise muscle-powered robots that do interesting things."'

Source: MIT (8 Apr 2024)

proved more difficult, as big batteries and wires clearly won't do here. Existing applications offer less-than-ideal solutions like overnight induction charging and other designs that rely on some type of external battery.

Now, a team from the University of Utah says they've developed a better solution: an all-in-one hybrid energy-generation unit specifically designed for eye-based tech."

Source: IEEE Spectrum (1 Apr 2024)