ARCHITECTURE

Lina Bo Bardi: Architect of Brazilian Modernism
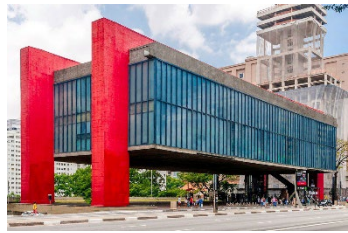
"The Italian-born Lina Bo Bardi dedicated her adult life to Brazil, the country that gave her the space to practice as an architect and designer. Her São Paulo Museum of Art, with a glass-enclosed interior that effortlessly hangs above its plaza thanks to four bright red support pillars, is an iconic example of Brazilian modernism. Yet, working at the same time as architects like Oscar Niemeyer and Lucio Costa saw Bo Bardi's work overshadowed for decades.

Source: JSTOR (2 May 2023)

AI

### Structured Exploration Allows Biological Brains to Learn Faster Than AI

"Neuroscientists have uncovered how exploratory actions enable animals to learn their spatial environment more efficiently. Their findings could help build better AI agents that can learn faster and require less experience.

Researchers at the Sainsbury Wellcome Centre and Gatsby Computational Neuroscience Unit at UCL found the instinctual exploratory runs that animals conduct is not random. These purposeful actions allow mice to learn a map of the world efficiently. The study, published today in Neuron, describes how neuroscientists evaluated their hypothesis that the specific exploratory actions that animals undertake, such as darting quickly towards objects, are important in helping them learn how to navigate their environment..."

Source: Sainsbury Wellcome Centre (28 April 2023)

AI

Study Finds ChatGPT Outperforms Physicians in High-Quality, Empathetic Answers to Patient Questions
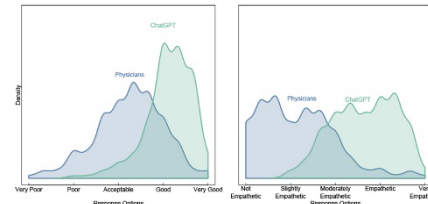
"A new study published in JAMA Internal Medicine led by John W. Ayers, Ph.D., from the Qualcomm Institute at University of California San Diego provides an early glimpse into the role that AI assistants could play in medicine. The study compared written responses from physicians and those from ChatGPT to real-world health questions. A panel of licensed healthcare professionals preferred ChatGPT's responses 79% of the time and rated ChatGPT's responses as higher quality and more empathetic.

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Source: UCSD (28 April 2023)

COMPUTATIONAL BIOLOGY

'Remarkable' AI Tool Designs mRNA Vaccines That Are More Potent and Stable


"An artificial intelligence (AI) tool that optimises the gene sequences found in mRNA vaccines could help to create jabs with greater potency and stability that could be deployed across the globe.

Developed by scientists at the California division of Baidu Research, an AI company based in Beijing, the software borrows techniques from computational linguistics to design mRNA sequences with more-intricate shapes and structures than those used in current vaccines. This enables the genetic material to persist for longer than usual. The more stable the mRNA that's delivered to a person's cells, the more antigens are produced by the protein-making machinery in that person's body. This, in turn, leads to a rise in protective antibodies, theoretically leaving immunised individuals better equipped to fend off infectious diseases."

Source: Nature (2 May 2023)

NEUROSCIENCE

### Mind-Reading Machines Are Here: Is It Time to Worry?
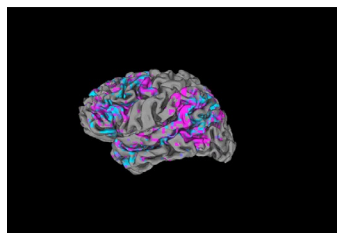
"The little voice inside your head can now be decoded by a brain scanner — at least some of the time. Researchers have developed the first non-invasive method of determining the gist of imagined speech, presenting a possible communication outlet for people who cannot talk. But how close is the technology — which is currently only moderately accurate — to achieving true mind-reading? And how can policymakers ensure that such developments are not misused?

Most existing thought-to-speech technologies use brain implants that monitor activity in a person's motor cortex and predict the words that the lips are trying to form. To understand the actual meaning behind the thought, computer scientists Alexander Huth and Jerry Tang at the University of Texas at Austin and their colleagues combined functional magnetic resonance imaging (fMRI), a non-invasive means of measuring brain activity, with artificial intelligence (AI) algorithms called large language models (LLMs), which underlie tools such as ChatGPT and are trained to predict the next word in a piece of text."

Source: Nature (2 May 2023)

PHOTOLUMINESCENCE

Structural and Photoluminescence Characterisation of Oxyfluorides for Phosphor Applications
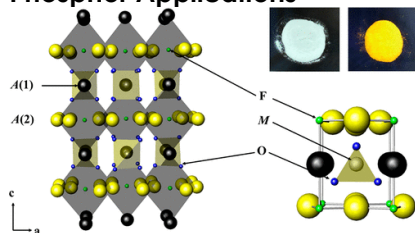
"Rare-earth-containing phosphors were crucial to the advances made to compact fluorescent lamps (CFLs), which assisted in protecting a widely used halophosphate phosphor from degrading after exposure to a high ultraviolet flux. The CFL phosphors are often coated twice by depositing a light coat of rare-earth-containing phosphors over the inexpensive halophosphate phosphor, which generates white light with high efficacy and a good color rendering index and possesses a balance between phosphor cost and performance. Costs of phosphors can be mitigated by requiring lower rare-earth ion concentrations or by completely eliminating rare-earth ions, which was one of the main goals of investigating the oxyfluorides Sr3AlO4F and Ba2SrGaO4F as potential phosphors."

Source: ACS (28 April 2023)

PHOTOLUMINESCENCE

Researchers Explore Why Some People Get Motion Sick Playing VR Games While Others Don't

"Cybersickness is a form of motion sickness that occurs from exposure to immersive VR and augmented reality applications.

A new study, led by researchers at the University of Waterloo, found that the subjective visual vertical – a measure of how individuals perceive the orientation of vertical lines – shifted after participants played a high-intensity VR game.

"Our findings suggest that the severity of a person's cybersickness is affected by how our senses adjust to the conflict between reality and virtual reality," said Michael Barnett-Cowan, a professor in the Department of Kinesiology and Health Sciences. "This knowledge could be invaluable for developers and designers of VR experiences, enabling them to create more comfortable and enjoyable environments for users."

Source: Uwaterloo (1 May 2023)

ROBOTICS

Highly Dexterous Robot Hand Can Operate in the Dark — Just Like Us
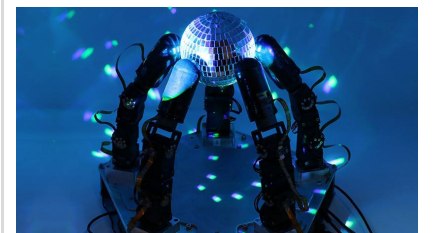
"Researchers at Columbia Engineering have demonstrated a highly dexterous robot hand, one that combines an advanced sense of touch with motor learning algorithms to achieve a high level of dexterity.

As a demonstration of skill, the team chose a difficult manipulation task: executing an arbitrarily large rotation of an unevenly shaped grasped object in hand while always maintaining the object in a stable, secure hold. This is a very difficult task because it requires constant repositioning of a subset of fingers, while the other fingers have to keep the object stable. Not only was the hand able to perform this task, but it also did it without any visual feedback whatsoever, based solely on touch sensing.

In addition to the new levels of dexterity, the hand worked without any external cameras, so it's immune to lighting, occlusion, or similar issues. And the fact that the hand does not rely on vision to manipulate objects means that it can do so in very difficult lighting conditions that would confuse vision-based algorithms--it can even operate in the dark..."

Source: Columbia (28 April 2023)

ROUTING PROBLEM

The First AI4TSP Competition: Learning to Solve Stochastic Routing Problems


"This paper reports on the first international competition on AI for the traveling salesman problem (TSP) at the International Joint Conference on Artificial Intelligence 2021 (IJCAI-21). The TSP is one of the classical combinatorial optimisation problems, with many variants inspired by real-world applications. This first competition asked the participants to develop algorithms to solve an orienteering problem with stochastic weights and time windows (OPSWTW). It focused on two learning approaches: surrogate-based optimisation and deep reinforcement learning. In this paper, we describe the problem, the competition setup, and the winning methods, and give an overview of the results. The winning methods described in this work have advanced the state-of-the-art in using AI for stochastic routing problems. Overall, by organising this competition we have introduced routing problems as an interesting problem setting for AI researchers. The simulator of the problem has been made open-source and can be used by other researchers as a benchmark for new learning-based methods.

Source: ScienceDirect (June 2023)

SUSTAINABILITY

### Artificial Photosynthesis for Environmentally Friendly Food Production
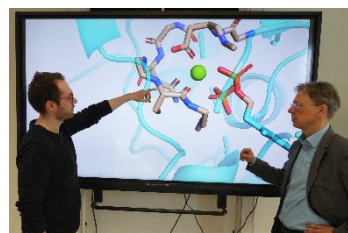
"A group led by Prof. Volker Sieber at the TUM Campus Straubing for Biotechnology and Sustainability (TUMCS) has succeeded in producing the amino acid L-alanine, an essential building block in proteins, from the environmentally harmful gas CO2. Their indirect biotechnological process involves methanol as an intermediate. Until now, protein for animal feed has been typically produced in the southern hemisphere with large-scale agricultural space requirements and negative consequences for biodiversity.

The CO2, which is removed from the atmosphere, is first turned into methanol using green electricity and hydrogen. The new method converts this intermediate into L-alanine in a multi-stage process using synthetic enzymes; the method is extremely effective and generates very high yields. L-alanine is one of the most important components of protein, which is essential to the nutrition of both humans and animals."

Source: TUM (27 April 2023)

TRANSISTORS

### MIT Engineers "Grow" Atomically Thin Transistors on Top Of Computer Chips
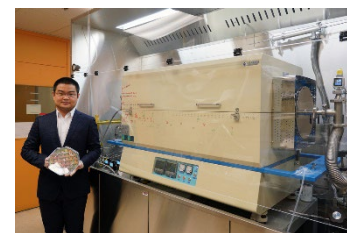
""Using 2D materials is a powerful way to increase the density of an integrated circuit. What we are doing is like constructing a multistorey building. If you have only one floor, which is the conventional case, it won't hold many people. But with more floors, the building will hold more people that can enable amazing new things. Thanks to the heterogeneous integration we are working on, we have silicon as the first floor and then we can have many floors of 2D materials directly integrated on top," says Jiadi Zhu, an electrical engineering and computer science graduate student and co-lead author of a paper on this new technique.

Zhu wrote the paper with co-lead-author Ji-Hoon Park, an MIT postdoc; corresponding authors Jing Kong, professor of electrical engineering and computer science (EECS) and a member of the Research Laboratory for Electronics; and Tomás Palacios, professor of EECS and director of the Microsystems Technology Laboratories (MTL); as well as others at MIT, MIT Lincoln Laboratory, Oak Ridge National Laboratory, and Ericsson Research. The paper appears today in Nature Nanotechnology."

Source: MIT (27 April 2023)

WAVE PROPAGATION DYNAMICS

Wave Propagation Dynamics Inside A Complex Scattering Medium By The Temporal Control Of Backscattered Waves
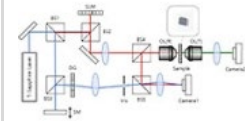
"Shaping the wavefront of an incident wave to a complex scattering medium has demonstrated interesting possibilities, such as sub-diffraction wave focusing and light energy delivery enhancement. However, wavefront shaping has mainly been based on the control of transmitted waves that are inaccessible in most realistic applications. Here, we investigate the effect of maximising the backscattered waves at a specific flight time on wave propagation dynamics and energy transport. We find both experimentally and numerically that the maximisation at a short flight time focuses waves on the particles constituting the scattering medium, leading to the attenuation of the wave transport. On the contrary, maximisation at a long flight time induces constructive wave interference inside the medium and thus enhances wave transport. We provide a theoretical model that explains this interesting transition behavior based on wave correlation. Our study provides a fundamental understanding of the effect of wave control on wave dynamics inside scattering medium."

Source: Optica (1 May 2023)