SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

# Weekly Discovery

We SHARE to inspire and ignite ideas!

7 Aug – 11 Aug 2023

AI

## As Militaries Adopt AI, Hype Becomes a Weapon

"Excitement about generative artificial intelligence has reached fever pitch since the launch of ChatGPT and image engines like MidJourney in the past year. Yet both elation or anxiety about the new technology's applications in the present lead soon to bigger, existential projections about the future. With the exception of the "singularity" and AI replacing humanity directly, no outcome provokes quite the same amount of anxiety as the effect AI could have on warfare. Could autonomous weaponry and strategy bots oppress civilians, defy human operators—or even ignite World War III?"

Source: JSTOR (4 Aug 2023)

ARCHITECTURE

## Concrete Jungle: Houses That Explore the Contrast Between Concrete and Vegetation

"There is something very attractive about the combination of lush vegetation and exposed concrete roughness. This is what the book Concrete Jungle: Tropical Architecture and Its Surprising Origins, published by Gestalten, proposes to investigate. The publication offers a reading on modern "tropical architecture", presenting houses located between the Tropics of Cancer and Capricorn and their relationships with their cultural, constructive, and environmental origins. It features several projects and architects, from the 1950s to the present day, tracing a multifaceted panorama that includes residential buildings located in regions as distinct as Brazil, Mexico, India, and Kenya."

Source: ArchDaily (6 Aug 2023)

Cybersecurity

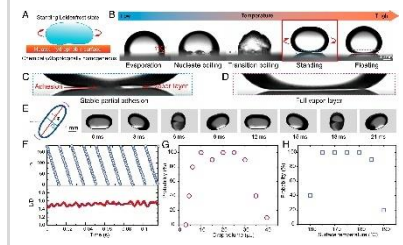
## Rethink Physical Security: Protecting Vehicles via Battery-Enabled Sensing and Control [Point of View]

"Cyberisation is the foundation of vehicle electrification and automation, requiring the deployment of ever-increasing on-board sensing, communication, and computing services. However, vehicle cyberisation also introduces new cyber vulnerabilities. In this article, we discuss the opportunities and challenges of using the common 12/24V automotive batteries as sensors and actuators to provide vehicles with three-pronged physical security protection: driver authentication, vehicle access control, and vehicle intrusion detection."

Source: IEEE (1 Aug 2023)

ENGINEERING

## A Standing Leidenfrost Drop with Sufi Whirling




"When a water drop is placed on a hot solid surface, it either undergoes explosive contact boiling or exhibits a stable state. In the latter case, the drop floats over an insulating layer of vapor generated by rapid vaporisation of water at the surface/drop interface; this is known as the Leidenfrost state. Here, we discuss a previously unrecognised steady state in which a water drop "stands" on a hot smooth surface. In this state, the drop stabilises itself with partial adhesion on the hot surface, leading to unique deformation and rotation behaviour reminiscent of Sufi whirling—a form of spinning dance. Our analysis of this standing Leidenfrost state reveals the underlying mechanisms that drive the drop's stable partial adhesion and subsequent deformation with rotation. The heat-transfer efficiency of this standing state is up to 390% greater than that of the traditional floating Leidenfrost state."

Source: PNAS (1 Aug 2023)

ENGINEERING

## 3D Display Could Soon Bring Touch to The Digital World

"Imagine an iPad that's more than just an iPad—with a surface that can morph and deform, allowing you to draw 3D designs, create haiku that jump out from the screen and even hold your partner's hand from an ocean away.

That's the vision of a team of engineers from CU Boulder. In a new study, they've created a one-of-a-kind shape-shifting display that fits on a card table. The device is made from a 10-by-10 grid of soft robotic "muscles" that can sense outside pressure and pop up to create patterns. It's precise enough to generate scrolling text and fast enough to shake a chemistry beaker filled with fluid.

It may also deliver something even rarer: the sense of touch in a digital age.

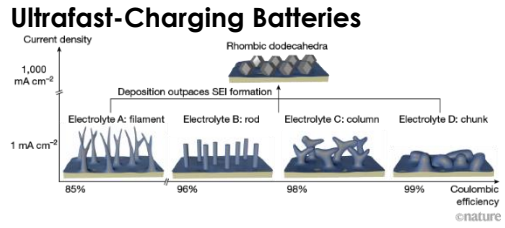
"As technology has progressed, we started with sending text over long distances, then audio and now video," said Brian Johnson, one of two lead authors of the new study who earned his doctorate in mechanical engineering at CU Boulder in 2022. "But we're still missing touch."

Johnson and his colleagues described their shape display July 31 in the journal "Nature Communications."

Source: Colorado (31 July 2023)

NEXT GENERATION BATTERIES

## Lithium Forms Perfect Polyhedra in Ultrafast-Charging Batteries

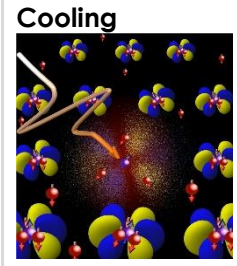



"The operation of today's lithium-ion batteries depends on the movement of lithium ions through the electrolyte between the anode and the cathode. By contrast, future batteries known as lithium-metal batteries will store more energy than lithium-ion batteries and will be charged through electrodeposition — a process in which ions are reduced to their metallic form at the anode. The performance of such batteries largely depends on the shape (morphology) of the lithium-metal deposits, which can vary drastically. Although scientists have known about electrodeposition for more than two centuries and it is now widely commercialised, lithium-metal electrodeposition does not follow any established theories that predict deposit morphology."

Source: Nature (27 Jul 2023)

QUANTUM MECHANICS

## When Electrons Slowly Vanish During Cooling



"Researchers observe an effect in the quantum world that does not exist in the macrocosm.

Many substances change their properties when they are cooled below a certain critical temperature. Such a phase transition occurs, for example, when water freezes. However, in certain metals there are phase transitions that do not exist in the macrocosm. They arise because of the special laws of quantum mechanics that apply in the realm of nature's smallest building blocks. It is thought that the concept of electrons as carriers of quantised electric charge no longer applies near these exotic phase transitions. Researchers at the University of Bonn and ETH Zurich have now found a way to prove this directly. Their findings allow new insights into the exotic world of quantum physics. The publication has now been released in the journal Nature Physics."

Source: UBonn (31 July 2023)

ROBOTS

## Robots Cause Company Profits to Fall – At Least At First

"The researchers, from the University of Cambridge, studied industry data from the UK and 24 other European countries between 1995 and 2017, and found that at low levels of adoption, robots have a negative effect on profit margins. But at higher levels of adoption, robots can help increase profits.

According to the researchers, this U-shaped phenomenon is due to the relationship between reducing costs, developing new processes, and innovating new products. While many companies first adopt robotic technologies to decrease costs, this 'process innovation' can be easily copied by competitors, so at low levels of robot adoption, companies are focused on their competitors rather than on developing new products. However, as levels of adoption increase and robots are fully integrated into a company's processes, the technologies can be used to increase revenue by innovating new products.

In other words, firms using robots are likely to focus initially on streamlining their processes before shifting their emphasis to product innovation, which gives them greater market power via the ability to differentiate from their competitors. The results are reported in the journal IEEE Transactions on Engineering Management."

Source: CAMBRIDGE (3 Aug 2023)

SUPERCONDUCTORS

## Claimed Superconductor LK-99 Is an Online Sensation — But Replication Efforts Fall Short

"A Korean team's claim to have discovered a superconductor that works at room temperature and ambient pressure has become a viral sensation — and prompted a slew of replication efforts by scientists and amateurs alike. But initial efforts to experimentally and theoretically reproduce the buzzworthy result have come up short, and researchers remain deeply sceptical.

The research team, led by Sukbae Lee and Ji-Hoon Kim at the start-up firm Quantum Energy Research Centre in Seoul said in preprints published on 25 July1,2 that a compound of copper, lead, phosphorus and oxygen, dubbed LK-99, is a superconductor at ambient pressure and temperatures above 127 °C (400 Kelvin)."

Source: Nature (4 Aug 2023)

TECH

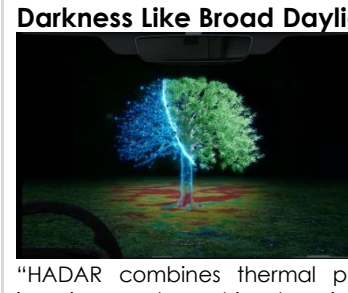
## Way Cool: UVA Professor Developing 'Freeze Ray' Technology for the Air Force

"You know that freeze-ray gun that "Batman" villain Mr. Freeze uses to "ice" his enemies? A University of Virginia professor thinks he may have figured out how to make one in real life.
The discovery – which, unexpectedly, relies on heat-generating plasma – is not meant for weaponry, however. Mechanical and aerospace engineering professor Patrick Hopkins wants to create on-demand surface cooling for electronics inside spacecraft and high-altitude jets.
"That's the primary problem right now," Hopkins said. "A lot of electronics on board heat up, but they have no way to cool down."
The U.S. Air Force likes the prospect of a freeze ray enough that it has granted the professor's ExSiTE Lab (Experiments and Simulations in Thermal Engineering) $750,000 over three years to study how to maximise the technology.
From there, the lab will partner with Hopkins' UVA spinout company, Laser Thermal, for the fabrication of a prototype device."

Source: UVA (28 July 2023)

THERMAL IMAGING

## Purdue Thermal Imaging Innovation Allows AI To See Through Pitch Darkness Like Broad Daylight



"HADAR combines thermal physics, infrared imaging, and machine learning to pave the way to fully passive and physics-aware machine perception.

"Our work builds the information theoretic foundations of thermal perception to show that pitch darkness carries the same amount of information as broad daylight. Evolution has made human beings biased toward the daytime. Machine perception of the future will overcome this long-standing dichotomy between day and night," Jacob said.

Bao said, "HADAR vividly recovers the texture from the cluttered heat signal and accurately disentangles temperature, emissivity and texture, or TeX, of all objects in a scene. It sees texture and depth through the darkness as if it were day and also perceives physical attributes beyond RGB, or red, green, and blue, visible imaging or conventional thermal sensing. It is surprising that it is possible to see through pitch darkness like broad daylight."

Source: Purdue (1 Aug 2023)

VR

## Modified Virtual Reality Tech Can Measure Brain Activity

"Researchers have modified a commercial virtual reality headset, giving it the ability to measure brain activity and examine how we react to hints, stressors, and other outside forces.
The research team at The University of Texas at Austin created a non-invasive electroencephalogram (EEG) sensor that they installed in a Meta VR headset that can be worn comfortably for long periods. The EEG measures the brain's electrical activity during the immersive VR interactions.
The device could be used in many ways, from helping people with anxiety, to measuring the attention or mental stress of aviators using a flight simulator, to giving a human the chance to see through the eyes of a robot.
"Virtual reality is so much more immersive than just doing something on a big screen," said Nanshu Lu, a professor in the Cockrell School of Engineering's Department of Aerospace Engineering and Engineering Mechanics who led the research. "It gives the user a more realistic experience, and our technology enables us to get better measurements of how the brain is reacting to that environment."

Source: UTEXAS (3 Aug 2023)