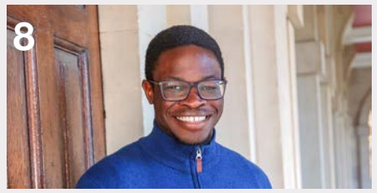
AUTUMN 2025
ISSUE 36

DEPARTMENT OF ENGINEERING

NEWS

UNIVERSITY OF CAMBRIDGE

In this issue



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Cover image: Professor Shaun Fitzgerald from the Centre for Climate Repair. Some of his team conducted experiments in Canada recently. Early results showed ice growth of about half a metre. Credit: Bernard Steffin. *This image has been edited with AI.*

Note from the editors

In this edition, we are delighted to share the achievements of engineers and technicians who have contributed to projects that are a little out of the ordinary.

We introduce the Department's Design and Technical Services team who designed and built the University's debut exhibit at this year's RHS Chelsea Flower Show. The exhibit, presented by the Sainsbury Laboratory Cambridge University, won a silver-gilt medal! The finished structure is a testament to the creative vision of a talented team that day to day work across a wide range of projects from designing and manufacturing medical devices to 3D printing high-performance stainless steels, and more (see page 9).

Then we have the engineers who are using structural modelling and vibration measurements to help 'save' the largest London plane tree in the UK. Their solution is a new cable bracing system that provides structural support to the tree whilst allowing it to move as naturally as possible. This conservation project is unique in bringing together arboriculturists, ecologists, engineers and educators, and is being supported by a National Lottery Heritage Fund grant (page 17).

Lastly, Research Fellow Dr Babak Bakhit has joined a European Space Agency mission to investigate signs of life on Jupiter's icy moons. The JUpiter ICy moons Explorer (JUICE) spacecraft is due to reach Jupiter in July 2031 and will orbit the planet while investigating its three ocean-bearing icy moons. Dr Bakhit was responsible for applying a protective coating to state-of-the-art sensors that make up the radio and plasma wave instrument. He describes this project as one of his most challenging to date (page 19).

Charlotte Hester and Jacqueline Saggers
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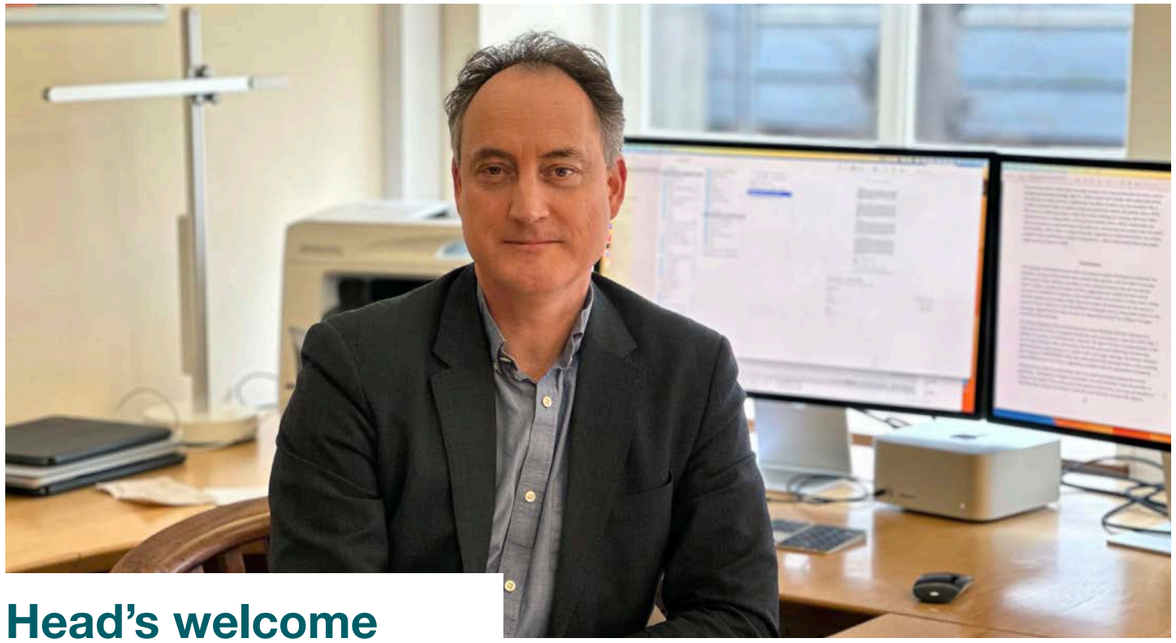


Head's welcome

Welcome to this latest edition of the Department of Engineering News for Autumn 2025.

Since the last newsletter, we have made significant advances in the push to reintegrate the Department in Cambridge West. Over the summer, the University Council approved its first ever capital plan, which lays out the funding envelope for building projects over the coming 10-20 years.

One of the first projects chosen for funding is "Technology West", which is predominantly based around Engineering. This will initially include the redevelopment of the Roger Needham Building as an AI/robotics hub and then the construction of the new teaching block, followed by a research hub for the remainder of the Trumpington Street activities.

We are at a point now where fundraising needs to begin in earnest. Construction on the New Whittle Laboratory has just completed, and by the time you read this, we will have started to move in. Some elements of the building will require additional work over the coming months, e.g. the demolition of some of the old sections and a complete installation of the National Centre for Propulsion and Power.

The new MPhil in Electrical Engineering has passed the final approval stage, is ready to go, and is due to have its first intake of students in Michaelmas term 2026.

The reform of Part I continues to move forwards under Professor Seb Savory's leadership, and the outline will be taken to the relevant University bodies over the coming two terms so that we can modify the prospectus in time for next summer. We will also have an accreditation visit in January 2026, during which we will have the opportunity to gain some input from the Professional Engineering Institutions. We are currently still on track to launch the new Part I in Michaelmas 2027.

This year, we continue to have record numbers of applications for our Tripos and have just now exceeded the ratio of applications:places of 10:1.

Looking through this edition of the newsletter, starting with the cover story, which then appears on **page 5**, you will see Professor Shaun Fitzgerald on a recent trip to Canada where he has been leading research on climate repair and looking at refreezing the Arctic. Professor Fitzgerald has recently been successful in obtaining significant tranches of funding from the Advanced Research and Invention Agency (ARIA) to take this work forward.

On **page 6** is an update on alumnus Alex Kendall's Wayve story – the UK AI company has recently signed a major partnership deal with Uber on the rollout of their embodied AI for autonomous driving.

On **page 8** is a piece on STEM SMART – I am very proud that Engineering continues to be involved in and supports this scheme, which is a widening-participation activity, and has helped many UK state school students to not only improve their maths, physics, chemistry and biology grades, but to reach their aspiration of applying to Cambridge or Oxford.

On **pages 11 to 13** you will see a series of pieces on the applications of AI to a range of problems including body fat/composition mapping, weather prediction and water management. This is a prime example of a core strength of the Department to initially develop the fundamental underpinning methods, in this case, machine learning and machine intelligence, and then seek to apply it to some of the pressing challenges of our age.

Then on **pages 20 and 21** are two stories on the energy transition. The first is a piece about electric aviation and how the Whittle Laboratory is working with a number of partners in this space. The second is to do with some work that has come out of the Cambridge Centre for Advanced Research and Education in Singapore (CARES) on moving away from fossil fuels for the chemical industry and energy systems in general, focusing on the use of hydrogen and ammonia.

Throughout the rest of the newsletter, you will see a wide range of stories about faculty, alumni and undergraduates, and as always, I hope you will find something interesting.

Professor Colm Durkan FREng FInstP FIET

→ Robot dexterity – made with AI

Credit: ChatGPT

Three Cambridge robotics projects part of £57m ARIA programme

The UK's Advanced Research and Invention Agency (ARIA) has launched a £57 million initiative to revolutionise robotic capabilities and deliver a step change in human productivity. Cambridge researchers will lead three projects developing new forms of tactile perception, control strategies and co-evolving robot designs.

ARIA's Robot Dexterity programme aims to overcome the current limitations of robotic manipulation by supporting breakthroughs in sensing, materials, control and machine learning.

Led by Professor Jenny Read, a founding programme director at ARIA and Professor of Vision Science at Newcastle University, the initiative reflects ARIA's focus on high-risk, high-reward research. Rather than supporting incremental improvements, ARIA encourages bold, interdisciplinary ideas that could unlock new levels of robot adaptability and control.

By fostering collaboration between scientists, engineers and industry partners, the programme is helping to bridge the software-hardware divide in robotics and accelerate the deployment of next-generation systems.

Cambridge leads in advanced robotic perception

One of the Cambridge-led projects focuses on next-generation electronic skin (e-skin) to improve robots' ability to perceive and respond to their environments. Professor Tawfique Hasan, Head of the NanoEngineering Group at the Electrical Engineering Division in the Department of Engineering, leads this work with a team combining expertise in nanomaterials, sensors and robotics.

Drawing on years of research in nanomaterials, the group is designing e-skins with miniaturised sensors that detect force in three dimensions and temperature in real time. The goal is to give robots a sense of touch that approaches human capability – critical for manipulating delicate objects or operating in unstructured environments.

"We are focused on designing e-skin systems that offer high sensory density, large coverage and superior force sensitivity," said Professor Hasan. "The integration of advanced nanomaterial-based sensors into robotic systems is a significant step towards developing robots capable of performing complex, force-sensitive tasks."

The project brings together Dr Guolin Yun, an expert in liquid metal systems and robotic sensor integration, and Dr Zhuo Chen, a specialist in sensor array fabrication and commercialisation. With additional expertise in electronics and system testing, the team is working to translate their lab-scale technologies into scalable solutions for industry.

A second Cambridge project, led by Professor Fumiya Iida, also from the Department of Engineering, is developing a scalable and flexible tactile sensing system based on Electrical Impedance Tomography (EIT). This system is designed to support real-time, closed-loop control for robots performing force-sensitive manipulation tasks – such as using scissors, screwdrivers or chopsticks.

"Advancing the manipulation of tools with robots is a key challenge," said Professor Iida. "Our work will push the boundaries of what robots can do, making them more adaptable and capable of performing a range of sensitive tasks traditionally reserved for humans."

The team aims to optimise key performance metrics – high sensory density, broad coverage, fast response times and robustness – while ensuring compatibility with existing robotic platforms. The long-term goal is to enable reliable, scalable tactile systems that can be widely deployed across sectors.

And Dr Rika Antonova from the Department of Computer Science and Technology is rethinking how robots learn and adapt to the physical world. Her project titled *Adaptive global optimisation for co-evolving hardware and policy learning (Ada-GO)* is developing a framework where robot bodies and control algorithms evolve together, guided by real-world performance data.

"Robots still struggle with many real-world tasks like recycling, agriculture and care work," said Dr Antonova. "We want to speed up how they learn to be useful, reliable and affordable."

Written by Michael Shuff

Read the full article at:
www.eng.cam.ac.uk/aria-robotics

→ Professor Shaun Fitzgerald from the Centre for Climate Repair. Some of his team conducted experiments in Canada recently, before receiving ARIA funding. Early results showed ice growth of about half a metre

Credit: Bernard Steffin

Can we cool the Earth? Cambridge scientists to lead research

Scientists are exploring ways to cool the Earth alongside vital emissions reduction.

Through controlled, small-scale outdoor experiments, they will assess the potential to re-thicken Arctic sea ice and whether there are natural, non-toxic materials that could be suitable for stratospheric aerosol injection. This will be done without releasing materials into the atmosphere.

The research is funded by the Advanced Research and Invention Agency (ARIA), as part of its Exploring Climate Cooling programme.

"There is a growing need for innovative solutions to combat the effects of climate change alongside emissions reduction," says Professor Shaun Fitzgerald from the Centre for Climate Repair, who is leading one of the teams.

"While emissions reduction is essential, it may not be enough to avoid catastrophic warming. By researching potential climate cooling approaches that are scalable, this programme offers a timely opportunity to build a knowledge base to better understand approaches that could help stabilise the Earth's climate and protect vulnerable ecosystems and communities."

Professor Fitzgerald's team will explore the feasibility of thickening sea ice in the Arctic to mitigate the loss of sea ice coverage and potentially cool the region.

"We've been seeing year-on-year reductions in the areal extent and volume of sea ice," says Professor Fitzgerald. "This has a significant impact on people who live in the Arctic. It's affecting how they move around, and it is changing the migration patterns of wildlife such as caribou, which in turn also affects the livelihoods of indigenous people."

The loss of sea ice also has a major impact on the global heat balance in the summer. Instead of the Arctic being covered with a white reflective sheet of ice, more of it is now a dark-blue ocean. The dark ocean absorbs a large proportion of the incoming radiation in the summer, whereas previously the white sea ice reflected it.

"Working with people in the High Arctic, we want to investigate ways to potentially reduce the rate of loss and potentially even rebuild some of the sea ice as a temporary measure until we fix the underlying problem, which is our emissions of greenhouse gases," said Professor Fitzgerald.

The team includes researchers from the Universities of Cambridge, Manchester and Washington, Arizona State University, University College London and teams from Real Ice and Arctic Reflections.

Together with members of local communities, they will conduct controlled, small-scale experiments in Canada across three winter seasons (2025-26 to 2027-28). The process involves pumping seawater from beneath existing ice and spreading it on top, where the frigid air freezes it quickly, creating thicker ice patches.

It will build on modelling and laboratory research, as well as environmental assessments and community engagement. By gathering real-world data, they aim to assess whether the intervention warrants further investigation.

Meanwhile, Professor Hugh Hunt from the Department of Engineering at the University of Cambridge is leading a project to advance the field of stratospheric aerosol injection (SAI).

SAI is based on the idea that aerosols in the stratosphere can reflect solar radiation and limit the amount that reaches the Earth. It is a widely discussed method, but the most commonly proposed materials – sulphates – carry significant hazards in this context. Professor Hunt's team will study the properties and behaviour of other natural materials.

As part of the study, specifically adapted weather balloons will carry tiny samples of potential materials into the stratosphere for varied exposure periods. No materials will be released; the recovered samples will effectively reveal how stratospheric conditions affect their properties over time.

Testing this foundational science will help the scientists to better understand the potential impacts of SAI and inform any future research.

These projects are just part of a new programme funded by ARIA.

Read the full article at:
www.eng.cam.ac.uk/aria-earth

→ Alex Kendall, Wayve co-founder and CEO

Credit: [LEFT] Wayve. [RIGHT] Oscar de Wit-Snijder from Pixabay

Wayve – a pioneer in Embodied AI for autonomous driving – partners with Uber for trials in the UK

UK AI company Wayve – co-founded by alumnus Alex Kendall in 2017 while studying for his PhD at Cambridge – has announced a partnership with Uber to develop and launch public road trials of fully autonomous vehicles in the UK.

The announcement made earlier this year highlights the UK as the largest market where Uber has announced an intention to pilot Level 4 (L4) autonomous vehicles. Wayve has said these trials will combine its industry-leading Embodied AI platform with Uber's global mobility network, marking a significant step forward in bringing autonomous vehicles to the streets of Europe at scale.

The opportunity has been enabled by the UK Secretary of State for Transport's announcement of an accelerated framework for self-driving commercial pilots, a crucial step towards making the UK a world leader in this technology. Wayve and Uber will collaborate with the UK Government and Transport for London on the permitting and regulatory approval process prior to launch.

London and other UK cities represent complex driving environments, with significantly different road layouts and traffic laws compared to locations in the US, where a majority of global L4 testing has until now been conducted. The lessons learnt from the UK will therefore be a major step forward in the development of L4 technology for deployment in cities around the world.

Alex Kendall, CEO and co-founder of Wayve, said: "This is a defining moment for UK autonomy. With Uber and a global OEM partner, we're preparing to put our AI Driver technology into real service on the streets of London, delivering on our AV2.0 vision for scalable autonomy. Our Embodied AI learns to drive anywhere, in any vehicle, and this trial brings us closer to bringing safe and intelligent driving to everyday rides across the UK and beyond."

Andrew Macdonald, President and Chief Operating Officer of Uber, said: "We're excited to take the next step in our journey with Wayve, bringing autonomous mobility to one of the world's busiest and most complex urban environments. Wayve's globally scalable AV2.0 approach makes them an ideal partner to bring Uber's autonomous vision to reality in new cities around the world. Our vision is to make autonomy a safe and reliable option for riders everywhere, and this trial in London brings that future closer to reality."

Speaking at the time, Heidi Alexander, Secretary of State for Transport, said: "This agreement, between two leading names at the forefront of the sector, is a fantastic vote of confidence in this new technology. By fast tracking pilots of self-driving vehicles to spring 2026, we are excited to see safety-first tests that will drive growth, create 38,000 jobs and add £42 billion to our economy."

Wayve – the early days

It was during his PhD in Deep Learning, Computer Vision and Robotics, under the supervision of Professor Roberto Cipolla in the Machine Intelligence Laboratory, that the groundwork for what would become Wayve began to take shape. And in November 2024, Alex returned to Cambridge to give a talk at the Department of Engineering as part of the Department's 150th anniversary celebrations.

The Princess Royal Silver Medal

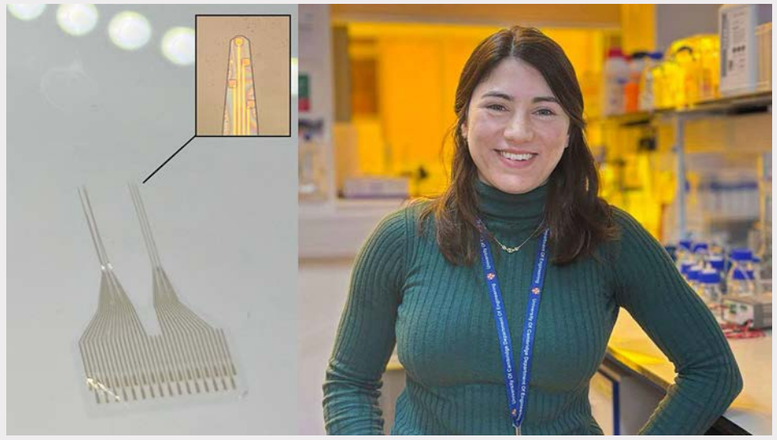
Alex has recently been presented with The Princess Royal Silver Medal for 2025 – one of the Royal Academy of Engineering's most prestigious individual awards.

Luke Logan FREng, Chair of the Academy's Awards Committee, said: "The winners of The Princess Royal Silver Medal for 2025 are each leading lights in their fields. They have transformed cutting-edge research into commercial success with their entrepreneurial leadership. They have also created technologies that have potential applications in multiple spheres that will have impact on future innovations for decades to come."

> This is a defining moment for UK autonomy. With Uber and a global OEM partner, we're preparing to put our AI Driver technology into real service on the streets of London.
>
> Alumnus Alex Kendall

Read the full article at:
www.eng.cam.ac.uk/wayve-uber
Watch Alex's talk at the Department:
youtu.be/tYoi7OSEyl8

→ [LEFT] Implantable electrocorticography device made using the heat treatment method. [RIGHT] Co-author Margaux Forner



Credit: [LEFT] Margaux Forner

Chance discovery improves stability of popular bioelectronic material used in medical research and computing

New research involving a team of scientists from the University of Cambridge, Rice University and Stanford University could make bioelectronic devices easier and more reliable to manufacture – all thanks to a chance discovery made during an experiment.

Using a heat-based approach, the scientists were able to streamline the production of a conductive composite material known as PEDOT:PSS, which is widely used in medical implants, computing applications and biosensors.

For more than two decades, scientists working with PEDOT:PSS have used a chemical crosslinker to make the conductive polymer stable in water. But now, new research, published in the journal *Advanced Materials*, reveals that heating PEDOT:PSS beyond the usual threshold not only makes it stable without needing any crosslinker, but it also creates higher quality devices. Potential applications include neural implants, biosensors and next-generation computing systems.

PEDOT:PSS is a blend of two polymers: one that conducts electronic charge and does not dissolve in water and another that conducts ionic charge and is water-soluble. Because it conducts both types of charges, PEDOT:PSS bridges the gap between living tissue and technology.

The researchers' new method produces a material with three times higher electrical conductivity and more consistent stability between batches – key advantages for medical applications.

"This method pretty much simplifies a lot of these problems that people have working with PEDOT:PSS," said co-author Dr Scott Keene from Rice University and a former postdoc at the Department of Engineering, University of Cambridge. "It also essentially eliminates a potentially toxic chemical."

The heat-based approach came to light during experiments looking at ways to precisely pattern the material for applications in biomedical optics. Co-first author Siddharth Doshi, a doctoral student at Stanford University, in collaboration with Dr Keene, skipped adding the crosslinker and used a higher temperature while prepping the material. To their surprise, the resulting sample turned out to be stable on its own – with no crosslinker needed.

Co-author Margaux Forner, PhD student in the Bioelectronics Laboratory at the Department of Engineering, University of Cambridge, said the heat-treated bioelectronic devices such as transistors, spinal cord stimulators and electrocorticography arrays[1], were easier to fabricate, more reliable and maintained high electrical performance.

"The devices made from heat-treated PEDOT:PSS proved to be robust in chronic *in vivo* experiments, maintaining stability for more than 20 days post implantation," she said. "Notably, the PEDOT:PSS thin film maintained excellent electrical performance when stretched, highlighting its potential for resilient bioelectronic devices both inside and outside the body."

By making PEDOT:PSS more reliable, this discovery could help advance neurotechnology, including implants to restore movement after spinal cord injuries and interfaces that link the brain to external devices.

Beyond simplifying fabrication, the research team found a way to pattern PEDOT:PSS into microscopic 3D structures – a breakthrough that could further improve bioelectronic devices. Using a high-precision femtosecond laser, the researchers can selectively heat sections of the material, creating custom textures that enhance how cells interact with the devices.

"We are really excited about the ability to 3D print the polymers at the microscale," said Siddharth Doshi. "This has been a major goal for the community, as writing this functional material in 3D could let you interface with the 3D world of biology. Typically, this is done by combining PEDOT:PSS with different photosensitive binders or resins; however, these additions affect the properties of the material or are challenging to scale down to micron-length scales."

[1] Implanted grids or strips of neuroelectrodes used to record brain activity.

Open access paper:
www.eng.cam.ac.uk/bioelectronic-material

Credit: Natalie Sloan-Glasberg / University of Cambridge

→ Samuel Iranloye, engineering undergraduate at Churchill College, joined STEM SMART before Cambridge

Cambridge's STEM SMART success

More than 700 state school students have seen their A-level grades rise and have secured places at top universities after receiving free Cambridge tuition through a UK-wide STEM SMART initiative.

The students were given free weekly tutoring by University of Cambridge academics following the COVID-19 pandemic after taking part in STEM SMART – the University's pioneering initiative to tackle educational disadvantage.

The most engaged of these students – more than 360 – saw their results jump by a grade on average across maths, further maths, physics, chemistry and biology. They were more than twice as successful in achieving an A* in maths, around four times as successful in achieving an A* in physics, and around twice as successful in securing an Oxbridge place than students from similar backgrounds who did not join the STEM SMART programme.

A total of 80 students from its first two cohorts secured a place at Oxbridge.

Cambridge's STEM SMART programme launched in 2021 to help bridge attainment gaps in maths and science A-level subjects and mitigate educational disruption caused by the pandemic. In total, 848 students joined the first STEM SMART cohort in 2022, and 1,083 joined the second cohort in 2023.

The new data – which compares the outcomes of 1,120 sixth formers from STEM SMART's first two cohorts with those of around 9,000 demographically matched students who did not – is reported in the first independent UCAS analysis of the programme, which has now been running for four years and has so far welcomed 6,500 students.

Overall, the evaluation shows that STEM SMART students – or 'STEM SMARTies' as they have named themselves – were more aspirational, received higher grades, and were more successful at securing places at top universities. And sixth formers from the most deprived backgrounds in the UK saw the biggest average grade boost in their A-levels across maths, further maths, physics, chemistry and biology, with physics students on average achieving a grade higher.

Samuel Iranloye, 19, a second-year engineering undergraduate at Churchill College, joined STEM SMART's first cohort while studying for A-levels in maths, further maths, physics and chemistry in south-east London.

He said: "I wasn't certain that I would apply to Cambridge until I visited as part of STEM SMART; I felt more comfortable having had that experience. We spent every day going to the Cavendish Laboratory with 300 other students on the STEM SMART course, which was useful because you're able to bounce ideas off each other. The extra tuition also helped consolidate the learning in school. It also helped me when it came to preparing for my university admission tests."

Professor Bhaskar Vira, Pro-Vice-Chancellor (Education and Environmental Sustainability) at the University of Cambridge, said: "As well as supporting sixth formers in realising their true potential, and encouraging more applications to top universities from students who might not otherwise apply, STEM SMART is benefitting the UK as a whole – through the boost it is providing for STEM industries and innovation. Cambridge takes its role as a national university seriously, and I'm delighted that STEM SMART is ultimately helping to address the UK's skills shortage in science, technology, engineering and maths (STEM) subjects."

Written by Stephen Bevan

> I wasn't certain that I would apply to Cambridge until I visited as part of STEM SMART; I felt more comfortable having had that experience.
>
> Undergrad Samuel Iranloye

Read the full article at:
www.eng.cam.ac.uk/stem-smart

Credit: Charlotte Hester

↑ Members of the Department's Design and Technical Services team who designed and built the Fibonacci spiral wall exhibit. From left, Kynan Wright, Thomas Glenday, Dan Boutell and Barney Coles

Cambridge awarded silver-gilt medal at RHS Chelsea Flower Show debut

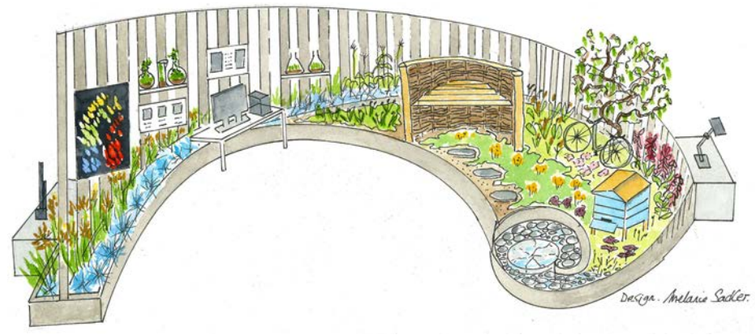
The University's debut exhibit at the 2025 RHS Chelsea Flower Show, which was built by the Department of Engineering's Design and Technical Services team, has won a prestigious silver-gilt medal.

Presented by the Sainsbury Laboratory Cambridge University, the *Blooming Numbers* exhibit was part of a brand-new GreenSTEM section that celebrated cutting-edge research and innovation in the world of plant science.

Starting with the initial idea of the Fibonacci sequence – an iconic numerical pattern found throughout nature – Thomas Glenday, Head of Design and Technical Services at the Department of Engineering, and his team, took on the challenge of designing a curved structure in metal and wood to bring mathematical beauty to life with a Fibonacci spiral wall.

Thomas said: "It was a fantastic opportunity and a pleasure to work with the Sainsbury Laboratory to support them in delivering such a successful Chelsea exhibit, which we hope educated and inspired many of our visitors."

Blooming Numbers took visitors on an immersive journey through the latest discoveries in quantitative plant biology – starting with the humble flower and diving deep into molecular biology, genetics, imaging technologies, computational modelling, and the often-overlooked mathematical patterns that govern plant development.



"One of our fellow exhibitors, who have been coming to Chelsea for years, told us that getting a silver-gilt on your first try is a real achievement," said Kathy Grube from the Sainsbury Laboratory.

The exhibit used sustainably sourced timber while the planters were designed to minimise metal waste by incorporating cut-offs.

Now that the show is over, the accessible lab benches will be used in the Sainsbury Laboratory as mobile lab workstations, and the modular Fibonacci spiral exhibit will be relocated to community gardens in Cambridge, where it will serve as raised planter boxes with trellis screens for growing climbing plants.

The Chelsea exhibit design is just one of the many projects that Thomas' team work on. Current projects include (but are not limited to) developing accessibility solutions; design and manufacture of medical devices and supporting instrumentation; 3D printing high-performance stainless steels (advanced materials with superior qualities); and trialling innovative materials for use in industry sectors varying from aerospace to civil engineering.

→ Alumni Simon Corkery (left) and Ignacio Andreu Angulo (right) lift the America's Cup as part of Emirates Team New Zealand (ETNZ)

ALUMNI UPDATE

Meet the fluid mechanics duo who helped steer New Zealand's sailing team to victory

Yacht racing is a rewarding yet gruelling challenge, but what does it take to win? Alumni Simon Corkery and Ignacio Andreu Angulo were part of the design team behind the 'fastest yacht' that won the 37th America's Cup – yachting's most coveted prize.

Here they talk us through the role engineering played in the success of the AC75 class – a yacht that's designed to 'fly'.

The duo, who both studied for PhDs at Cambridge in the Department's Energy, Fluids and Turbomachinery division, also share their experiences as part of Emirates Team New Zealand (ETNZ).

Simon: The America's Cup is held approximately every three to four years and showcases the world's top sailors in the most technologically sophisticated race yachts.

The event is extremely prestigious and competitive, with each team investing around £100 million in the hope of winning the trophy. Over the course of a campaign, the teams must design, build, learn to sail and compete in a yacht, where its basic specification has been defined by the current defender and challenger of record.

The latest iteration of yacht, the AC75 class, is a 75-foot foiling monohull capable of reaching speeds of up to 55 knots (63mph), where the water around the hydrofoils boils because of the surrounding pressures. The hull lifts out of the water on hydrofoils – or 'flies' – when the wind gets above a certain speed.

These yachts are designed to be as aero and hydrodynamically efficient as possible, which comes at a cost, namely that of stability and the yacht's ability to sail, thus rewarding the sailors who can sail accurately in ever-changing conditions.

Fluid mechanics for yacht design

Simon: The primary aim of the yacht design team is to deliver a racing yacht to the sailors that gives them a competitive edge. What is the most effective advantage you can have, you ask? Well, that is a yacht that can sail upwind and accelerate out of manoeuvres faster than the opposing yacht. This in turn allows the sailing team to tactically control each race.

A strong understanding of fluid mechanics is critical in achieving such an advantage. There are only three ways to increase the boat speed:

- By improving the aerodynamic thrust on the yacht provided by the hull and sails.
- By reducing the hydrodynamic drag on the hydrofoils.
- By understanding the environment in which the boat is extracting its energy from (e.g. wind, wave and tidal fields) to ensure that the aerodynamic surfaces are optimised for the race conditions.

Fluid mechanics is at the heart of each of these areas. We spend a lot of our design time developing the aerodynamic and hydrodynamic models employed in the design of the boat, whether that be low fidelity models or all the way up to complex computational fluid dynamics simulations of the entire yacht.

One of the real challenges that we face is determining whether we can sufficiently trust that our models are a good representation of the real-world physics, so, where possible, we will also embark on experimental campaigns to validate either some of the physics, or the performance of the yacht as a whole.

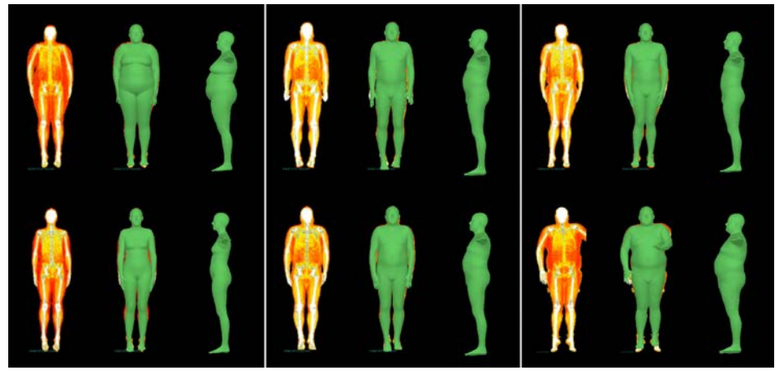
Lifting the America's Cup

Ignacio: Winning the Cup was an unforgettable experience – a sense of accomplishment that I will always remember.

Simon: The design team at ETNZ is only around 35 people in its entirety. This group is responsible for the aero- and hydrodynamics, optimisation, structural design, software and control, hydraulics, electronics, mechanical design, and finally the production of all the parts. It is a real collaborative effort, which presents many opportunities to learn from those around you and ultimately become a better, more rounded engineer.

Read the full interview at:
www.eng.cam.ac.uk/yacht-racing

→ DXA scan of body showing fat (red), muscle (yellow), bone (white), and 3D avatars used as training data



Credit: npj Digital Medicine

Body fat accurately predicted from AI-powered smartphone app

Cambridge researchers have developed a smartphone app that uses machine learning to accurately determine body composition – which is linked to a higher risk of heart disease, stroke and related conditions – from photographs.

The researchers developed the smartphone app called 3D BodyShape, which is currently a research prototype and will soon be available for iOS and Android devices. The app incorporates a machine-learning algorithm, which was trained on detailed medical imaging data from more than 12,000 adults.

From just four smartphone photographs, the app constructs a three-dimensional model of the human body from which it can determine body composition – how and where fat and muscle tissues are distributed across the body – with a high level of accuracy. The results are reported in the journal *npj Digital Medicine*.

Body composition is a strong predictor of diabetes and heart disease. Those with an 'apple-shaped' body, or with low muscle mass in the upper arms and lower legs, are at higher risk of metabolic conditions such as diabetes, heart disease, stroke and certain cancers.

The researchers say that while the app is not intended as a substitute for medical care, it could give individuals the ability to monitor changes in their health and associated risks and make necessary lifestyle adjustments.

Cardiovascular disease – such as heart disease and stroke – is the leading cause of death worldwide, and many of these deaths are associated with poor metabolic health. One third of the world's adult population suffers from conditions related to metabolic health, including obesity.

"Poor metabolic health is highly correlated with body shape and composition – how and where fat and muscle is distributed on the body, but it's also strongly correlated with poor quality of sleep and high stress levels," said Professor Roberto Cipolla from Cambridge's Department of Engineering, who led the research. "Genetics also plays a role, but many diseases are preventable with lifestyle and behaviour."

Body mass index, or BMI, is commonly used to estimate obesity, but since BMI does not distinguish between fat and muscle, it's not as strong an indicator of health as measurement methods that do make this distinction.

"In clinical assessments, we use more accurate methods of body composition, but these are expensive and only available in research or healthcare facilities and so are not suitable for regular health monitoring," said co-author Dr Emanuella De Lucia Rolfe from the Medical Research Council (MRC) Epidemiology Unit. "This new tool has the potential to provide similar information for everybody with a smartphone whenever they want it and for free."

The researchers used more than 20,000 DXA (dual energy X-ray absorptiometry) scans from 12,000 Fenland Study participants, showing detailed body composition and how it changed over time. The study contains weight, height, hip and waist ratios, as well as body fat percentage and several other health parameters for every participant, who were between 30 and 65 years of age when they joined the study.

This dataset was used as training data for a machine-learning algorithm to determine body composition from 3D body shape alone. The researchers converted the two-dimensional DXA images into three-dimensional body shapes, or avatars.

The avatars were then used to train a deep-learning network to predict body composition, including visceral abdominal fat and skeletal muscle. Results showed that the model was able to accurately predict body composition, and changes over time, for Fenland Study participants.

The app uses computer vision algorithms to convert four mobile phone photographs (front, back, left and right) into a 3D body shape avatar and then into body composition. All the processing is done on the phone and no images or data are shared. Results from the app also predicted body composition with high accuracy.

Written by Sarah Collins

Open access paper:
www.eng.cam.ac.uk/body-fat-app

→ Professor Richard Turner using Aardvark Weather

Credit: The Alan Turing Institute

Fully AI-driven weather prediction system could start revolution in forecasting

A new AI weather prediction system, developed by researchers from the University of Cambridge, can deliver accurate forecasts tens of times faster and using thousands of times less computing power than current AI- and physics-based forecasting systems.

The system, Aardvark Weather, has been supported by The Alan Turing Institute, Microsoft Research and the European Centre for Medium-Range Weather Forecasts (ECMWF). It provides a blueprint for a new approach to weather forecasting with the potential to transform current practices. The results are reported in the journal *Nature*.

"Aardvark reimagines current weather prediction methods, offering the potential to make weather forecasts faster, cheaper, more flexible and more accurate than ever before, helping to transform weather prediction in both developed and developing countries," said Professor Richard Turner from Cambridge's Department of Engineering, who led the research. "Aardvark is thousands of times faster than all previous weather forecasting methods."

Current weather forecasts are generated through a complex set of stages, each taking several hours to run on powerful supercomputers. Aside from daily usage, the development, maintenance and use of these systems require significant time and large teams of experts.

More recently, research by Huawei, Google and Microsoft has shown that one component of the weather forecasting pipeline, the numerical solver (which calculates how weather evolves over time), can be replaced with AI, resulting in faster and more accurate predictions. This combination of AI and traditional approaches is now being used by the ECMWF.

But with Aardvark, researchers have replaced the entire weather prediction pipeline with a single, simple machine learning model. The new model takes in observations from satellites, weather stations and other sensors – and outputs both global and local forecasts.

This fully AI-driven approach means predictions that were once produced using many models – each requiring a supercomputer and a large support team to run – can now be produced in minutes on a desktop computer.

When using just 10% of the input data of existing systems, Aardvark already outperforms the United States national GFS forecasting system on many variables. It is also competitive with United States Weather Service forecasts that use input from dozens of weather models and analysis by expert human forecasters.

"These results are just the beginning of what Aardvark can achieve," said first author Anna Allen, from Cambridge's Department of Computer Science and Technology. "This end-to-end learning approach can be easily applied to other weather forecasting problems, for example hurricanes, wildfires and tornadoes. Beyond weather, its applications extend to broader Earth system forecasting, including air quality, ocean dynamics and sea ice prediction."

The researchers say that one of the most exciting aspects of Aardvark is its flexibility and simple design. Because it learns directly from data, it can be adapted quickly to produce bespoke forecasts for specific industries or locations, whether that's predicting temperatures for African agriculture or wind speeds for a renewable energy company in Europe.

This contrasts with traditional weather prediction systems, where creating a customised system takes years of work by large teams of researchers.

"The weather forecasting systems we all rely on have been developed over decades, but in just 18 months, we've been able to build something that's competitive with the best of these systems, using just a tenth of the data on a desktop computer," said Professor Turner, who is also Lead Researcher for Weather Prediction at The Alan Turing Institute.

Open access paper:
www.eng.cam.ac.uk/ai-weather

Credit: teksomolika – stock.adobe.com

Exploring the potential for AI to enhance water quality management

Researchers from the University of Cambridge have convened a workshop and produced a policy brief to identify opportunities to leverage AI to improve water quality.

Managing the threat of water pollution is central to public health and environmental quality in the UK. While significant improvements in water quality have been attained, water quality across the country still does not meet regulatory standards.

"Climate change, ageing and inadequate infrastructure, increasing concentrations of forever chemicals and pathogens mean that the nation's water quality is under pressure. Moreover, as communities' interests and expectations for better water quality increase, so does the need for decision-makers to drive significant improvements in the nation's rivers and seas," said Dr Edoardo Borgomeo from Cambridge's Centre for Sustainable Development. "We partnered with the Environment Agency (EA) to organise a one-day workshop focused on understanding if and how AI and machine learning can be leveraged to address these issues."

As the environmental regulator, the EA leads efforts to monitor water quality across the country and regulate practices that might lead to increased pollution. Luke Holmes, Senior Research Scientist in the EA's Chief Scientist's Group, said: "The workshop was very helpful in beginning to develop a framework for assessing the potential of AI to contribute to our mission. It was also a great opportunity to connect with researchers and practitioners interested in advancing the responsible use of AI in environmental sciences."

Participants at the workshop included representatives from academia, the public sector and industry. The workshop identified four core priority areas where AI might contribute to managing water quality in the UK:

- **Operational efficiency.** Managers and regulators are tasked with making cost-effective and timely decisions with regards to water quality, such as issuing water quality forecasts, prioritising inspections or collecting data on new, emerging contaminants. The workshop explored ways in which AI can support these decisions, for example by helping optimise the location of sensors or by harmonising datasets with different spatial and temporal resolutions.
- **Modelling and understanding.** To inform water quality management, we also need to develop novel understanding of the status and trends of water quality. This entails, for example, understanding how water quality might change under alternative climate change and land-use scenarios, or modelling which factors are more significant in influencing sewer overflows in different locations. Under certain conditions, AI offers opportunities to improve our understanding of the water quality process, thus enabling better decisions and predictions in the future.
- **Institutional knowledge and trustworthiness.** Water is a public resource and therefore all decisions made with respect to water should be transparent and understandable. Can AI help improve the transparency and trustworthiness of decisions with respect to water quality? The workshop explored the limits and potential for AI approaches to make environmental models more understandable to users, and to also improve our understanding of the reliability of predictions.
- **Last mile and dissemination.** Citizens and the natural environment are the ultimate beneficiaries of any decision made with regards to water quality. The workshop identified ways that AI can help provide better and more timely information to the public, and improve citizen engagement through, for example, citizen science and data collection.

"It is essential that academia, government and the industry work together to leverage new opportunities that AI offers," said Dr Borgomeo. "This workshop, supported by an EPSRC Impact Accelerator Award, is the first step in developing a community of practice on these topics and an improved identification of the knowledge gaps that are most relevant to water policy in the country."

Download the policy brief:
www.eng.cam.ac.uk/ai-water-quality

Researchers demonstrate the UK's first long-distance ultra-secure communication over a quantum network

Credit: Panuwat – stock.adobe.com

Researchers have successfully demonstrated the UK's first long-distance ultra-secure transfer of data over a quantum communications network, including the UK's first long-distance quantum-secured video call.

The team, from the Universities of Bristol and Cambridge, created the network, which uses standard fibre-optic infrastructure, but relies on a variety of quantum phenomena to enable ultra-secure data transfer.

The network uses two types of quantum key distribution (QKD) schemes: 'unhackable' encryption keys hidden inside particles of light; and distributed entanglement: a phenomenon that causes quantum particles to be intrinsically linked.

The researchers demonstrated the capabilities of the network via a live, quantum-secure video conference link, the transfer of encrypted medical data, and secure remote access to a distributed data centre. The data was successfully transmitted between Bristol and Cambridge – a fibre distance of over 410 kilometres.

This is the first time that a long-distance network, encompassing different quantum-secure technologies such as entanglement distribution, has been successfully demonstrated. The researchers presented their results at the *2025 Optical Fiber Communications Conference (OFC)* in San Francisco.

Quantum communications offer unparalleled security advantages compared to classical telecommunications solutions. These technologies are immune to future cyber attacks, even with quantum computers, which – once fully developed – will have the potential to break through even the strongest cryptographic methods currently in use.

In the past few years, researchers have been working to build and use quantum communication networks. China recently set up a massive network that covers 4,600 kilometres by connecting five cities using both fibre optics and satellites. In Madrid, researchers created a smaller network with nine connection points that use different types of QKD to securely share information.

In 2019, researchers at Cambridge and Toshiba demonstrated a metro-scale quantum network operating at record key rates of millions of key bits per second. And in 2020, researchers in Bristol built a network that could share entanglement between multiple users. Similar quantum network trials have been demonstrated in Singapore, Italy and the USA.

Despite this progress, no one has built a large, long-distance network that can handle both types of QKD, entanglement distribution, and regular data transmission all at once, until now.

The experiment demonstrates the potential of quantum networks to accommodate different quantum-secure approaches simultaneously with classical communications infrastructure. It was carried out using the UK's Quantum Network (UKQN), established over the last decade by the same team, with funding from the Engineering and Physical Sciences Research Council (EPSRC) and as part of the Quantum Communications Hub project.

"This marks the culmination of more than 10 years of work to design and build the UK Quantum Network," said co-author Adrian Wonfor from Cambridge's Department of Engineering. "Not only does it demonstrate the use of multiple quantum communications technologies, but also the secure key management systems required to allow seamless end-to-end encryption between us."

"This is a significant step in delivering quantum security for the communications we all rely upon in our daily lives at a national scale," said co-author Professor Richard Penty, also from Cambridge, who headed the Quantum Networks work package in the Hub. "It would not have been possible without the close collaboration of the two teams at Cambridge and Bristol, the support of our industrial partners Toshiba, BT, Adtran and Cisco, and our funders at UKRI."

The current UKQN covers two metropolitan quantum networks around Bristol and Cambridge, which are connected via a 'backbone' of four long-distance optical fibre links spanning 410 kilometres with three intermediate nodes.

The network uses single-mode fibre over the EPSRC National Dark Fibre Facility (which provides dedicated fibre for research purposes), and low-loss optical switches allowing network reconfiguration of both classical and quantum signal traffic.

The team will pursue this work further through a newly funded EPSRC project, the Integrated Quantum Networks Hub, whose vision is to establish quantum networks at all distance scales.

Written by Sarah Collins

Read the full article:
www.eng.cam.ac.uk/quantum-network

→ Dr Spencer Brennan, founder and CEO (left), and Professor Jonathan Cullen, Head of Climate Science at Neutreeno

Neutreeno: The journey of a Cambridge cleantech start-up on the rise

Zoe Loughlin, who leads the Canopy innovation community, provides insights on the Cambridge innovation ecosystem by following Neutreeno, the Cambridge-born cleantech start-up, which is going from strength to strength.

We all know the old proverb: it takes a village to raise a child. Well, it takes an ecosystem to scale a start-up. Meet Neutreeno, the start-up which personifies how a thriving innovation community can help scale new ventures. Neutreeno help international businesses tackle 'Scope 3 emissions' with advanced tools that decarbonise supply chains up to 50 times faster than traditional methods.

From the Department of Engineering to programme support at the Cambridge Judge Business School (JBS), funding from Cambridge Enterprise Ventures, and now a member of Cambridge Institute for Sustainability Leadership's (CISL) Canopy Innovation Hub, Neutreeno is accelerating from campus innovation to a global decarbonisation leader.

Born in Cambridge but scaling globally

Neutreeno was conceived within the academic environment of Cambridge, where its team developed a rigorous, science-driven approach to tackling emissions, built on decades of research into resource-efficient industrial processes. Led by Professor Jonathan Cullen and others in the Department of Engineering, Neutreeno remains deeply rooted in Cambridge and the Department of Engineering, while ambitiously scaling its groundbreaking technology across the globe.

Their research-led deep tech system harnesses proprietary industrial production networks and advanced machine-learning algorithms to eliminate greenhouse gas emissions at source. Neutreeno address the lion's share of corporate emissions in Scope 3 to accelerate decarbonisation and redefine how sustainability is managed within complex supply chains.

By making decarbonisation simple, trustworthy and effective, businesses cut costs by becoming more material- and energy-efficient. Their work with AeroEdge, a major Asian manufacturer, showed savings of more than €1.6 million a year: a leap forward for future-proofing industries with ambitious climate goals.

A success story from the University of Cambridge ecosystem

After spinning out a business from their research, Neutreeno capitalised on support available within Cambridge's innovation ecosystem. Founder Spencer Brennan joined the Cambridge Judge Entrepreneurship Centre's 2021 Accelerate Cambridge programme, one of Cambridge's most established start-up programmes for early-stage entrepreneurs. Neutreeno subsequently joined CISL's Sustainable Product Launch Programme, run by their Canopy Accelerator team, which helped participants to fine-tune their product market fit, sales and marketing strategies.

Cambridge Enterprise Ventures provided Neutreeno with early-stage financial backing, and the company has since attracted significant investment. Regeneration.VC led a $5 million seed financing round with a syndicate of strategic, mission-aligned investors including Closed Loop Partners, Remarkable Ventures, Scania Group, Beacon Venture Capital and Prequel Ventures. Given the challenging fundraising environment, this financial backing belies market confidence in Neutreeno's revolutionary potential to reshape the decarbonisation landscape.

Press coverage from industry-leading publications has noted that Neutreeno is poised to capitalise on a decarbonisation market estimated at $130 trillion, underscoring the global demand for its solution. Features by Closed Loop Partners and *ESG Today* provide detailed insights into Neutreeno's engineering capabilities and the strategic rationale behind this investment.

In 2024, Neutreeno joined CISL's Canopy to work from their central Cambridge workspace, providing access to an ecosystem of corporates, investors and peers, fostering deep connections and collaborative opportunities to scale sustainability-targeted ventures. CISL recognised Neutreeno's leadership tackling major corporate emissions and decarbonisation strategies by nominating them for the 2025 Earthshot Prize.

Despite policy headwinds, and ESG plans stalling globally, Neutreeno has already achieved traction among corporations across North America, Europe and Asia that are looking to decarbonise their supply chains, cut costs and drive resource efficiency. Neutreeno's approach sets the standard for supply chain management, proving that sustainability is a competitive advantage for business and not just a cost centre.

www.neutreeno.com

→ The founders of Refute, from left, Vlad Galu and alumnus Tom Garnett

ALUMNI UPDATE

Meet Tom Garnett

CEO and co-founder of Refute

Tom Garnett is CEO and co-founder of Refute – a tech start-up focused on fighting disinformation on behalf of organisations, detecting and responding to campaigns at the speed of the attackers. Refute uses data to model and score threat behaviours, in context and over time, enabling effective in-channel response.

Tom studied electronic engineering at Cambridge from 2001 to 2006 at St Catharine's College, specialising in instrumentation and control. He then worked in National Security, creating data analysis solutions to fight terrorist attacks. He has had senior leadership roles in BAE Systems and Ripjar, where he has managed business units building and selling solutions to fight cyber attacks and financial crime.

We spoke to Tom about his path from Cambridge to co-founding Refute

At the start of my career, I was building very large-scale data analysis solutions to fight criminal activity with a particular focus on counter terrorism following 9/11 and the London 2005 attacks.

I then moved to Muscat in Oman. I ran the BAE Systems business focused on cyber security and national security, delivering large-scale complex solutions to tackle criminal activity within Oman.

I then joined a company called Ripjar, a start-up of 25 people, focused on finding criminal activity be it financial crime, cyber attacks or government-related risks. I was part of their journey to becoming a 160-person organisation. As part of the leadership team, I ran the government and cyber security part of the business, building and delivering solutions into military, policing, commercial organisations and particularly large tech.

I saw that the next wave of risk was in disinformation. There has been massive change over the last couple of years with geopolitical tensions around the world including in Gaza, Ukraine and China, but also the advent of generative AI making it much easier to create disinformation and to propagate disinformation attacks.

The risk to the democratic process and the impact on elections is clear but there's also highly impactful attacks on corporates, particularly high-risk organisations, whether that's oil and gas, mining, renewables, financial services or pharmaceuticals. The attacks have huge financial impacts with hundreds of millions to billions taken off company valuations.

Tell us about Refute

Refute is a pure tech company focused on fighting disinformation attacks. We're automating the process so that we can keep ahead of the attacker. We focus on both detecting the threat and responding. It's important for us that we do both, because you can have just minutes or hours to both detect and respond to these campaigns before they have huge financial and reputational impacts, particularly to commercial organisations.

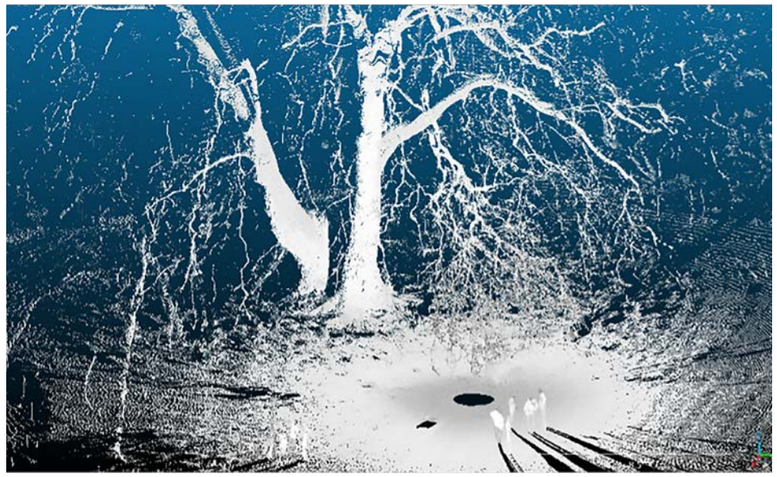
Last year, we announced the closure of our pre-seed funding round where we secured £2.3 million from Playfair, Episode 1, Amadeus and Notion Capital.

What inspired you into your field?

I wanted to be in the space of building solutions and being very close to end customers, delighting them and meeting their end-user needs. When I graduated in 2006, terrorism was particularly high threat and there was high need for software solutions in that space. So, it was almost by chance that I ended up in that area and that's been the backbone of my whole career ever since, along with the move to the commercial space.

Even before studying at Cambridge, I knew I eventually wanted to be running my own company. It was by following that backbone of solving criminal activity challenges, and eventually seeing that it was moving from a bespoke solution to having a viable product company in that space, that I then started up Refute with my co-founder Vlad Galu.

Read the full interview at:
www.eng.cam.ac.uk/tom-garnett



→ Sample image of the largest London plane tree in the UK, taken from a laser scan point-cloud

Cambridge engineers lend support to a UK first in the conservation of ancient trees

Using structural modelling and vibration measurements to help guide the thinking around ways of 'saving' the largest London plane tree in the UK, a conservation project offers significant potential to inform the way in which we conserve our ancient trees.

The Great London Plane Tree of Ely, in East Cambridgeshire, was planted in around 1674 in the gardens of the Old Bishop's Palace, home to The King's School Ely Sixth Form Centre. The tree is believed to have been a gift from King Charles II to the Bishop of Ely.

Now the largest London plane in the UK and one of the oldest, at around 360 years old and over 42 metres tall, it is recognised by The Tree Council as one of the Top 50 Great British Trees. The tree is in good health, but, following a whole-tree survey commissioned by King's School Ely (the custodians of the tree), it is clear that some extra support is now required to ensure that it continues to prosper into the future.

King's School Ely approached Cambridge engineers Dr James Talbot, Dr Sam Cocking, Paul Fidler and Jonah Barretto, who have been working alongside Suffolk Tree Services, to offer a unique engineering perspective on the problem and its solution: a new cable bracing system that provides structural support to the tree whilst allowing it to move as naturally as possible.

Dr Talbot explains: "Our aim has been to complement the arboricultural design of the cabling arrangements with some engineering analysis using a structural model. We've developed a finite-element model of the tree, having used a laser scanner to scan its geometry and a system of accelerometers to measure its dynamic response to wind loading. The vibration data helps us to validate the model in such a way that it may be used to assess the potential bracing arrangements.

"We use real-time monitoring to continuously log the accelerometer data – something that we are used to doing at the Cambridge Centre for Smart Infrastructure and Construction (CSIC) but on typical engineering structures rather than a living tree! One of the reasons for monitoring is to establish the seasonal variations in the response and, we hope, enable a before-and-after assessment of the final bracing system."

He said the engineers hoped to understand how to share the load of a "poorly branch" among healthier branches using the model of the tree. "Engineers are more used to working with seasoned timber than living wood – if they work with wood at all," he added.

The award of a National Lottery Heritage Fund grant is testament to the fact that this is a very special tree. The project is unique in bringing together arboriculturists, ecologists, engineers and educators, as well as attracting interest from a number of national institutions, including Kew Gardens, The Woodland Trust and The Tree Council. It has significant potential to inform the way in which we conserve our ancient trees, as well as contributing to our scientific understanding of trees more generally.

The conservation work started in July 2025, and real-time data monitoring is being gathered in order to assess the new bracing and pruning regime across the seasons, with the information collected made available to help inform conservation efforts for other heritage trees. The final bracing arrangement is scheduled for installation during Easter 2026.

The Great London Plane of Ely (*Platanus x hispanica*) is a hybrid of the Oriental plane and American sycamore, and is believed to be one of the UK's original London planes.

> "Our aim has been to complement the arboricultural design ... with some engineering analysis using a structural model.
>
> Dr James Talbot

treecouncil.org.uk/science-and-research/the-london-plane-of-ely

UK and Canada forge deep-tech ties at Cambridge event

The University of Cambridge has welcomed a high-profile Canadian technology delegation with the aim to strengthen UK-Canada collaboration in cutting-edge research and commercialisation in photonics and semiconductors.

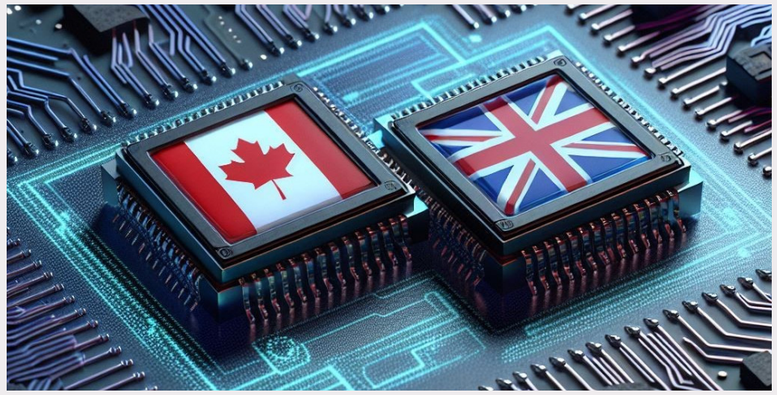
The delegation, led by the High Commission of Canada in the UK, was hosted earlier this year by Professor Andrea C. Ferrari, Director of the Cambridge Graphene Centre. The delegation toured Cambridge West, home to the Cambridge Graphene Centre and the Department of Engineering's Electrical Engineering Division, where they explored state-of-the-art electronic R&D shaping the future of global industries.

The UK and Canada are at the forefront of research in several key areas, including quantum technology and next-generation photonic circuits and packaging.

Advances in graphene-integrated photonics, layered materials-based quantum communications, halide perovskite, organic semiconductors, organic solar cells, thin-film transistors and thermoelectric waste heat harvesting were also highlighted.

The delegation explored next-generation optical networks and emerging applications for space power systems, which have the potential to revolutionise global digital infrastructure.

Professor Ferrari said: "We were honoured to welcome the UK and Canada delegations as an ideal follow-up to the G7 Semiconductors meeting we hosted in Cambridge in September 2024. The Canadian delegation showcased state-of-the-art facilities and capabilities in semiconductors, photonics and packaging technologies. The creation of strong links and collaborations with UK companies and universities will strengthen both countries. The UK can learn from Canada's investment in pilot facilities, benefitting the high-tech ecosystem."



Credit: Microsoft Copilot AI

↑ AI-generated concept image of Canadian and UK flags on semiconductors

Speaking at the time, Colin Barker, Senior Trade Commissioner at the High Commission of Canada in the UK, stated: "Canada and the United Kingdom share a deep and enduring partnership, built on our common values, strong trade ties and mutual commitment to innovation. This trade mission to Cambridge highlighted the immense potential for collaboration between our two nations in pioneering technologies that will define the industries of the future."

Written by Michael Shuff

Read the full article at:
www.eng.cam.ac.uk/uk-canada

Cambridge to trial cutting-edge semiconductor tech for wider use in major European project

The University of Cambridge is one of two UK participants named as part of the PIXEurope consortium, a collaboration between research organisations from across Europe, which will develop and manufacture prototypes of their products based on photonic chips.

The Cambridge Graphene Centre and CORNERSTONE Photonics Innovation Centre at the University of Southampton will partner with members from across Europe to host a pilot line, coordinated by the Institute of Photonic Sciences in Spain, combining state-of-the-art equipment and expertise from 20 research organisations.

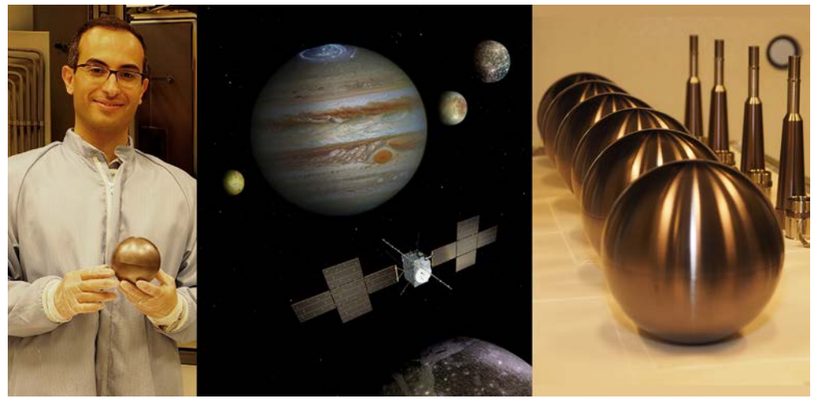
The UK participants will be backed by up to £4.2 million in funding from the Department of Science, Innovation and Technology (DSIT), match-funded by Horizon Europe. The UK joined the EU's Chips Joint Undertaking in March 2024, allowing the country to collaborate more closely with European partners on semiconductor innovation.

Researchers at the Cambridge Graphene Centre will be responsible for the integration of graphene and related materials into photonic circuits for energy efficient, high-speed communications and quantum devices. "This may lead to life-changing products and services, with huge economic benefit for the UK and the world," said Professor Andrea C. Ferrari, Director of the Cambridge Graphene Centre.

Written by Sarah Collins

Read the full article at:
www.eng.cam.ac.uk/semiconductor-tech

→ [LEFT] Dr Bakhit holding a test probe. [CENTRE] An artist's illustration of JUICE on its journey towards Jupiter. [RIGHT] The probes and their stubs after coating with dense, smooth TiAlN thin films



Cambridge scientist joins mission to investigate signs of life on Jupiter's icy moons

Research Fellow Dr Babak Bakhit has encountered one of his most challenging projects to date – contributing to the European Space Agency's (ESA) JUpiter ICy moons Explorer (JUICE) mission.

The spacecraft is currently on its way to orbit Jupiter and investigate the planet's three ocean-bearing icy moons – Ganymede, Callisto and Europa – with a suite of remote sensing, geophysical and in situ instruments. It is due to reach Jupiter in July 2031, with flybys en route to Venus (August 2025), Earth (September 2026), and Earth again (January 2029).

These moons are expected to have extraterrestrial liquid water under their frozen surfaces, which is the subject of significant interest as a key prerequisite for extraterrestrial life. The spacecraft will also explore Jupiter's complex environment and its system (atmosphere, ring system and magnetic environment) as a model for other gas giants in our solar system – these being Saturn, Uranus and Neptune.

Dr Bakhit, who is from the Department of Engineering's Electronic Devices and Materials Group, was responsible for applying a protective coating to state-of-the-art sensors that make up the radio and plasma wave instrument (RPWI). The RPWI consists of four 10cm diameter Langmuir probes for exploring the atmosphere around Jupiter's icy moons.

Each probe is mounted at the end of three-metre-long deployable booms, enabling it to extend from the spacecraft body.

These probes, which will characterise plasma and measure radio emissions, are made of titanium grade 5 alloy and have spherical shapes, designed to be like eggshells, with a 400-micro-metre thickness. Resistor-capacitor circuit elements exist inside the spheres.

"To make the Langmuir probes sensitive enough to detect a wide range of frequencies and electrical charges (both electrons and ions), it was essential to coat them with special layers," said Dr Bakhit. "In fact, the coatings needed to be extremely sensitive to the electrical charges and capable of surviving harsh environments, such as extreme weather, temperature and radiation, during this mission."

He added: "The coatings had to have excellent electrical performance, high temperature durability, chemical inertness, optical properties and adhesion, together with high sensitivity to plasma density variations, and ultra-low surface roughness and sensitivity to contaminations. This combination of properties required the coatings to be made of a particular material with precise composition and nanostructure."

Titanium aluminium nitride (TiAlN) alloys were grown by magnetron sputtering – a highly controlled and repeatable physical vapour deposition process. However, sputter-depositing these coatings on such large spheres proved to be no easy task.

"We dealt with a series of challenges in this project," said Dr Bakhit. "First of all, the shape and size of the probes were not suitable for common sputtering systems. We used an industrial-scale sputtering system and redesigned the inside of its growth chamber. We came up with a carousel-like structure with two rails that allowed the spheres to freely roll around during the deposition process, leading to uniform coatings."

"The other unexpected issue was severe arcing that occurred during the growth. To overcome this challenge of unwanted discharge occurring on the surface of the spheres, a special approach with optimised electrical charge density was utilised," he added.

The RPWI on board the spacecraft is described in detail as part of a paper published in the journal *Space Science Reviews*.

Reflecting on the mission, Dr Bakhit said: "I have been involved in several projects in collaboration with partners from both academia and industry. Admittedly, the JUICE mission was the most challenging, but at the same time, the most important and exciting one. It was a great opportunity to contribute to such a large space-related project and I am keen on any life discovery on Jupiter."

Open access paper:
www.eng.cam.ac.uk/icy-moons

Credit: Maisie Ormrod

Cambridge flying high on electricity

From left, Dr Deepanshu Singh (AIA) and Eliot Whittington (CISL) stand next to the Pipistrel Velis Electro aeroplane

Researchers from the Whittle Laboratory and the Cambridge Institute for Sustainability Leadership's (CISL) Aviation Impact Accelerator (AIA) were among the passengers on the first demonstration flights out of Cambridge Airport in a two-person Pipistrel Velis Electro aircraft.

The aircraft is the only electric plane certified for passenger flights in the UK. It charges up in just 45 minutes and can be airborne for up to an hour. It is powered by a battery that is a third of the size of an electric car battery.

Among those eagerly collecting their boarding passes was Dr Deepanshu Singh, a researcher in sustainable aviation and the head of strategic partnerships at the University's world-leading AIA in the Whittle Laboratory.

About 36 airfields around the UK are in the process of installing the charging equipment for electric planes, with 14 already installed. However, experts describe the transition to electric flights as just one piece of the puzzle. Sustainable aviation will require a mix of technologies, including novel fuels, new aircraft designs and smarter air traffic systems to truly decarbonise the skies.

Prior to joining the AIA programme, Dr Singh completed a PhD in aerospace at the University of Oxford in collaboration with Rolls-Royce, focusing on an experimental aerothermal study of low-emission aircraft engines. He is also building a start-up called Neela Biotech that leverages synthetic biology and AI to power the future of flight with carbon-negative fuels, which won the 2025 Cambridge Zero Climate Challenge.

"Sometimes our work can feel a bit abstract but flying in this tiny electric plane, it made everything come alive," said Dr Singh. "I was struck by how remarkably quiet the aircraft was – electric aviation eliminates in-flight emissions and offers improved efficiency over combustion engines."

The aircraft is based at London's Fairoaks Airport and has been partly funded with support from aviation sustainability group 4AIR, a sister company to business aircraft charter group Flexjet.

Eliot Whittington, the chief systems change officer at CISL and spokesperson for the AIA, said the aviation industry offers people the opportunity to travel, making the world smaller and building new partnerships and connections.

"That benefit comes at an increasingly unaffordable environmental cost," he said. "As more and more of the world starts to fly, it's important for aviation to innovate and find ways to reduce its impact."

Professor Rob Miller, Director of the Whittle Laboratory, said that decarbonising aviation is one of the greatest challenges facing humanity and the Whittle Laboratory's highest priority.

"We are tackling this challenge at every level: from rethinking the entire aviation system and modelling accelerated pathways to net zero, to developing the deep technologies that will power the future of flight."

He said the Whittle Laboratory's work spans a range of solutions – from battery-electric propulsion for short-range aircraft to hydrogen-powered aircraft for longer distances.

Professor Miller added this particular flight was especially exciting because it demonstrates the potential of electric aviation and also offers critical hands-on experience with the infrastructure needed to support the transition to net zero.

"Transforming aviation is only possible through close collaboration between industry and academia – and our partnership with 4AIR is a great example of what can be achieved. It is really great to get our scientists out of the lab and on this electric plane to see what can be achieved in the real world."

Written by Paul Casciato

Read the full article at:
www.eng.cam.ac.uk/electric-plane

Cambridge Centre for Advanced Research and Education in Singapore (CARES)

New overseas decarbonisation project launched with Cambridge expertise

Professor Epaminondas Mastorakos

The University's overseas research centre in Singapore has launched a new project, which will investigate non-fossil fuel-based pathways for the country's chemical manufacturing industry and energy systems.

The project titled *Hydrogen and Ammonia Combustion in Singapore (HYCOMBS)* is led by Cambridge engineer Professor Epaminondas Mastorakos, Director of Industrial Relations at the Cambridge Centre for Advanced Research and Education in Singapore (CARES). It is one of two projects launched, which aims to aid Singapore's business transition away from petrochemicals towards a net zero emissions target by 2050.

Project HYCOMBS is part of the newly launched CREATE Thematic Programme in Decarbonisation, supported by the National Research Foundation (NRF). It involves universities from Singapore, the UK, Japan, France and Norway, working together to investigate the underlying combustion process of hydrogen and ammonia to minimise pollutants and accelerate industry innovation.

In 2022, Singapore's National Hydrogen Strategy was launched with the aim to accelerate the development and deployment of hydrogen as a major decarbonisation pathway. It is anticipated that by 2030, at least nine hydrogen-ready power plants will be in situ, with low-carbon hydrogen potentially accounting for around 50% of Singapore's electricity mix by 2050.

Last year, the Chairman of the NRF and former Deputy Prime Minister of Singapore (2019-2025), Mr Heng Swee Keat, toured the first of three laboratories set up for the CREATE Thematic Programme in Decarbonisation. This included the HYCOMBS project and the Sustainable Manufacture of Molecules and Materials in Singapore (SM_3) project.

Speaking at the time, Mr Heng Swee Keat said: "The need to tackle climate change and its impact grows ever more urgent. During my visit to Cambridge CARES – Cambridge University's first and only research centre outside the UK – I witnessed how research and international collaboration are driving innovative solutions to combat climate change, particularly in the area of decarbonisation.

"In just a decade, Cambridge CARES has established cutting-edge R&D facilities dedicated to decarbonisation projects that not only reduce emissions, but also pave the way for a more sustainable future for Singapore. From hydrogen combustion and laser-based combustion diagnostics to the development of cleaner fuels for gas stoves, their work is closely aligned with the goals outlined in our Singapore Green Plan 2030, and achieving Singapore's net zero emissions goal by 2050.

"It was encouraging to hear from former Director of Cambridge CARES [2013-2024], Professor Markus Kraft, as he shared how being based in the CREATE facility at the National University of Singapore facilitates interactions with researchers from diverse countries and disciplines. This collaborative and interdisciplinary approach embodies the essence of research – working together to address shared global challenges."

Since 2013, Cambridge CARES has been involved in research programmes with Nanyang Technological University and the National University of Singapore as the University of Cambridge's first overseas centre. One of its early flagship programmes, the Centre for Carbon Reduction in Chemical Technologies (C4T), has investigated areas from sustainable reaction engineering, electrochemistry and maritime decarbonisation to digitalisation.

www.cares.cam.ac.uk

→ Demonstrating use of a handheld device for heart disease screening

Credit: Acoustics Lab at the Department of Engineering

Handheld device could transform heart disease screening

Cambridge researchers have developed a handheld device that could potentially replace stethoscopes as a tool for detecting certain types of heart disease.

The researchers developed a device that makes it easy for people with or without medical training to record heart sounds accurately. Unlike a stethoscope, the device works well even if it's not placed precisely on the chest: its larger, flexible sensing area helps capture clearer heart sounds than traditional stethoscopes.

The device can also be used over clothing, making it more comfortable for patients – especially women – during routine check-ups or community heart health screening programmes.

The heart sound recordings can be saved on the device, which can then be used to detect signs of heart valve disease. The researchers are also developing a machine learning algorithm which can detect signs of valve disease automatically. The results are reported in the *IEEE Journal of Biomedical and Health Informatics*.

Heart valve disease (valvular heart disease or VHD) has been called the 'next cardiac epidemic', with a prognosis worse than many forms of cancer. Up to 50% of patients with significant VHD remain undiagnosed, and many patients only see their doctor when the disease has advanced and they are experiencing significant complications.

In the UK, the NHS and NICE have identified early detection of heart valve disease as a key goal, both to improve quality of life for patients and to decrease costs.

An examination with a stethoscope, or auscultation, is the way that most diagnoses of heart valve disease are made. However, just 38% of patients who present to their GP with symptoms of valve disease receive an examination with a stethoscope.

"The symptoms of VHD can be easily confused with certain respiratory conditions, which is why so many patients don't receive a stethoscope examination," said Professor Anurag Agarwal from Cambridge's Department of Engineering, who led the research. "However, the accuracy of stethoscope examination for diagnosing heart valve disease is fairly poor, and it requires a GP to conduct the examination."

In addition, a stethoscope examination requires patients to partially undress, which is both time consuming in short GP appointments and can be uncomfortable for patients, particularly for female patients in routine screening programmes.

The 'gold standard' for diagnosing heart valve disease is an echocardiogram, but this can only be done in a hospital and NHS waiting lists are extremely long – between six to nine months at many hospitals.

"To help get waiting lists down, and to make sure we're diagnosing heart valve disease early enough that simple interventions can improve quality of life, we wanted to develop an alternative to a stethoscope that is easy to use as a screening tool," said Professor Agarwal.

Professor Agarwal and his colleagues have developed a handheld device, about the diameter of a drinks coaster, that could be a solution. Their device can be used by any health professional to accurately record heart sounds, and can be used over clothes.

While a regular or electronic stethoscope has a single sensor, the Cambridge-developed device has six, meaning it is easier for the doctor or nurse – or even someone without any medical training – to get an accurate reading, simply because the surface area is so much bigger.

The device contains materials that can transmit vibration so that it can be used over clothes, which is particularly important when conducting community screening programmes to protect patient privacy. Between each of the six sensors is a gel that absorbs vibration, so the sensors do not interfere with each other.

The researchers tested the device on healthy participants with different body shapes and sizes and recorded their heart sounds. Their next steps will be to test the device in a clinical setting on a variety of patients, against results from an echocardiogram.

In parallel with the development of the device, the researchers have developed a machine-learning algorithm that can use the recorded heart sounds to detect signs of valve disease automatically. Early tests of the algorithm suggest that it outperforms GPs in detecting heart valve disease.

"If successful, this device could become an affordable and scalable solution for heart health screening, especially in areas with limited medical resources," said Professor Agarwal.

Written by Sarah Collins

Read the full article at:
www.eng.cam.ac.uk/handheld-device-heart

Honours, awards and prizes

BHF Translational Award

The Department has received a British Heart Foundation Translational Award for a three-year project seeking to replace synthetic haemodialysis grafts (used to connect an artery and a vein to facilitate kidney dialysis) with a patented biological graft.

The project, led by Professor Athina Markaki (pictured), will demonstrate lower risks of infection, thrombosis and other complications, leading to reductions in surgical interventions and reduced demand for hospital access.

Timoshenko Medal 2025

Professor Norman Fleck is the 2025 recipient of the prestigious Timoshenko Medal in recognition of distinguished contributions to the field of applied mechanics.

Professor Fleck is renowned as the world's leading authority in micro-architected materials, having pioneered the field long before it became popular.

The Medal is formally awarded at the annual American Society of Mechanical Engineers (ASME) conference, where the recipient is invited to deliver a lecture on a topic of their choice related to their contributions to the field.

Pilkington Prize winner

Dr Tore Butlin, Associate Professor in Dynamics and Vibration, has been awarded one of the University's Pilkington Prizes for excellence in teaching.

Dr Butlin and 13 other winners were presented with their awards by the University's Vice-Chancellor, Professor Deborah Prentice, at a ceremony also attended by Pro-Vice-Chancellor (Education and Environmental Sustainability), Professor Bhaskar Vira.

In a citation, Dr Butlin was praised for the key role he has played in "reshaping the engineering course content and integrating it with other disciplines – particularly mathematics and computing – since 2016".

Royal Society Fellow

Professor Gábor Csányi has been elected as a Fellow of the Royal Society.

His work is in the field of computational chemistry and is focused on developing algorithms to predict the properties of materials and molecules from first principles.

Professor Csányi pioneered the application of machine learning to molecular modelling, which led to enormous gains in the efficiency of molecular dynamics simulation.

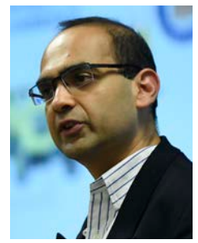
He is also interested in statistical problems in molecular dynamics, e.g. in enhanced sampling algorithms that can be used to explore the global configuration space of materials and molecules.

Schmidt Science Fellow

Dr Poppy Oldroyd, a 2025 Schmidt Science Fellow, plans to pioneer a new frontier in understanding brain communication through optical measurements, ultimately advancing treatments for memory-related diseases such as Alzheimer's disease and epilepsy.

The human brain communicates through intricate networks of neurons, crucial for learning and memory. However, how these neural conversations translate into memory formation remains a mystery in neuroscience.

Dr Oldroyd's research aims to use light-based tools such as advanced optogenetics to explore these pathways in detail. By uncovering how specific brain circuits contribute to learning and memory, this research could revolutionise our understanding of these essential brain functions.



Nadai Medal 2025

Professor Vikram Deshpande is the 2025 recipient of the prestigious Nadai Medal in recognition of significant contributions and outstanding achievements which broaden the field of materials engineering.

Professor Deshpande is a leading authority in failure modelling in complex materials, including architected solids and electromechanical systems.

The Medal is awarded by the American Society of Mechanical Engineers (ASME).

Credit: EFT Mobility

From left, Jonas Fauser (Head of Software Development), alumnus Tobias Kahnert (CEO) and Simon Rudolph (Head of Projects)

ALUMNI UPDATE

Alumnus' start-up sets sights on accelerating the world's transition to sustainable mobility

An electric-aircraft-powertrain start-up, co-founded by alumnus Tobias Kahnert, is pushing the boundaries of innovation to develop and manufacture batteries and charging solutions for unmanned aerial vehicles (UAVs) – identified as a new niche market for the company.

EFT Mobility – formerly known as Electric Flytrain (founded in 2019) – has widened its existing aviation focus (developing tailor-made (hybrid)-electric powertrain solutions for aircraft manufacturers) to recognise the potential of its technology in delivering cutting-edge, scalable solutions for UAVs, or drones as they are commonly known – boosting flight time in the process.

Other markets of future interest for the company include utility vehicles such as electric-powered street cleaners and construction machines, electric motorcycles and battery solutions for robotics.

The Munich-based company, whose mission is to accelerate the transition to sustainable mobility, recently announced a partnership with Quantum Systems, working on the design and build of an entire family of batteries and charging solutions for all of Quantum Systems' UAV platforms. Quantum Systems specialises in the development, design and production of advanced multi-sensor unmanned aerial systems (UAS) for aerial intelligence.

Tobias studied the MPhil in Engineering for Sustainable Development at Cambridge in 2018-19 and has a background in software development engineering for electric vehicles. In 2024, under his leadership as CEO, EFT Mobility doubled the size of its team, with plans for future growth and a developing customer base in Europe and North America.

"Now we are in a position as a company to become a true supplier of batteries and chargers, including batteries optimised for super-high-energy densities to allow as much flight time as possible," said Tobias.

"This strategic investment by Quantum Systems into EFT Mobility means that we can drive the entire UAV and mobility industry forward. All the battery and charging components are built with modular, interchangeable parts, allowing for customised solutions tailored to specific customer needs, strengthening the supply chain in the process."

"The result will be high-performing batteries, chargers and power distribution systems, compliant with all required regulations and manufacturable at scale," he added.

> "Now we are in a position to become a true supplier of batteries and chargers, including batteries optimised for super-high-energy densities to allow as much flight time as possible.
>
> Tobias Kahnert (CEO)

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