AUTUMN 2026
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DEPARTMENT OF ENGINEERING

# NEWS

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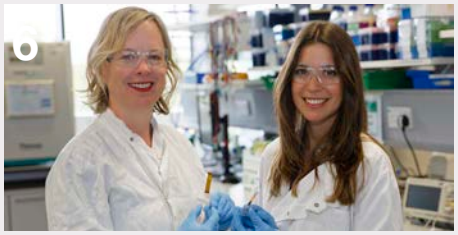
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Cover image: His Majesty The King officially opens the New Whittle Laboratory. Pictured with him is the Vice-Chancellor Professor Deborah Prentice. Credit: Ian Jones

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## Note from the editors

Amongst the wealth of news covered in this issue, you will read on **page 13** that this year marks a major milestone for the Institute for Manufacturing (IfM), part of our Department, as it celebrates six decades of pioneering manufacturing engineering education at Cambridge.

Originating in 1966 as the Advanced Course in Production Methods and Management, the programme has evolved through its 1980s design iteration into today's formal MPhil in Industrial Systems, Manufacture and Management (ISMM).

What has sustained the programme for 60 years is its deep-rooted commitment to experiential, industry-grounded learning. Rather than relying solely on theory, students tackle real-world industrial challenges through in-company projects, overseas study tours, and collaboration with a diverse range of corporate partners. This hands-on approach builds essential professional judgement, resilience and problem-solving capabilities.

Growing from an initial cohort of just 12 students to a global network of over 1,800 alumni, the programme has continually shaped leaders who drive impactful change across manufacturing, technology, consulting, entrepreneurship and policy.

**Charlotte Hester and Jacqueline Saggers**
Email: marketing@eng.cam.ac.uk

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# Head's welcome

Welcome to the Autumn 2026 edition of the Department of Engineering News.

As usual, you will find a plethora of inspiring stories about some of the world-changing research that continues to be carried out within the Department.

The cover story is about the opening of the New Whittle Laboratory in West Cambridge by His Majesty the King in July, which houses the National Centre for Propulsion and Power as well as the Bennett Innovation Lab. The opening coincided with the Frank Whittle Summit, where we got together with industry leaders and government for a round-table event on how universities and departments such as ours can help UK industry.

The Programme board, which will oversee the move of the Department to West Cambridge, has now met twice since the last newsletter and is working to move the Roger Needham Building project. This building will house Information Engineering (Division F) as well as a significant proportion of the Department's professional services functions and the AI/Robotics hub in collaboration with the Department of Computer Science and Technology.

Fundraising has been stepped up significantly in recent months now that we have a tangible timeline of the project to get to RIBA 3 early in 2027, for a build start in late 2028. Should you wish to be a part of this story from a fundraising perspective, please email Victoria Thompson at victoria.thompson@admin.cam.ac.uk or Ann Cernek at Ann.Cernek@admin.cam.ac.uk at the Development and Alumni Relations office or feel free to reach out directly to me by emailing head@eng.cam.ac.uk.

The new MPhil in Electrical Engineering has just started and it is very pleasing to see how quickly that has gone from inception to having our first students.

The new Part I is now at the stage of being planned in detail for the first intake in Michaelmas 2027. Thanks to Professor Seb Savory who spearheaded the reform and got it to the point where we have now handed it over to the Teaching Office to work on implementation. To help with this, we have added a new function, in splitting the role of Director of Undergraduate Education into two: Dr Graham McShane who is taking care of Part I and has taken over the Part I reform and Dr Matthew Tang who is now looking after Part II. I am also delighted to say that Professor Savory has stepped into the role of Head of Electrical Engineering (Division B) as of 1 October, and Professor Joan Lasenby has stepped into the role of Head of Division F.

Looking through this edition of the newsletter, starting with the story which appears on **page 6**, you will see one of our recent faculty appointments, Dr Amparo Güemes, whose work is looking at the electrophysiology of the gut.

On **page 7** is a story about our success in winning two grants as part of UKRI Doctoral Focal Awards in Nuclear Skills which is a topic of increasing importance in the UK, especially with the development of the Sizewell plant.

On **page 8** is an update on the Artemis II mission which included Department faculty alumna Dr Jenni Gibbons who played a key role in preparations and on comms.

Well done to Dr Osarenkhoe Ogbeide, whose story you will find on **page 9**. Dr Ogbeide was awarded a highly prestigious Royal Society Career Development Fellowship to continue his work on gas sensors.

I am also very pleased to be able to let you know that some recently announced awards for our faculty are an FRS for Professor Malcolm Smith and an FREng for Professor Duncan MacFarlane.

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

I am sure you will note that, as expected, AI is playing an ever-increasing role in our research and activities in general. As well as pushing the technology forward for societal benefit and as an invaluable addition to the engineer's toolkit, I would also like you to be aware that we are looking into the responsible use of AI, with Dr Miri Zilka who we appointed to a faculty position last year on Responsible AI, and Professor Alessandro Abate (**see page 19**), who just took up the role of the Control chair, and whose interest lies in issues around AI safety.

**Professor Colm Durkan FREng FInstP FIET**




Credit: Ian Jones

→ His Majesty The King officially opens the New Whittle Laboratory. Pictured with him are the Vice-Chancellor Professor Deborah Prentice and Professor Rob Miller, Director of the Whittle Laboratory

# The King officially opens Cambridge's New Whittle Laboratory

**His Majesty The King has officially opened Cambridge's New Whittle Laboratory, a £58 million facility designed to be the world's leading research centre for jet engines and power generation.**

He met with researchers, government representatives and industry leaders from the aviation and energy sectors in July 2026 to find out more about the Laboratory's mission: to shrink the time it takes to develop key technologies in aerospace, energy and defence from years to weeks, in order to accelerate UK growth.

The King last visited the Whittle Laboratory in 2023 – in his first engagement following the Coronation – to break ground on the New Whittle Laboratory. As the Prince of Wales, His Majesty previously visited the Whittle Laboratory in January 2020 and March 2022, and hosted an industry roundtable in February 2020 in London with the Sustainable Markets Initiative and World Economic Forum.

The New Whittle Laboratory encompasses two elements: the Bennett Innovation Lab – designed to launch around 20-30 missions over a decade, each building a new industry in the UK; and the National Centre for Propulsion and Power – a rapid test facility designed to cut the time between ideas and testing from years to weeks.

Missions will involve small teams of elite engineering talent, operating in a culture which promotes risk and provides access to Formula 1-style rapid fabrication and testing.

Professor Deborah Prentice, Vice-Chancellor of the University of Cambridge, said: "We need to speed up innovation in the UK's engineering sector. The Bennett Innovation Lab offers the incredible opportunity for the UK to build a mission capability which can deliver the UK's leading science into new industries at an unparalleled pace. This will be a partnership between Cambridge and the other leading technology clusters and institutes across the UK. It's only by building a partnership of the UK's leading clusters that we deliver the speed of technology development and deployment that the UK needs."

Professor Rob Miller, Chair in Aerothermal Technology and Director of the Whittle Laboratory at Cambridge, said: "AI is dramatically accelerating hardware innovation across the aerospace, energy and defence sectors. Britain has the capacity and the audacity to compete and win in a global race. What's missing is a bold new approach that champions rapid iteration over incremental improvement. That's why we've established the Bennett Innovation Lab – a sovereign capability designed to launch transformative new missions, each of which is designed to build or transform a UK industry."

The formal opening of the New Whittle Laboratory marks another significant milestone in the development of the Cambridge West Innovation District, home to the University's world-leading research in science and technology.

> "The Bennett Innovation Lab offers the incredible opportunity for the UK to build a mission capability which can deliver the UK's leading science into new industries at an unparalleled pace.
>
> Professor Deborah Prentice

**Watch the video:**
youtu.be/KyFh93Xncu4
whittle.eng.cam.ac.uk
bennettinnovationlab.com



Credit: Natalie Hall/SDC

→ From left, Professor Rob Miller, Director of the Whittle Laboratory, and Dr Elliott Grant, Co-Director of the new Bennett Innovation Lab

# The Frank Whittle Summit – reigniting Britain's industrial engine in aerospace, energy and defence

**The Frank Whittle Summit – which was held on the same day as the official opening of the New Whittle Laboratory – brought together major industrial businesses and tech giants to reignite Britain's industrial engine in aerospace, energy and defence.**

The Summit was hosted in partnership with the Sustainable Markets Initiative, founded in 2020 by the King – then the Prince of Wales – to help convene global business leaders, investors and innovators to accelerate the deployment of breakthrough technologies and strengthen collaboration between industry, academia and government.

The Summit brought together executives from companies including Rolls-Royce, Boeing, Mitsubishi Heavy Industries and Siemens Energy, along with leading AI firms, senior government officials and top researchers, to kickstart a series of missions to pioneer new technologies and industries in the UK.

These missions will transform and accelerate the UK's approach to innovation in hardware development and manufacturing across aerospace, energy and defence, harnessing AI and autonomous laboratories to shrink today's multi-year technology development cycles from years to months.

An initial proof-of-concept pilot mission, made possible by philanthropic gifts from Lord Sainsbury of Turville and Peter Bennett, with support from Rolls-Royce, has demonstrated these capabilities. This has resulted in the development of a novel cryogenic jet engine, representing the biggest shift in jet engine design since Frank Whittle's original design, and in nine new patents being filed by the project team. Rolls-Royce plans to use these learnings to accelerate technology development for its future narrowbody engine.

Around 20 to 30 such missions could be launched over the coming decade, potentially resulting in up to £30 billion in economic value to the UK and creating as many as 10,000 new skilled jobs.

Representatives from the UK's world-leading innovation clusters and labs, including the Henry Royce Institute, the Advanced Manufacturing Research Centre, the Harwell Campus, the Silverstone Technology Cluster and the Manufacturing Technology Centre, were also present at the Summit.

Speaking at the time, Lord Vallance, the former Minister for Science, Innovation, Research and Nuclear, said: "The UK's universities are among the best in the world, driving breakthroughs that will shape the future and transform lives. The New Whittle Laboratory is an excellent example of how we can turn world-class research into innovation and growth, and I look forward to seeing the pioneering technologies that will be developed here."

Professor Julia Sutcliffe, Chief Scientific Adviser at the Department for Business and Trade, said: "To remain internationally competitive and at the forefront of critical industries for the UK economy – including aerospace, energy and defence – we must find new models to move much faster. We need to ensure that our great ideas support the growth of businesses in this country, and we believe the mission-led approach being pioneered through the New Whittle Laboratory and our other leading research clusters will be transformative in delivering this."

*Written by Stephen Bevan and Sarah Collins*

> "The New Whittle Laboratory is an excellent example of how we can turn world-class research into innovation and growth, and I look forward to seeing the pioneering technologies that will be developed here."
>
> Lord Vallance

→ Professor Róisín Owens (CEB), left, with Dr Amparo Güemes (Department of Engineering), each holding the miniature devices they have created



Credit: Department of Chemical Engineering and Biotechnology (CEB)

# Tiny device to transform understanding of our 'second brain'

## Scientists have been able to measure the electrical signals in the 'second brain in our guts' for the first time ever, giving renewed understanding to its interconnection with the brain.

Researchers from the Department of Chemical Engineering and Biotechnology (CEB) and the Department of Engineering at the University of Cambridge, and the Thayer School of Engineering at Dartmouth, have created a miniature device, thinner than the width of a hair, that can be placed between the layers of the colon to record these signals.

The device, a soft, flexible electronic implant, has been tested in rodents and pigs so far and works even in freely moving animals, detecting responses to various stimulants and physical pressure. The findings are reported in the journal *Nature Communications*.

The researchers believe the secret to many neurological disorders lie in the way the enteric nervous system (ENS), the gut's own complex nervous system, and the brain interact. But it has been hard to study this interaction previously, as the gut is constantly moving and neurons are spread out and hard to reach.

The tiny device could be inserted laparoscopically as an outpatient procedure, enabling researchers to investigate like never before.

CEB's Bioelectronic Systems Technology group research leader Professor Róisín Owens said: "Because the ENS neural activity is 'dampened' down under anaesthesia, the ability to record in awake animals is crucial, as it allows recording of the ENS while the animal experiences stress or during and after eating. This new technology will build a better understanding of how the gut and brain communicate, and it could lead to new treatments for digestive and neurological disorders."

Co-first author Dr Amparo Güemes is an Assistant Professor at the University of Cambridge, Royal Academy of Engineering and Rosetrees Research Fellow at the Bioelectronics Laboratory (Department of Engineering), Fellow of Pembroke College, and Head of the Neuro-Metabolic Control Systems Lab.

She said: "With our chronic implant technology, we can, for the first time, record real-time electrophysiology signals from the 'second brain' in the gut over extended periods.

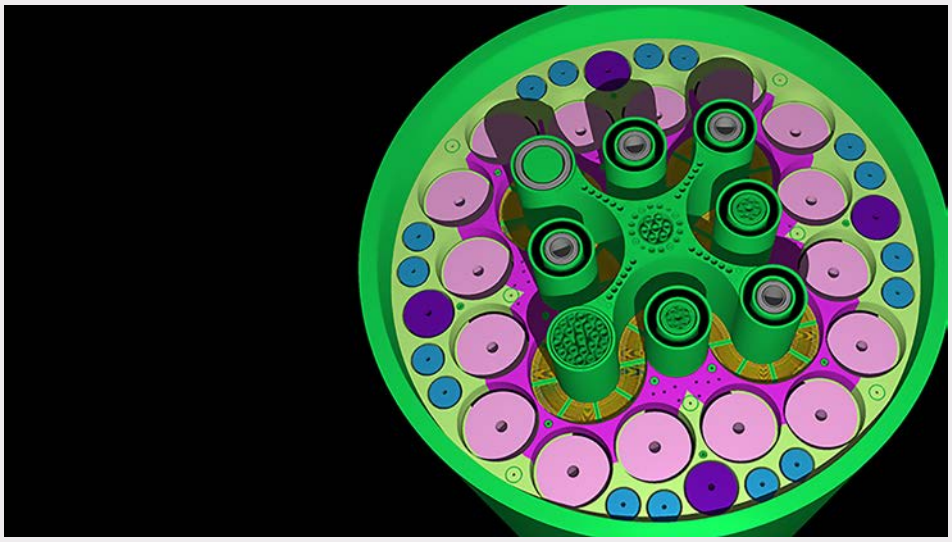
"This allows us to study how the gut responds to physiological stimuli, such as stress, and how it reacts to treatments or dietary changes, something that wasn't possible with previous methods. This opens the door to a much deeper understanding of gut–brain communication and its impact on health. It was just not possible to do this before."

Co-first author Dr Alex Boys, Dartmouth, added: "This platform creates a pathway to a variety of therapeutic interventions in the gut, which has connotations for conditions like inflammatory bowel disease, gastroparesis and others. The gut's nervous system has been historically difficult to access, and we show here not only that it can be done, but that we can extract fairly intricate information."

> "With our chronic implant technology, we can, for the first time, record real-time electrophysiology signals from the 'second brain' in the gut over extended periods.
>
> Dr Amparo Güemes

**Open access paper:**
www.eng.cam.ac.uk/second-brain
bioelectronics.eng.cam.ac.uk
elec.eng.cam.ac.uk

→ A visualisation of a nuclear reactor (the Advanced Test Reactor) produced by our Department's in-house code called SCONE – Stochastic Calculator Of the Neutron transport Equation



Credit: SCONE

# Cambridge joins UKRI programmes to train next generation of nuclear scientists

## The University of Cambridge will help train industry-ready nuclear scientists as part of two UK Research and Innovation (UKRI) Doctoral Focal Awards in Nuclear Skills.

The funding for doctoral students is being provided by the Department for Energy Security and Net Zero and Ministry of Defence as part of the Nuclear Skills Plan, which brings together government, industry and education providers to deliver the skilled workforce and 24,000 additional jobs required in the nuclear sector by 2030.

### PANDA

As part of the **P**rogramme for **A**ccelerating **N**uclear **D**evelopment and **A**pplications (PANDA), led by Bangor University, 10 PhD studentships are expected to be secured at Cambridge, shared between the Department of Engineering and the Department of Chemical Engineering and Biotechnology, over four years, as part of a £24 million programme training up to 100 PhD students.

The £9 million awarded by the Department for Energy Security and Net Zero, the Ministry of Defence and UKRI will be matched by support from major nuclear organisations, including Rolls-Royce Submarines, the UK Atomic Energy Authority and TWI.

PANDA will be delivered by Bangor University in partnership with the United Kingdom National Nuclear Laboratory and the Universities of Cambridge (led by Dr Paul Cosgrove and Dr Nathaniel Read), Bristol, Birmingham, Derby, Manchester and Imperial College London. Together, these partners will support a new generation of researchers equipped to meet the UK's future nuclear- and clean-energy needs, including a specific focus on defence.

Alongside advanced nuclear science and engineering, PANDA students will receive training in project management, budgeting, regulatory awareness, communication and broader leadership skills. This holistic approach ensures graduates are fully prepared for employment in a rapidly expanding sector that requires both technical excellence and professional capability.

### PLANET

As part of the **P**hysics-**L**ed **A**pplications for **N**uclear **E**ngineering and **T**echnology (PLANET) programme, led by the University of York, 16 PhD studentships are expected to be secured at Cambridge, shared between the Department of Engineering and the Cavendish Laboratory, Department of Physics, over four years. This is part of an £8 million initiative to train at least 80 industry-ready nuclear scientists, serving as a key part of a national drive to quadruple the number of nuclear specialists in the UK.

Match-funded by industry, PLANET will equip students and researchers to work in fields vital to national security, clean energy and healthcare.

In a first-of-its-kind collaboration, the partnership consists of three Nuclear Physics research groups at the Universities of York, Surrey and Edinburgh and two Nuclear Engineering groups at the Universities of Cambridge (led by Professor Geoff Parks, Dr Valeria Raffuzzi and Dr Paul Cosgrove) and Lancaster. The partnership is designed to close the historical gap between fundamental science and real-world energy solutions.

By partnering with UK national laboratories and private industry, the programme will ensure that every PhD project is co-created with real-world applications in mind. Through access to world-leading infrastructure – including the National Physical Laboratory (NPL) and the nToF and ISOLDE facilities at CERN – students will develop the skills and hands-on training needed to build and monitor nuclear systems.

Dr Paul Cosgrove, Research Associate in the Nuclear Energy Group at the Department of Engineering, said: "The PANDA and PLANET programmes highlight Cambridge's strength in nuclear reactor physics and design. We are delighted that these programmes will allow us to further expand research in areas of clear national importance, working closely with colleagues at York, Bangor and other partner universities, with the support of industry collaborators including EDF Energy and Rolls-Royce."

→ **Read the full article at:**
www.eng.cam.ac.uk/UKRI-nuclear
panda.ac.uk
planet-dfa.ac.uk



Credit: NASA/James Blair

→ CSA astronauts Jeremy Hansen and Jenni Gibbons who were members of the prime and backup crew of Artemis II, pose with NASA astronaut Reid Wiseman (centre), Commander of the mission

ALUMNI UPDATE

# To the Moon – Cambridge alumna's key role in historic Artemis II mission

**Cambridge alumna and Canadian Space Agency (CSA) astronaut Dr Jenni Gibbons supported her fellow astronauts during the historic Artemis II mission – by acting as the critical voice link between the astronauts in space and the teams on the ground at NASA's Mission Control Center.**

As the first person from an international partner country to be certified as an Artemis capsule communicator (capcom), Dr Gibbons was on console for several shifts during the 10-day mission – which launched on 1 April 2026 – including the first crewed lunar flyby of the Moon in more than 50 years.

Dr Gibbons was assigned as CSA astronaut Jeremy Hansen's backup for the mission in November 2023, and this means that she has undergone the same training as the prime crew.

Jeremy Hansen said: "Jenni is someone who's extraordinarily operationally competent, but also one of the kindest people you will ever meet. It was great to have her backing us up on this mission. I'm excited about all the amazing things that Jenni is going to do in the future for Canada."

Having trained closely with the crew for more than two years meant that Dr Gibbons understood the kind of information she needed to communicate with her crewmates from Mission Control.

Dr Gibbons said that being a capcom also prepares you to be a more effective crewmember, because you have a window into the processes in Mission Control which support spaceflight.

After completing a PhD in Engineering at Jesus College in 2015, Dr Gibbons became a University Lecturer in Internal Combustion Engines, teaching students in the Energy, Fluid Mechanics and Turbomachinery Division. She was an Assistant Professor in Engineering at Cambridge, and is an Honorary Fellow at St Catharine's College.

## Dr Gibbons' role in preparing the Orion spacecraft for launch

Just before the launch on 1 April, a closeout crew were responsible for securing the Artemis II astronauts in the Orion spacecraft and closing its hatches. Dr Gibbons was part of the extended closeout team.

About 40 hours prior to the launch and again 16 hours before, her job as an Astronaut Support Person was to prepare the Orion spacecraft, making sure everything was as expected – from the seats to the switches. She also performed voice checks from inside the capsule to make sure communications loops were clear and legible before the crew entered the spacecraft.

## Contributing to the foundation of future lunar missions

As part of their training, both Jeremy Hansen and Dr Gibbons also play a key role in defining and validating astronaut training and processes for future lunar missions, putting their expertise in service not only of this flight, but also of the Artemis programme as a whole.

Dr Gibbons will be the lead capcom for NASA's Artemis III mission, due to launch in 2027. She is working on developing the ground support for the mission with the rest of the flight control team, including working on crew procedures and operations. Watch this space!

> "Jenni is someone who's extraordinarily operationally competent, but also one of the kindest people you will ever meet. It was great to have her backing us up on this mission. I'm excited about all the amazing things that Jenni is going to do in the future for Canada.
>
> CSA astronaut Jeremy Hansen

→ Dr Osarenkhoe Ogbeide



Credit: Lloyd Mann

# Researcher awarded prestigious Royal Society Career Development Fellowship

**Dr Osarenkhoe Ogbeide, Junior Research Fellow at Churchill College and a member of the Department of Engineering's Electrical Engineering Division, has been awarded a Royal Society Career Development Fellowship 2025.**

This highly competitive scheme supports early career researchers from underrepresented backgrounds in STEM.

Awardees receive up to £690,000 over four years, alongside bespoke mentoring, training in grant writing and public engagement, and also opportunities to connect with world-leading scientists through the Royal Society's Fellowship network.

Fewer than 10 fellowships are awarded across the UK each year, making it one of the most selective programmes of its kind.

## Pioneering advances in nanoengineered gas sensing

Dr Ogbeide's research is at the forefront of nanoengineered sensing technology. During his PhD, he pioneered a first-of-its-kind predictive gas sensor capable of identifying and quantifying multiple gases simultaneously in complex environments. This innovation combined advanced nanostructured materials with machine intelligence to achieve unprecedented sensing performance.

Building on this foundation, he now develops low-power, highly sensitive and scalable gas sensors that integrate graphene and metal oxides to detect harmful pollutants – including formaldehyde and other volatile organic compounds – at parts-per-billion concentrations, even under challenging conditions such as high humidity. By integrating these sensors into portable platforms, his work aims to enable applications in indoor air quality monitoring, agri-tech and personal healthcare, including early disease detection through breath analysis.

Dr Ogbeide's upcoming project titled *Pioneering novel nanoengineered gas sensors for ultrasensitive indoor air quality monitoring* seeks to transform how indoor pollution is detected and understood.

"Indoor air pollution is a serious but often overlooked health issue," said Dr Ogbeide. "We spend most of our time indoors, where pollutant concentrations can be far higher than outdoors. My goal is to develop intelligent, affordable sensing technologies that empower individuals to monitor and improve their own environments."

His work has the potential to make personalised air quality monitoring accessible to millions, providing evidence to shape future health policy, protect public health and guide manufacturers toward safer, cleaner products.

## Championing equality, diversity and inclusion

Beyond his research, Dr Ogbeide is a champion of equality, diversity and inclusion in education. He has influenced national discussions on representation and belonging in academia and policy, advising policymakers and educational leaders across the UK. He has contributed to debates on discrimination in schools at 10 Downing Street and consulted the Equality and Human Rights Commission on national guidance to prevent Afro hair discrimination in schools, which was published in 2022.

## Creativity, outreach and inspiring future scientists

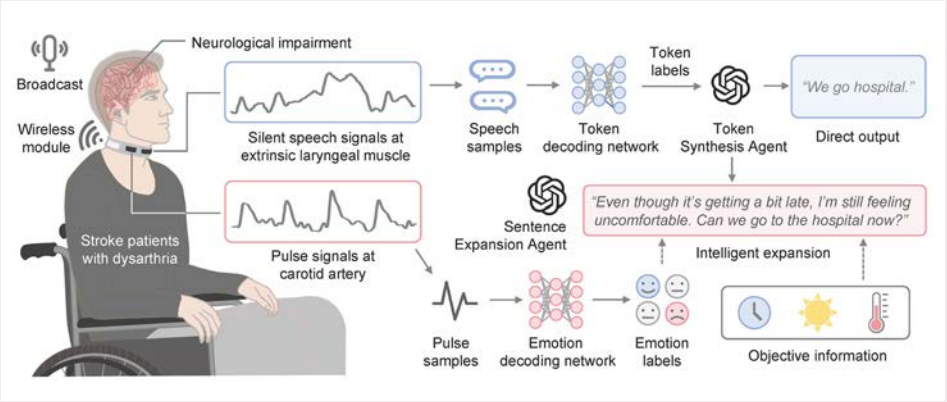
Alongside his scientific work, Dr Ogbeide is a talented illustrator and comic creator. Through his company, New Africa Comics, he writes and illustrates original stories that blend culture, imagination and social commentary, exploring themes of identity, discovery and resilience. His creative work informs his approach to science and has become a powerful tool for science outreach, transforming complex research into engaging visual narratives for schools and community programmes across the UK and globally.

Speaking about the fellowship, Dr Ogbeide said: "I am deeply honoured to receive this award from the Royal Society. It not only supports my research but also connects me with mentors and colleagues who are shaping the future of science. I hope my journey can inspire others from underrepresented backgrounds to see themselves in STEM."

*Written by Michael Shuff*

ogbeide.co.uk

→ Illustration of the Revoice device in action




Credit: Occhipinti Group

# 'Revoice' device gives stroke patients their voice back

**Researchers have developed a wearable, comfortable and washable device called Revoice that could help people regain the ability to communicate naturally and fluently following a stroke, without the need for invasive brain implants.**

The device, whose development was led by researchers at the University of Cambridge, uses a combination of ultra-sensitive sensors and artificial intelligence (AI) to decode speech signals and emotional cues to allow people with post-stroke speech impairment to communicate naturally.

The Revoice device, worn as a soft and flexible choker, captures the wearer's heart rate and tiny vibrations from throat muscles, and uses those signals to reconstruct intended words and sentences in real time.

The signals from the device are processed by two AI agents: one reconstructs words from fragments of silently mouthed speech, while the other interprets emotional state and contextual information, such as the time of day or weather conditions, to expand short phrases into complete, expressive sentences.

In a small trial with five patients with dysarthria, a common type of post-stroke speech impairment, the device achieved a word error rate of 4.2% and a sentence error rate of just 2.9%. Unlike existing assistive speech technologies which often require slow letter-by-letter input, eye tracking or brain implants, the Revoice device provides seamless real-time communication, turning just a few mouthed words into full, fluent sentences.

The results, reported in the journal *Nature Communications*, could not only have implications for stroke rehabilitation, but could also help support people with conditions such as Parkinson's and motor neurone disease.

"When people have dysarthria following a stroke, it can be extremely frustrating for them, because they know exactly what they want to say, but physically struggle to say it, because the signals between their brain and their throat have been scrambled by the stroke," said Professor Luigi Occhipinti from Cambridge's Department of Engineering, who led the research. "That frustration can be profound, not just for the patients, but for their caregivers and families as well."

Most stroke patients with dysarthria work with a speech therapist to regain their ability to communicate, primarily through repetitive word drills, where patients repeat words or phrases back to the speech therapist. Typical recovery time varies from a few months to a year or more.

"Patients can generally perform the repetitive drills after some practice, but they often struggle with open-ended questions and everyday conversation," said Professor Occhipinti. "And as many patients do recover most or all of their speech eventually, there is not a need for invasive brain implants, but there is a strong need for speech solutions that are more intuitive and portable."

Professor Occhipinti and his colleagues developed the Revoice device as such a solution. The sensors in the device capture subtle vibrations from the throat to detect speech signals and decode emotional states from pulse signals – a simplified but effective proxy. The device also uses an embedded lightweight large language model (LLM) to predict full sentences, so only uses minimal power.

Working with colleagues in China, the researchers carried out a small trial with five stroke patients with dysarthria, as well as 10 healthy controls. In the study, participants wore the device and mouthed short phrases. By nodding twice, they could choose to expand those phrases into sentences using the embedded LLM.

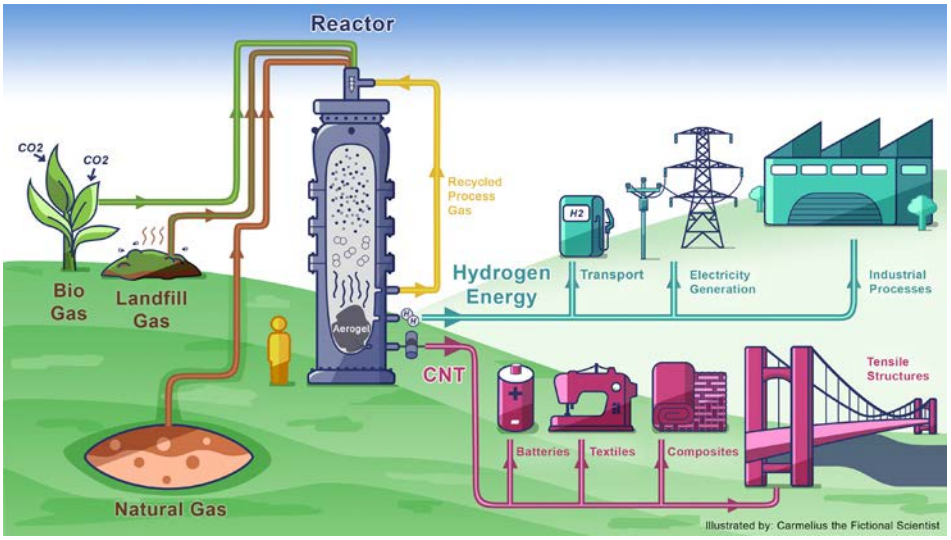
In one example, "We go hospital" became "Even though it's getting a bit late, I'm still feeling uncomfortable. Can we go to the hospital now?" The sensors in the Revoice device inferred that the wearer was feeling frustrated due to their elevated heart rate, and that it was getting late at night. The LLM was able to use this data to expand three mouthed words into a fuller sentence.

Participants in the study reported a 55% increase in satisfaction, showing that the device could be a promising development to help stroke patients regain their ability to communicate. Although extensive clinical trials will be required before the device can be made widely available, the researchers hope that future versions of the device will include multilingual capabilities, a broader range of emotional states and fully self-contained operation for everyday use.

"This is about giving people their independence back," said Professor Occhipinti. "Communication is fundamental to dignity and recovery."

*Written by Sarah Collins*

**Open access paper:**
www.eng.cam.ac.uk/revoice-stroke




Credit: Carmelius the Fictional Scientist

→ An overview of the researchers' continuous-flow reactor, which uses a technique known as floating catalyst chemical vapour deposition (FCCVD) to enable the continuous mass production of CNTs

# Energy-efficient reactor captures and recycles methane to produce clean hydrogen and carbon nanotubes

**Researchers have successfully converted methane (natural gas) into hydrogen with low $CO_2$ emissions alongside high-performance carbon nanotube (CNT) materials. These CNTs can act as sustainable replacements for $CO_2$-intensive materials such as steel, aluminium and copper.**

The process is made possible thanks to a research team from the University of Cambridge and Stanford University who modified a continuous-flow reactor to make it more efficient, but, crucially, without compromising the quality of the versatile and high-value nanotubes.

Hydrogen is sought as a sustainable fuel to aid in the decarbonisation of industries that are hard to electrify, like aviation and shipping. The world already produces 100 million metric tons of hydrogen per year, primarily as a feedstock for industrial processes like ammonia production, which is used for artificial fertilisers. This hydrogen production relies heavily on steam methane reforming of natural gas, which is a very $CO_2$-intensive process, contributing 2-3% of global greenhouse gas emissions.

But now, researchers present technology that has the potential to be scaled up for real-world use, providing an opportunity to produce sustainable fuel and materials from a single process. This process could be a key enabling step for methane pyrolysis, by which methane is converted into turquoise hydrogen, resulting in solid carbon, therefore avoiding the creation of $CO_2$. The results are reported in the journal *Nature Energy*.

The researchers' continuous-flow reactor uses a highly versatile and scalable technique known as floating catalyst chemical vapour deposition (FCCVD) – a process that enables the continuous mass production of CNTs, which take the form of mats, fibres and aerogels. These CNT materials can be stronger and lighter than steel, as well as being good conductors of electricity and heat. This combination of properties makes them suitable to displace current materials in a range of applications such as batteries and textiles.

However, the FCCVD process has historically consumed hydrogen, rather than produced it.

"We were able to overcome this problem by recycling gases inside our reactor in a multi-pass configuration, which allowed the production of hydrogen and CNTs at the same time," said co-author Jack Peden, a PhD student at the Department of Engineering, University of Cambridge, and a Harding Distinguished Postgraduate Scholar.

"The nanotubes produced in the multi-pass reactor possessed similar properties to those made in a conventional reactor, with the efficiency being many times higher than the conventional one."

He added: "Meeting today's hydrogen demand of 100 million metric tons per year using methane pyrolysis would produce 300 million metric tons per year of solid carbon. Only a few materials are currently used on this scale: typically, structural materials like concrete (16,000 million metric tons per year), steel (1,600 million metric tons per year), and plastics (350 million metric tons per year).

"To enable the meaningful scale up of methane pyrolysis, it is thus essential to produce carbon materials which can be used in these kinds of applications."

Co-author James Elliott from the Department of Materials Science and Metallurgy, University of Cambridge, said: "By capturing and recycling the gases within the reactor and optimising the furnace design, we have significantly reduced the energy required to run the process.

"The carbon nanomaterials produced already show promise in batteries and textiles, and could in future be used in lightweight composites, building materials or high-voltage electrical cables. Because these materials have substantial economic value, their sale can offset operating costs, making methane pyrolysis a commercially competitive route to low-carbon hydrogen."

**Open access paper:**
www.eng.cam.ac.uk/carbon-nanotubes
hyptcenter.asu.edu

→ Pictured from left, the Matta team. Douglas Brion, Damjan Denić, Sebastian Pattinson, Tom Walker



Credit: Matta

# Spin-out is helping factories become more productive, lower energy use and reduce emissions

## University of Cambridge spin-out Matta has raised $14 million in funding to transform how products are designed and manufactured.

Manufacturing underpins a third of global economic output yet remains plagued by inefficiencies that waste up to 20% of production value and raise emissions. Matta, founded on pioneering research from the University of Cambridge's Institute for Manufacturing (IfM), part of the Department of Engineering, aims to provide a practical route to improving productivity, quality and resilience on today's shop floor.

Its technology gives factories the ability to see, understand and improve themselves in real time, understanding any production line within days. It spots defects, traces root causes and helps teams fix problems before they become costly.

Highly adaptable, Matta can be applied to everything from electronics and automotive to defence and apparel, whether on manual inspection stations, conveyor lines or robot arms, to redefine how products are conceived and created.

It does this by using AI to learn the physical rules of production and apply them on the line. Its first product uses unsupervised and self-supervised computer vision to automate quality control and anomaly detection, perform measurements, diagnose root causes and recommend corrective actions in real time. A central platform lets teams monitor every camera, analyse results and trace parts across the factory for live visibility of issues and bottlenecks.

Matta's co-founders Douglas Brion, who completed a PhD in deep learning-enabled control at Cambridge, and Dr Sebastian Pattinson, Associate Professor in Manufacturing Engineering, first met at the IfM. Today, Matta is a fast-growing team with experience from MIT, Imperial, BBC R&D, Google X and Microsoft.

Douglas Brion, CEO of Matta, said: "Everything around us is manufactured, from the mug on your desk to the optical cables carrying our streaming service binges. Everyone talks about the glamorous side of manufacturing: generative design, material discovery, Digital Twins, but few spend time on the factory floor. The hard part isn't dreaming things up inside a computer; it's making them work at scale.

"Manufacturing still runs on human know-how, the kind that lets someone on the line kick a machine just right, or run a finger over a scratch, and say, 'that's thirty-four microns wide'. We're using AI to capture and scale that tacit knowledge, so engineers can design things that actually work in the real world. It's time to manufacture the impossible."

Dr Pattinson, Chief Scientist at Matta, added: "Manufacturing underpins modern living standards, but too much of it still turns materials and energy into waste. If we help factories understand themselves, we can prevent scrap and rework at the source, delivering a direct, scalable cut to industrial emissions."

The latest funding will accelerate customer adoption and AI development, expand self-serve deployment and support Matta's expansion into key manufacturing regions across Europe and the US, advancing the company's vision for fully autonomous, end-to-end production.

> "If we help factories understand themselves, we can prevent scrap and rework at the source, delivering a direct, scalable cut to industrial emissions.
>
> Dr Sebastian Pattinson

# Celebrating 60 years of manufacturing education at Cambridge



**In 2026, the Institute for Manufacturing (IfM), marks 60 years of manufacturing engineering education, celebrating a programme that has shaped generations of manufacturing leaders and which continues to evolve in response to industrial change.**

The course began in 1966 as the Advanced Course in Production Methods and Management. Initially funded by 96 companies that recognised the value of graduates with practical, hands-on experience, the course immersed students in real industrial projects from the outset – an emphasis that would become a defining feature of the programme.

Over six decades, the programme has grown from an initial cohort of 12 students to a global community of more than 1,800 alumni working across manufacturing, technology, consulting, entrepreneurship and policy.

In the 1980s, a design element was introduced, creating the Advanced Course in Design, Manufacture and Management. Then in 2004, the programme became the formal MPhil degree in Industrial Systems, Manufacture and Management (ISMM), as it is today.

Professor Tim Minshall, Head of the IfM, says the longevity of the programme reflects a consistent commitment to learning grounded in industrial reality: "What has kept this course relevant for 60 years is that it's never been just classroom learning. Students are taught the core engineering and management tools, but they develop their judgement by applying them immediately in real industrial settings – learning how to ask the right questions, work with uncertainty and deliver practical change."

## Learning grounded in industry

True to its origins as an industry-embedded programme, the course provides students with an integrated view of manufacturing engineering, combining rigorous taught modules with industrial projects and visits. Graduates develop a strong technical understanding of markets, product and process design, and operations and supply chains, alongside the professional skills needed to work confidently across organisational and disciplinary boundaries. These skills continue to make graduates sought-after across industry.

"In-company projects solving real business or technical problems are what make the ISMM unique, and we try to give students as wide a range of opportunities as possible by working with lots of different-sized companies," explains Vanessa McNiven, ISMM Executive Course Director.

"In a typical year, students visit around thirty companies that range in size. These cover a wide range of industrial sectors, including aerospace, automotive, beverages, chemicals, consumer products, defence, electronics, energy, food, healthcare, measurement systems, metals, pharmaceuticals and textiles.

"Students also get a chance to go overseas to see industry in a different culture and context – this provides the students with a truly international perspective on manufacturing."

## Reflecting on six decades of educational innovation

The anniversary also provides an opportunity to reflect on how manufacturing education must continue to adapt. A new working paper, with contributions from across the IfM's teaching programmes, examines the evolution of manufacturing education at Cambridge over six decades. It also considers how programmes may need to respond to emerging drivers such as AI, sustainability pressures, geopolitical instability and changing patterns of lifelong learning.

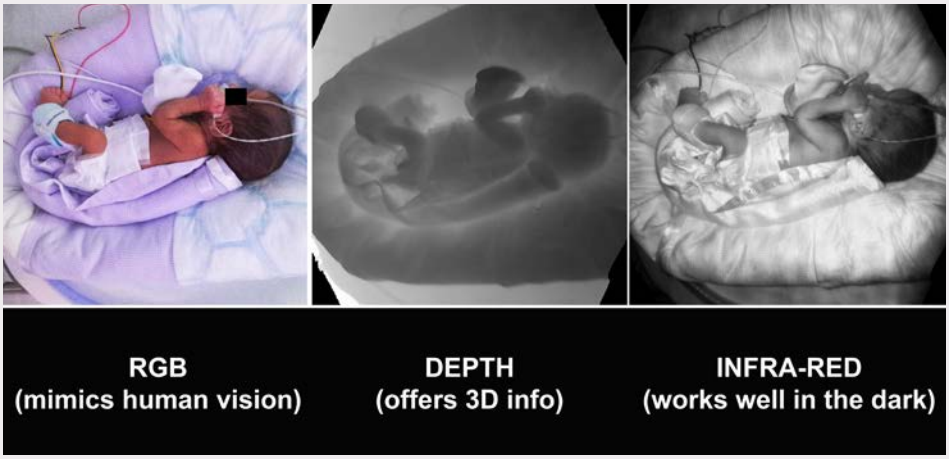
Dr Florian Urmetzer, ISMM Course Director notes that the anniversary is as much about the future as the past: "Manufacturing is changing rapidly and education has to keep pace. The anniversary is a chance to celebrate what has been achieved, but also to think seriously about what industry will need from manufacturing leaders in the next decade."

## Investing in the next 60 years

To support this long-term development, the IfM has launched a 60th Anniversary Fund. The fund will strengthen access to the programme through student support, enhance the learning experience through additional industrial teaching capacity and facilities, deepen engagement with industry, and support the development of new routes, including a potential new MSt course.

Professor Minshall says the programme's continued relevance depends on maintaining its distinctive blend of academic rigour and industrial engagement.

**Read the full article at:**
www.eng.cam.ac.uk/ifm-60th-anniversary




➔ What the 3D camera 'sees' in the neonatal incubator for real-time analysis of neonatal pose estimation. From left, RGB, depth, infra-red

# Researchers develop intelligent camera system for monitoring of premature babies

**Cambridge researchers have become the first to combine multiple image types – RGB (that mimics human vision), depth and infra-red – in a 3D camera set up to monitor premature babies in neonatal intensive care. The aim is to provide a second set of eyes for nurses through continuous visual monitoring of the babies' behaviour.**

The neonatal period (the first 28 days of life) is a critical time with an increased risk of short- and long-term complications. In the UK, more than 90,000 babies – approximately one out of every seven – are admitted to a neonatal unit every year.

The highest dependency patients are cared for in the neonatal intensive care unit (NICU). In the NICU, specialised round-the-clock care is required from a team of experts, but with so much pressure on nurses' time as they juggle responsibility for multiple babies, prepare feeds and carry out other clinical duties, continuous visual monitoring is not possible.

To address this monitoring gap, researchers harnessed machine learning technology and pose estimation – a computer vision task that uses AI to automatically track key points (in this case the hips and shoulders) – to monitor the position of 24 babies across the full range of clinical imaging scenarios. The data includes multiple 24-hour recordings during which nurses were instructed to continue delivering care as though the camera was not present. The findings are reported in the journal *npj Digital Medicine*.

The research team, led by Dr Alex Grafton, recorded babies in the NICU at Addenbrooke's Hospital, Cambridge, using a calibrated RGB, depth and infra-red camera system during one-hour and 24-hour sessions. The 24-hour recordings included real interventions, light changes, movement and interactions with parents.

Machine learning allows the researchers to extract via a computer information from video footage collected of each baby. This means that interventions (such as when staff or a parent's hands are in the cot) can be detected in real time, along with the ability to automatically locate the baby in the video frame and monitor the baby's behaviour.

Combining all three image types allows for detailed images to be captured even when incubators are covered or the room is dark.

The simplest imaging conditions are when the babies are uncovered or half-covered, but this only accounts for approximately half the time. The babies spend a lot of time covered, or lying on their sides which makes imaging difficult.

The findings showed that for uncovered and half-covered babies, the researchers' machine learning models recorded better than average human performance. This was also the case for babies lying on their backs and stomachs. However, for fully covered babies, or babies lying on their side, the model scored worse than average human performance.

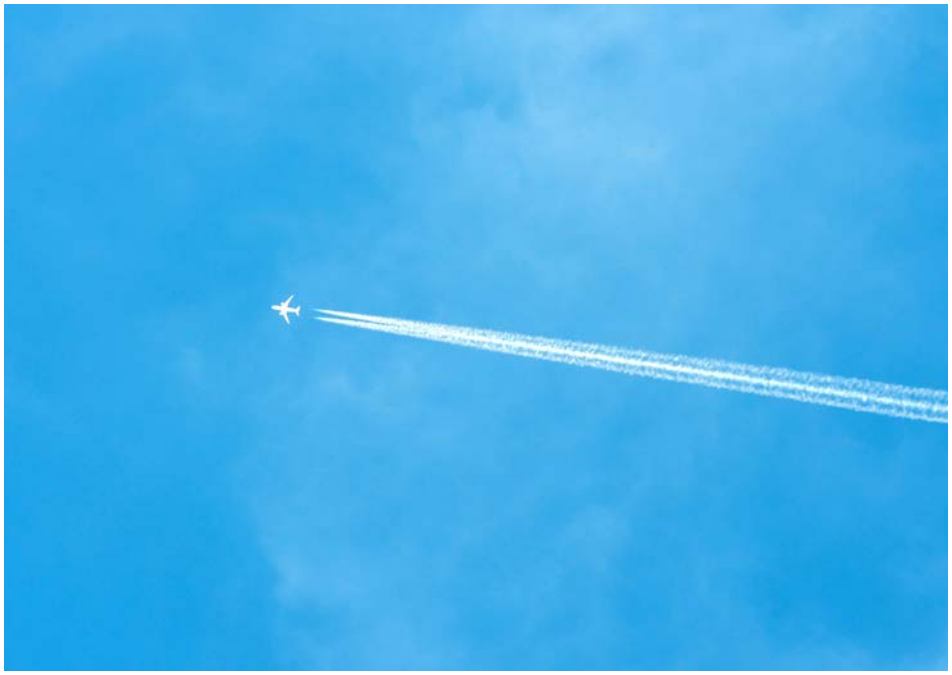
"This clinical study was a chance for us to try something new, with our 24-hour recordings offering a better representation of the real-life NICU environment," said co-author Dr Grafton, Research Associate in Non-Contact Neonatal Monitoring. "Accurate pose estimation can contribute to the early detection of developmental abnormalities and ongoing monitoring of premature babies' health. These advancements offer valuable insights that can inform clinical decisions and interventions, ultimately improving the standard of care for newborn babies."

He added: "No existing dataset includes images of babies in the presence of blanket coverings or clinical interventions. Understanding the performance of these algorithms in this environment is needed to demonstrate feasibility for continuous clinical use. Our study offers an alternative approach combining RGB (standard colour images that rely on external light), depth (which provides three-dimensional information) and infra-red (which acts like night vision) for real-time neonatal pose estimation. These models are based on retraining from machine learning models originally trained for pose estimation in adults, which is a much more well-studied task."

This research is part of the Meerkat project, a collaboration between the Departments of Engineering and Paediatrics, which aims to develop intelligent, non-contact monitoring to support care delivery in the neonatal unit.

➔ **Open access paper:**
www.eng.cam.ac.uk/premature-babies

→ Contrails against a blue sky



Credit: noon@photo – stock.adobe.com

# Operation Blue Skies takes off: landmark trial to test AI-driven contrail avoidance

**A UK-based consortium will conduct the world's first airspace trial aimed at reducing condensation trails – known as contrails – that could greatly reduce aviation's global warming impact.**

Backed by the UK Government, 'Operation Blue Skies' brings together partners, including the University of Cambridge, to evaluate AI-driven flight path adjustments across North Atlantic airspace.

Operation Blue Skies is a £5 million, 30-month programme, partly funded by £2.65 million from the Department for Transport (DfT). It includes two operational trials to be conducted during the winter months across NATS-controlled Shanwick oceanic airspace, the eastern half of the North Atlantic corridor.

The programme will evaluate the operational feasibility and environmental benefits of adjusting commercial flights' altitude to avoid the atmospheric conditions that contribute to the formation of persistent, warming contrails.

Contrails form when water vapour in a jet-engine's exhaust condenses and freezes around soot particles and other aerosols in the cold, humid air of the upper atmosphere. Persistent warming contrails trap outgoing heat, accounting for roughly one-third of aviation's total climate impact.

Atmospheric modelling shows that the Shanwick airspace accounts for approximately 5% of global contrail warming. A significant part of this warming is concentrated in the winter season between November and February. Operation Blue Skies will target this specific high-impact window by using AI models to identify where and when interventions have the greatest potential to reduce contrail-related climate impact.

The trials will focus on minor altitude adjustments within standard flight operations, coordinated through established and standard Air Traffic Control (ATC) communication channels. Trial manoeuvres will take place primarily during winter testing windows in 2026-2027 and 2027-2028, with approximately 20 to 40 test days per winter. Testing will be conducted during periods of lower air traffic.

In addition to the University of Cambridge, the Operation Blue Skies consortium includes Google, the DfT, the Met Office, NATS, Contrails.org and Imperial College London. The Cambridge and Imperial researchers will be evaluating trial outcomes and providing independent verification of climate impact.

"Contrail avoidance could drastically reduce the global climate impact of aviation, at minimal cost to passengers and companies," said Professor Steven Barrett, Regius Professor of Engineering at the University of Cambridge. "Operation Blue Skies is a big step forward in this process, as it will test the ability of the UK to reduce contrail coverage at an airspace-wide scale and in a real-world setting. It's an exciting step in building a more sustainable aviation industry."

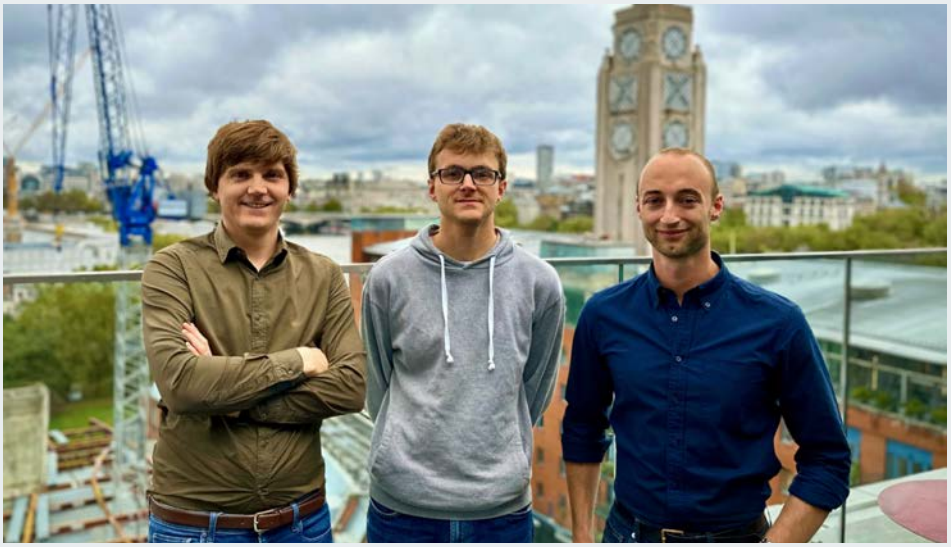
The trial sits alongside major UK Government investments in aviation decarbonisation projects, including £219 million to boost homegrown green fuel production to cut emissions from flying, while boosting growth and creating green jobs.

"This is a world-first, and it's British ingenuity leading the way," said Keir Mather, Minister for Aviation, Maritime and Logistics. "By testing small tweaks to flight paths over the Atlantic, we can cut the vapour trails left behind by planes. From £219 million for home-grown sustainable fuel to zero-emission aircraft, we're backing innovation to make UK aviation cleaner, support thousands of skilled jobs and drive growth in the sector."

The Operation Blue Skies programme is co-funded by its industry partners and the DfT through the Aerospace Technology Institute (ATI) Programme, a partnership between the ATI, the Department for Business, Innovation, Science and Trade (BIST) and Innovate UK. To ensure public funding directly advances sovereign scientific capabilities, 100% of the government grant funding is allocated directly to academic, non-profit and aviation partners.

*Written by Sarah Collins*

**Read the full article at:**
www.eng.cam.ac.uk/operation-blue-skies



Credit: SchemeFlow

➔ The team behind SchemeFlow, from left, Andrew Browning (CEO and Co-Founder), Jonny Browning (CTO and Co-Founder), alumnus James Griffith (COO and Co-Founder)

ALUMNI UPDATE

# Breaking the bottlenecks: AI platform to accelerate infrastructure and development planning

**Born out of witnessing pre-construction delays in consultancy and local government, two Cambridge alumni have co-founded SchemeFlow – an AI platform that rapidly generates technical documentation for construction projects.**

Over the past year, the Y Combinator-backed[1] start-up, co-founded by Engineering alumnus James Griffith and History alumnus Andrew Browning, has been used by civil and environmental engineers to generate more than 4,000 planning reports across the UK and US. By integrating AI with deterministic systems, SchemeFlow allows civil engineers to deliver technical documents 60% to 80% faster, unlocking delivery models that were not previously possible.

"But speed alone isn't enough," says James, who specialised in Civil, Structural and Environmental Engineering for his Master of Engineering (MEng) at Cambridge. "Civil engineering is a trust-based profession where decisions carry real accountability and public safety is always at stake. Engineers won't sign off output that they can't interrogate."

James (Emmanuel College 2010) explains: "The platform was built as a transparent, step-by-step process, with clear links to data sources, analysis and regulatory references at every stage. Engineers stay in control, while leveraging the full speed of AI.

"For comparison, in the UK, a typical planning application for a 20-home development might require over 40 technical reports, for example flood risk assessments, transport assessments, travel plans and environmental statements, on top of architectural and engineering drawings. Expensive, slow and growing in complexity every year, the result is years of delay before ground is ever broken."

He added: "Within the next two years, most technical planning and permitting reports will be produced by AI. The limiting factor won't be writing them; it will be how quickly experts can review and approve them."

## From Cambridge to Silicon Valley – a fusion of belief, expertise and execution

James describes the first two years of his MEng as providing him with the ability to consider multiple creative solutions to a problem.

"The breadth of the first two years was something I didn't fully appreciate at the time but have come to value enormously. Exposure to structures, thermodynamics, electrical systems and computing gave me a lateral fluency that is genuinely useful when building a technology company in a technical industry.

"The other takeaways from my time at Cambridge are ones I only fully recognised once I became a founder.

"The first is **multidisciplinary thinking**. Every real engineering project draws on structures, fluid mechanics, materials and computing, often simultaneously. The first two years at Cambridge are deliberately designed to build that breadth, and it turns out that building a company demands the same instinct: product, sales, finance and technology all at once.

"The second is **learning to operate under volume**. Cambridge forces you to juggle an extraordinary number of things simultaneously – problem sets, labs, supervisions, deadlines – and that relentless workload is, in retrospect, perfect preparation for founder life where the to-do list never gets shorter.

"The third is **performing under pressure**. The exams were painful, but they taught you to deliver on the day, regardless of circumstances. That ability to execute when it matters – not just when conditions are ideal – is something I draw on constantly."

[1] Y Combinator is a Silicon Valley start-up accelerator.

**Read the full article at:**
www.eng.cam.ac.uk/schemeflow-ai

→ From left, Dr Matteo Zallio, Tyler Holderness, Dr Florian Urmetzer and Dr Viviana Bastidas Melo



Credit: [SECOND LEFT] Trinity Hall

# University-council collaboration to develop AI solutions for operational public service needs

**Researchers from and affiliated to the Department of Engineering will work with local government to advance AI innovation in public services.**

The inaugural Local Government AI Accelerator, launched by ai@cam – the University of Cambridge's flagship mission on AI – is a programme that establishes a new model for how universities and local government can work together, developing practical, proof-of-concept AI solutions to real operational challenges, and delivering meaningful improvements for communities.

Funded by the Ministry of Housing, Communities and Local Government (MHCLG), the 12-month Accelerator pairs Cambridge researchers directly with local councils to develop a range of AI solutions that deliver tangible public value. The programme places public concerns directly into the research process.

The Accelerator was shaped by insights from a workshop held last year, where 21 local authorities shared their most pressing operational challenges, highlighting the significant potential for AI to provide practical support.

These discussions brought into sharp focus the pressures facing councils:

- Residents navigating fragmented services.
- Vulnerable people at risk of falling through gaps in provision.
- Staff burdened by manual administrative work.

The Accelerator has been designed to respond directly to these challenges, with six projects selected in total, three of which involve researchers from and affiliated to the Department of Engineering, and are listed as follows:

### SHIFT: AI-enabled Surveys for Housing Intelligence and Future Trajectories

Preparing the annual housing trajectory is a statutory requirement for all English local authorities, yet the process of distributing, chasing and analysing site-specific questionnaires sent to developers and housebuilders remains highly manual and time-consuming.

This project will develop a human-in-the-loop AI-enabled workflow to automate questionnaire drafting and distribution, convert free-text responses into structured data, and provide live monitoring dashboards for planning officers.

**Principal Investigator:** Dr Matteo Zallio, Assistant Professor in Architecture and Design at the Department of Architecture, and Co-Lead of the Inclusive Design Group at the Department of Engineering.

**Council Partner:** Greater Cambridge Shared Planning Service (Cambridge City Council and South Cambridgeshire District Council).

### Deep Learning for Fly-Tipped Waste Detection

This project will develop a deep-learning computer vision pipeline that leverages cameras already fitted to refuse collection vehicles to detect fly-tipped waste during routine rounds. The system will automatically extract the location, timestamp, waste description and photographic evidence needed to generate a report, with human-in-the-loop verification before any action is taken.

**Principal Investigators:** Dr Florian Urmetzer, Associate Teaching Professor, and Tyler Holderness, Doctoral Researcher, both from the Institute for Manufacturing (IfM).

**Council Partners:** South Cambridgeshire District Council and Greater Cambridge Shared Waste Services.

### Human-Oriented AI: Design Framework for Reaching Vulnerable Tenants

As local authorities develop AI-powered tools to support vulnerable tenants, there is a risk that technical development moves faster than the governance, ethical and public value frameworks needed to ensure those tools are legitimate and trustworthy.

This project will apply a Human-Oriented AI framework to the early warning system being developed by Cambridge City Council and South Cambridgeshire District Council. Human-Oriented AI is a framework designed to orient AI-based systems toward human and societal needs, with governance as the means to ensure that systems realise the intended public values.

**Principal Investigator:** Dr Viviana Bastidas Melo, Assistant Research Professor in Urban Systems and Infrastructure.

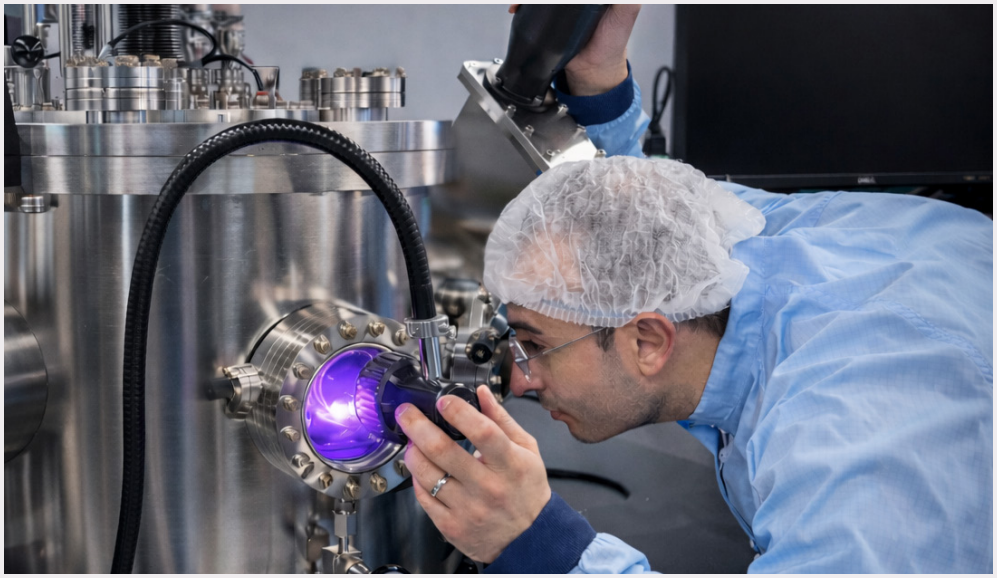
**Council Partners:** Cambridge City Council and South Cambridgeshire District Council.

### Scaling impact across local government

Each project will receive up to £25,000, dedicated technical support from machine learning engineers, and access to a structured community of practice (CoP). The findings will be shared through ongoing engagement with councils, residents and policymakers.

**Read the full article at:**
www.eng.cam.ac.uk/council-collaboration

→ Dr Bakhit looking into the growth chamber during the Hf(Sr,Ti)O2 co-sputtering



Credit: Ms Kasia Surowiecka

# New computer chip material inspired by the human brain could slash AI energy use

## Researchers have developed a new kind of nanoelectronic device that could dramatically cut the energy consumed by AI hardware by mimicking the human brain.

The researchers, led by the University of Cambridge, developed a form of hafnium oxide that acts as a highly stable, low-energy 'memristor' – a component designed to mimic the efficient way neurons are connected in the brain. The results are reported in the journal *Science Advances*.

Current AI systems rely on conventional computer chips that shuttle data back and forth between memory and processing units. This constant movement consumes large amounts of electricity, and global demand is exploding as AI adoption expands across industries.

Brain-inspired, or neuromorphic, computing is an alternative way to process information that could reduce energy use by as much as 70% by storing and processing information in the same place, and doing so with extremely low power. Such a system would also be far more adaptable, in the same way our own brains are able to learn and adapt.

"Energy consumption is one of the key challenges in current AI hardware," said lead author Dr Babak Bakhit who is affiliated with Cambridge's Department of Engineering. "To address that, you need devices with extremely low currents, excellent stability, outstanding uniformity across switching cycles and devices, and the ability to switch between many distinct states."

Most existing memristors rely on the formation of tiny conductive filaments inside metal oxide material. But these filaments behave unpredictably and typically require high forming and operating voltages, limiting their usefulness in large-scale data storage and computing systems.

The Cambridge team instead created a new type of hafnium-based thin film that switches states in a completely different way. By adding strontium and titanium and growing the film using a two-step method, the researchers were able to form tiny electronic gates, or 'p-n junctions', inside the oxide where the layers meet. This allows the device to change its resistance smoothly by shifting the height of an energy barrier at the interface, rather than by growing or rupturing the filaments.

Dr Bakhit said this mechanism overcomes one of the biggest challenges in developing memristor technology. "Filamentary devices suffer from random behaviour," he said. "But because our devices switch at the interface, they show outstanding uniformity from cycle to cycle and from device to device."

Using the hafnium-based devices, the researchers achieved switching currents about a million times lower than those of some conventional oxide-based devices. The memristors also produced hundreds of distinct, stable conductance levels, a key requirement for analogue 'in-memory' computing.

Laboratory tests showed the devices could reliably endure tens of thousands of switching cycles and store their programmed states for around a day. They also reproduced fundamental learning rules observed in biology, such as spike-timing dependent plasticity: the mechanism by which neurons strengthen or weaken their connections depending on when signals arrive.

"These are the properties you need if you want hardware that can learn and adapt, rather than just store bits," said Dr Bakhit.

However, the current fabrication process requires temperatures of around 700°C – higher than standard semiconductor manufacturing tolerances. "This is currently the main challenge in our device fabrication process," said Dr Bakhit. "But we're now working on ways to bring the temperature down to make it more compatible with standard industry processes."

Despite this, he believes the technology could ultimately be integrated into chip-scale systems. "If we can reduce the temperature and put these devices onto a chip, it would be a major step forward," he said.

*Written by Sarah Collins*

**Open access paper:**
www.eng.cam.ac.uk/computer-chip

→ Professor Alessandro Abate



Credit: Fisher Studios

# Alessandro Abate appointed to the Professorship of Control Engineering

**Professor Alessandro Abate has been elected to the Professorship of Control Engineering at the University of Cambridge.**

Professor Abate joins the Department of Engineering from the University of Oxford where he is Professor of Verification and Control in the Department of Computer Science. There, he leads OXCAV – the Oxford Control and Verification research group, and earlier he served as Deputy Head of Department. At Oxford, he also co-directs the Ellison Institute of Technology CDT in Fundamentals of AI.

Professor Abate's research focuses on control theory, formal verification and AI, and is underpinned by interests spanning decision theory, logic and probability. The overall goal of his work is to provide formal guarantees to ever more complex AI agents, particularly in the context of safety-critical, sequential decision-making problems.

"These are exciting times to work on AI Safety, and Cambridge is a wonderful platform to advance this broad research initiative," he said. "Cambridge's Department of Engineering and its Chair in Control represent the perfect platform for advancing science and for impactful real-world engineering applications of modern agentic AI."

### What is agentic AI and why is Safe AI a significant challenge?

Imagine a complex engineered cyber-physical system where physical components embedded with digital devices (AI agents) interact dynamically, possibly with humans in the loop, and which are accessed through data. Is it possible to design such complex engineering components, underpinned and enabled by modern AI, with rigorous guarantees on their deployment and on their interactions with other AI agents and humans?

Professor Abate said: "As we are witnessing an inter-disciplinary convergence between scientific areas underpinned by model-based engineering and by data-driven learning, access to information-rich data and to generative models has to be traded off with a demand for safety criticality in autonomy.

"I am eager to engage with diverse stakeholders around complex and impactful issues related to AI Safety: from rigorous scientific questions, through complex technical aspects, to cogent issues of actual uptake and governance. Breakthrough research holds broad and long-ranging technological, economic and societal repercussions."

Professor Abate joins the long-established Control Group in the Division of Information Engineering, which carries out broad research ranging from fundamental theory through to control applications in Engineering and the Sciences. Control Engineering is a significant component of the Engineering Tripos at Cambridge.

Professor Abate's chair will provide senior leadership and establish a new research initiative, connecting core control aspects with areas of Computer Sciences (formal methods, automata theory, logic), towards applications in modern agentic AI.

Professor Colm Durkan, Head of the Department of Engineering, said: "Given the rise of AI from its fundamental underpinnings towards a wealth of cross-cutting applications and the evidence of emergence of unexpected behaviour from large language models (LLMs), I am very pleased to welcome Professor Abate to the Department to continue his work on verification and control of AI agents which should have far-reaching consequences."

The Professorship of Control Engineering was previously held by Rodolphe Sepulchre, Keith Glover and Sir Alistair MacFarlane.





→ Engineering undergraduates Madeleine Conway (left) and Malaika Jha

Student internships

# Madeleine Conway and Malaika Jha

**Industrial placements are a key part of the Cambridge Master of Engineering (MEng) degree, helping students gain valuable experience, industry insights and career development opportunities. Madeleine Conway and Malaika Jha describe their experiences of working as summer interns.**

### Madeleine Conway – Trigon

I spent summer 2025 working at Trigon, an independent fire safety engineering consultancy. Fire engineering involves designing and implementing strategies to prevent fires, reducing fire spread, minimising risk and prioritising life safety. Fire engineering is vital in almost every construction project, from building a new block of flats to creating a new opening in a lift shaft. Trigon specialises in solving unique fire safety challenges for all building types and uses.

I was involved in a wide range of tasks that spanned different stages of project development. These included helping to prepare fee proposals, drafting fire safety strategy reports, producing technical advice notes, marking up floor plans with fire doors and compartment walls and conducting research. Since fire engineering makes up only a small section of most developments, I had the opportunity to work on several projects.

I went on several site visits. These are extremely important for projects involving pre-existing buildings that are being renovated, as information on the existing building is often not very certain.

I had the opportunity to work on two research projects. The first was a literature review focused on green roofs. Given the limited existing fire safety guidance on this topic, I compiled and summarised various documents to produce a technical note. This will now be used to support the development of future reports for projects involving green roofs. My second project was influenced by a live project involving a climbing gym. Since climbing gyms are a non-traditional building use, they are not explicitly mentioned in current guidance documents, so more in-depth research is needed to provide advice.

Over the course of the internship, I developed a stronger understanding of the fire engineering industry and the consultant's role within larger construction projects. I improved my technical writing, gained practical knowledge through site visits and learned how to communicate technical information clearly and concisely.

### Malaika Jha – Rolls-Royce

I joined Rolls-Royce for a 10-week internship over summer 2025. I wanted to experience working in an aerospace engineering company at the forefront of innovation and growth, and see how different technologies, such as additive manufacturing, are explored to promote this. Rolls-Royce's reputation for revolution and the chance to contribute to real-world projects made it a perfect fit.

I wrote a Directed Energy Deposition (DED) Design and Process Guide, a resource to support engineers across the company. I also completed the Additive Academy to develop my computer-aided design (CAD) and simulation skills, and organised supplier visits and networking sessions to understand how Rolls-Royce works as both an engineering company and a business.

I learnt how to use NX CAD and apply Design for Additive Manufacturing (DfAM) principles, while understanding the importance of balancing technical capability with cost, performance and supplier relationships. I built upon my professional skills in networking, presenting and seeking feedback effectively.

I was surprised by how much initiative interns are trusted with. I expected to just support ongoing work, but instead I led visits, delivered a company-wide technical guide and interacted with senior engineers and managers.

Presenting my finished DED Guide to a panel of global Application Lifestyle Management (ALM) specialists, knowing it will continue to be used across Rolls-Royce was incredibly rewarding.

This placement confirmed my passion for working in a large aerospace company like Rolls-Royce. It has made me more confident in tackling open-ended projects and motivated me to pursue a career where I can combine technical design with strategic thinking.

**The Department of Engineering Industrial Placements team supports undergraduate students as they search and apply for summer internships. The team works closely with employers to promote vacancies and encourage applications for their internship opportunities, whilst developing lasting partnerships with companies. To find out more, email placements-coordinator@eng.cam.ac.uk**

→ Professor Nathan Crilly (second left) receiving the award alongside members of Cambridge Advance Online



Credit: Callum Baker

# International award for teaching creativity and solution development skills

**University of Cambridge engineers have shared a national award for their work to teach creativity and practical solution development skills to a global audience.**

Professor of Design Nathan Crilly and the team at Cambridge Advance Online (CAO) won Gold at the Learning Technologies Awards for their course, 'Creativity, Problem Solving and Design Thinking'. The award was for the best use of social and collaborative learning technologies.

Using research from the Department of Engineering, Professor Crilly and the CAO team have developed and delivered the course to help participants become effective problem-solvers through structured creativity. The course is unique in bringing together skills that are usually considered separately, including design thinking, systems thinking and entrepreneurial thinking.

Professor Crilly said: "This award is the perfect way to recognise the whole team's dedication to developing such an innovative, high-impact course."

The course focuses on individual and collective cognition, taking learners on a journey through problem framing, idea generation and solution development. Participants have ranged from healthcare professionals and environmentalists to accountants.

Professor Crilly said that their objective was to make Cambridge research on creativity available to the world.

"Learners tell us it makes a huge difference to their working practices, often before they've even finished the course. They've reported landing new roles and changing sectors as a result."

The course draws on research, conducted by Professor Crilly and his group, into human behaviour in problem-solving. The focus is on how designers, inventors and entrepreneurs think and act, especially how they frame and reframe solutions. Other areas include the impact of implicit assumptions on creative exploration and how users, customers or other stakeholders are considered. And the course has also taught the team valuable lessons by putting theory into practice.

From developing and delivering the course, Professor Crilly has identified five approaches that can contribute to successful creativity training:

1. Support learners to reflect on the different ways of thinking they exhibit, and how that thinking gets stuck.
2. Explain the underpinning mechanisms behind creative techniques to avoid a confusing jumble of methods.
3. Acknowledge the distinct disciplines that learners bring to the course.
4. Encourage learners to select the elements that mean most to them.
5. Acknowledge the importance of ensuring immediate and ongoing application of the course's content in the learners' professional context.

Three PhD graduates from the Department of Engineering have acted as lead tutors on the course: Dr Esdras Paravizo, Dr Leon Pietschmann and Dr Devmalya Sarkar.

Dr Paravizo said that he had been able to share insights and examples from his PhD research into Design Creativity with course participants.

"The course has provided an extremely valuable opportunity to bring research concepts to a general audience, focusing on actionable tools and techniques," he said. "Interacting in the course prompted me to further refine the way I present my research."

Dr Pietschmann reported that: "Teaching this course has reminded me that creativity is not a single skill but a combination of mindset, method and practice." The course encouraged participants to see creativity as something to learn rather than just being a talent.

Dr Sarkar said that teaching the course had been an enriching experience for his work as an innovation strategist, working in complex, highly regulated sectors, such as health tech.

He added: "Early in the course, many describe their problems in broad, familiar terms. By the end, it is encouraging to see them mapping systems, reframing problems, and testing small changes in their own organisations. That pattern is very close to what I have seen in my wider work, when organisations become more deliberate about early-stage innovation."

The next six-week, part-time course will run from 1 February 2027 to 14 March 2027 (enrol by 25 January 2027). CAO courses bring together experts from the University of Cambridge and Cambridge University Press and Assessment. The financial success of this course also supports the University, including directly funding related undergraduate activities in the Department of Engineering.

**For further information on the course visit:** https://bit.ly/4ggx0S2

→ Professor Somenath Bakshi



# ERC funding to explore virus-bacteria interactions to combat antibiotic resistance

**Somenath Bakshi, Professor of Systems and Synthetic Microbiology, is one of eight Cambridge researchers who received a share of the European Research Council's (ERC) record €728 million Consolidator Grant awards for 2025.**

Professor Bakshi will map how bacterial physiology, including cellular resources, energy and stress, controls the infection dynamics of phage – a virus that infects and kills bacteria. To achieve this, he will use a high-throughput microfluidic phage infection assay, developed in his lab, to track phage infection in individual bacterial cells for the first time.

"As antibiotic resistance surges, phages offer a transformative therapeutic alternative," said Professor Bakshi. "Insights from our ERC research project will guide the design of engineered phages and treatment strategies that remain effective in highly dynamic environments of real infections, such as urinary tract infections, chronic lung infections and persistent wound infections."

He added: "Our technology allows us to follow thousands of individual bacteria under the microscope, recording detailed movies of how phages infect each cell, from injecting their DNA, expressing their genes, to eventually breaking the cell open."

"We combine this with fluorescent reporters of cell physiology, AI-based advanced image analysis and tracking – using the Synthetic Micrographs of Bacteria (SyMBac) pipeline also developed in our lab – to connect the observed infection dynamics with the physiology of the infected host with unprecedented precision.

"These rich datasets will train a data-driven model of phage infection dynamics grounded in host physiology, allowing us to predict how phages behave across cellular and population scales. We will validate these predictions using our microCOSM platform, which links single-cell dynamics to population-level behaviour in real time.

"We have recently collaborated with groups at Huazhong Agricultural University and Shandong Academy of Agricultural Sciences in China to analyse phages with potential applications against Salmonella infections associated with foodborne disease. We have also been working with the Leicester Centre for Phage Research to characterise a phage that can infect and eradicate dormant bacterial cells which are particularly difficult to treat with antibiotics."

The ERC selected 349 mid-career researchers to receive awards in 2025. With funding from the EU's Horizon Europe programme, the grants support research at universities and research centres in 25 EU Member States – and associated countries including the UK.

Professor Maria Leptin, President of the ERC, said: "To see all this talent with groundbreaking ideas, based in Europe, is truly inspiring. This bold research may well lead to new industries, improve lives and strengthen Europe's global standing.

"This was one of the most competitive ERC calls ever, with record demand and many excellent projects left unfunded. It is yet another reminder of how urgent the call for increased EU investment in frontier research has become."

Ekaterina Zaharieva, European Commissioner for Startups, Research and Innovation, added: "Congratulations to all the researchers on winning the ERC grants. The record budget of €728 million invested to support these scientific projects shows the EU is serious about making the continent attractive for excellent researchers."

> "As antibiotic resistance surges, phages – viruses that infect and kill bacteria – offer a transformative therapeutic alternative. Insights from this research will guide the design of engineered phages and treatment strategies that work reliably in complex, real-world clinical settings.
>
> Professor Somenath Bakshi

→ www.bakshilab.net

# Honours, awards and prizes



## University researcher awards

Research Associate Dr Curie Park (pictured left) and PhD student Dr Saleyha Ahsan have been recognised by the University with awards for their contributions to research impact and engagement.

A pioneering project to reduce and recycle plastic waste in Nepal has seen its leader Dr Park win the Collaboration Award. Launched in 2022, Plastic to Ghar (P2G) is transforming Himalayan plastic waste into durable housing products.

Dr Ahsan has been highly commended for a workshop that she ran as part of the Healthcare in Conflict Network (HCiC), which encouraged collaborative analysis of the lack of global and interdisciplinary consensus on challenges to healthcare delivery in armed conflict. It built upon her own work presented in a World Health Organization (WHO) and World Innovation Summit for Health (WISH) 2024 report titled *In the Line of Fire – Protecting Health in Armed Conflict*.



## Royal Society Fellow

Malcolm Smith, Professor of Control Engineering, has been elected as a Fellow of the Royal Society – the UK's national academy of sciences. His research on active and passive suspensions led him to propose a novel mechanical device and concept, coined the 'inerter', which made a significant impact in F1 racing and motorsport, and is now extensively researched for a wide variety of applications.

Professor Smith has also made fundamental contributions across a range of topics in control theory (including H-infinity control), robustness and the gap metric, foundations of systems theory, nonlinear systems, delay systems, adaptive control and filtering, and passive network synthesis.



## Helios Prize winner

PhD student Jack Peden has been announced as the winner of the Department's 2025 Helios Prize – awarded for research on sustainable energy and/or energy efficiency.

Jack won the Prize for his co-authored research paper titled *Production of hydrogen and carbon nanotubes from methane using a multi-pass floating catalyst chemical vapour deposition reactor with process gas recycling*.

Published in the journal *Nature Energy*, the paper details the results of a technology that has the potential to be scaled up for real-world use, providing an opportunity to produce sustainable fuel and materials from a single process (see page 11).



## Double award winner

Bill O'Neill, Professor of Laser Engineering and Director of the Centre for Industrial Photonics at the Institute for Manufacturing (IfM), has been honoured with prestigious awards.

The Laser Institute (LIA) announced Professor O'Neill as the 2025 recipient of the Arthur L. Schawlow Award, recognising his outstanding contributions to basic and applied research in laser science and engineering.

He was also named the 2025 AILU Fellowship Award winner by the Association of Industrial Laser Users (AILU), granted for an outstanding lifetime contribution to the industrial use of lasers in the UK.



## New leadership position

Professor Garth Wells has been named as Deputy Executive Chair of the Engineering and Physical Sciences Research Council (EPSRC), part of UK Research and Innovation (UKRI).

Areas that he will be involved in include Skills and Talent, Digital Research Infrastructure, Trusted Research and Innovation, and the R&D Missions Accelerator Programme.

Professor Wells has joined the EPSRC on secondment from the University, where he holds the position of Hibbitt Professor of Solid Mechanics.



## Pilkington Prize winner

Julian Allwood, Professor of Engineering and the Environment, has been awarded a University Pilkington Prize for excellence in teaching.

The prizes were presented by the Vice-Chancellor, Professor Deborah Prentice, who praised the winners for their transformative and visionary approach to teaching. Professor Allwood was lauded for delivering a high teaching load with clarity and humour.



Credit: James Goh

→ James Goh and his Guinness World Record-breaking Pulsar fidget spinner

# Student cracks formula for Guinness World Record-breaking fidget spinner

**James Goh, a Cambridge Engineering undergraduate and spinning top hobbyist, used physics and precision engineering to design a 'next-level' fidget spinner and set a new Guinness World Record for the longest ever spin.**

James – whose fascination with gyroscopes began when he saw the iconic spinning top in Christopher Nolan's 2010 sci-fi film *Inception* – spun the device for 30 minutes 34.54 seconds, almost five minutes longer than the previous record for 'the longest duration spinning a fidget spinner on one finger', and around 20 times longer than a standard spinner bought in a shop.

He said: "This has been a hobby of mine since I was a kid, so I'm delighted to get the record – although my finger did ache a little bit after holding it in the same position for so long. I suppose in a way I've taken the fidget out of fidget spinning!"

As part of their degree, Cambridge engineering students study the physics of gyroscopes, which are critical components used in everything from smartphones to spacecraft navigation systems. And so James has been able to draw on his learning, specifically in aerodynamics, and tribology – the science of friction – to boost his hobby.

The Queens' College student – who has also engineered spinning tops which spin for almost two hours, and has his sights set on more Guinness World Records – was at school when fidget spinners took the world by storm in 2017, and when he first challenged himself to create the ultimate spinner.

"Like most kids my age, I loved fidget spinners and was swept up in the craze back then," he said. "I probably spent more money than I should have buying them, and I always thought, 'one day I'll do this myself, but I'll do it better…"

James' passion for fidget spinners – which are designed to spin with little effort, and are marketed as relieving stress – grew out of his original interest in designing spinning tops which share many of the same scientific principles.

"*Inception* was a big inspiration – when I saw the spinning top something clicked with me; I started looking into the physics of tops and I never really stopped. The top in the film is visually iconic, but from an engineering perspective it's actually a bad design!"

James – who is currently studying the Manufacturing Engineering Tripos (MET), an option for the final two years of a Cambridge Engineering degree – used academic papers to inform his experiments and help figure out the Guinness World Record-breaking formula. He originally devised his formula for spinning tops, but then used it to engineer his 'Pulsar' fidget spinner and set the new record. As far as he is aware, the formula did not previously exist.

The core of James's Pulsar spinner is made from lightweight hollow aluminium, while tungsten – an extremely dense metal – is concentrated around the edges to store kinetic energy. It means all the weight is on the outside – creating a 'high moment of inertia' – and helping it spin for longer.

He said: "Designing a spinner is basically about three things: maximising the energy you start with, minimising the energy you end with, and transitioning between those two states as slowly as possible, so you're losing energy as slowly as possible. The tricky thing is that these factors are all in conflict with each other, and in a really complicated way."

*Written by Stephen Bevan*

**Watch the video:**
youtube.com/shorts/WwKdH2vo1YM

**Read the full article at:**
www.eng.cam.ac.uk/fidget-spinner

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