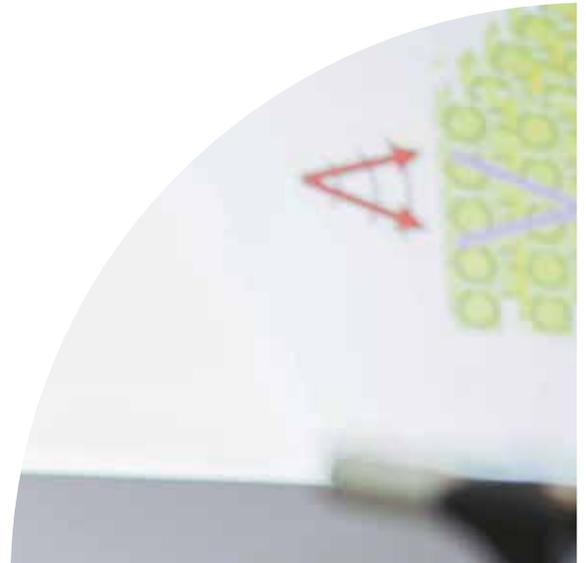


DEPARTMENT OF ENGINEERING SCIENCE NEWSLETTER

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INSIDE THIS ISSUE:

003 | ALUMNI NEWS

Meet the winner of the WISE
Woman of Industry Award 2017

009 | ENTREPRENEURSHIP

Oxbotica spinout wins Award for
execution, risk-taking and results

007 | RESEARCH NEWS

Using satellite data to respond to
environmental and natural disasters

012 | STUDENT NEWS

The Undergraduate Project Exhibition
and our award-winning students.

News from the Head of Department

The Department has continued to go from strength to strength in 2017. During the past year, we have welcomed 12 new academics to the Department. In the last five years, there has been a 60% increase in academic staff headcount, an 82% growth in research overheads, a 122% increase in research staff and a 75% increase in support staff. As a result of this growth, we are now spread over 14 buildings, and it is a real challenge (and one of my main priorities as Head of Department) to maintain the cohesion and unity of the Department.

After the successful transfer of the Oxford-Man Institute (OMI) in Quantitative Finance (with a focus on machine learning) into the Department in the summer of 2016, the Oxford e-Research Centre also moved into the Department on 1st August 2017. The multi-disciplinary e-Research Centre develops computational techniques to solve problems across a wide range of topics, from energy and the environment to biomedical

data management. (See page 10.)

With the rapid growth of the Department, we are not sacrificing quality for quantity: for example, the two academic staff appointments made in 2017 to support the growth of machine learning in the OMI were from the MIT Media Lab and the University of Cambridge. We were also very pleased to have retained our third place in the Times Higher Education World University Rankings in Engineering & Technology, behind Stanford and Caltech.

Teaching is of course an equally important priority for the Department. In October, Professor Steve Sheard stepped down from the position of Associate Head of Department (Teaching) and Chair of Faculty. During his three years as Associate Head, Steve oversaw a steady rise in student satisfaction levels. (These annual surveys are now part of life in higher education.) In 2017, Steve also masterminded the re-accreditation of our undergraduate degree course by all engineering institutions and saw the

first cohort of undergraduates through the new Engineering, Entrepreneurship and Management pathway (see page 8). A number of teaching laboratories were also refurbished, most recently the electrical engineering lab on the fifth floor of the Thom building. We are now working on plans to refurbish the fourth floor to accommodate a new undergraduate 3-D printing lab.

Finally, it is a real pleasure to report the election of two colleagues to Fellowships of the Royal Academy of Engineering (Professors Eleanor Stride and Roger Reed) and of one colleague to a Fellowship of the Royal Society (Professor Alison Noble). Professor Constantin Coussios should also be congratulated on winning the Silver Medal of the Royal Academy of Engineering. (See Page 15.)

I look forward to seeing as many of you as possible at the Lubbock lecture on 14th May (by Professor Tim Leighton FREng FRS) or at the Alumni Weekend in mid-September.



Professor Lionel Tarassenko with Naomi Climer FREng (5th from left) and the 4th Year Undergraduate Project Exhibition Prize-winners at the 43rd Maurice Lubbock Memorial Lecture in May 2017.

CONTENTS

Alumni News.....	3
Research News.....	4
Entrepreneurship.....	8
Research Institutes.....	10
Student News.....	12
Outreach.....	14
Future Events.....	14
Academic Awards.....	15
New colleagues and Farewells.....	15
Tribute to Professor Brian Bellhouse.....	16

Front cover image: Professor Ekaterina Shamonina, Engineering Science Professor, gives a talk on Metamaterials at the 2017 Alumni weekend.



Amelia Gould wins WISE Woman of Industry Award

Engineering Science alumna Amelia Gould (Somerville College, 1996) won the WISE* Woman of Industry Award in 2017 for her inspirational career to date and her outstanding work to promote STEM (Science, Technology, Engineering and Maths) as a career. Amelia was presented with the award at a London ceremony by the WISE Patron Her Royal Highness The Princess Royal in front of 500 invited guests.

Amelia is now Head of Engineering at BAE Systems, managing an Engineering Function of 700 engineers designing, delivering and supporting Naval Combat Systems. Amelia says of her role, "I truly believe I am helping to make this country safer, and that inspires me".

Professor Tarassenko congratulated Amelia on her award, adding "We are delighted

that one of our alumnae has been recognised in this way and in this field, particularly as we are committed as a department to advancing women's careers in STEM subjects. In the last year our women's networking group have organised an International Women in Engineering Day and inspiring speaker events with high profile women in the field, as well as social events and workshops on work-life balance".

Amelia says of her undergraduate days at Oxford, "I am still grateful about the way I was taught to think and problem solve. I still use many of the skills I learnt doing my degree and remember fondly my time at the department".

(Some details courtesy of WISE wisecampaign.org.uk)

*The campaign for gender balance in science, technology and engineering



Amelia Gould with HRH The Princess Royal at the Awards Ceremony

Alumni Weekend and Jenkin lecture 'Metamaterials: beyond conventional'

We hope you were able to come along to the 2017 Alumni Weekend last year. However if you weren't able to come, you can watch the presentations online – see below for links.

Professor Ekaterina (Katya) Shamonina (pictured on the front cover), Engineering Science Professor and the first female Jenkin lecturer, gave a fascinating talk on Metamaterials. Katya was appointed as a Professor in the Department and as Tutorial Fellow at Wadham College in 2012. Katya's research focuses on metamaterials, artificial structures that can produce electromagnetic properties not available

from natural materials. Only recognised by the international scientific community 17 years ago, metamaterials are producing exciting results in many fields, with 4000 papers now published on them annually. Their unusual properties are useful for applications from invisibility cloaks and 'perfect' lenses which exceed the classical limits of optical microscopes, to more down-to-earth applications including improved medical imaging and superdirective antennas. They can produce any values of permittivity and permeability, which can be controlled on a microscopic scale. Metamaterials can be

tailored to such an extent, in fact, that Katya describes them as 'electromagnetism to order – the only limit is your imagination'.

Professor Rod Smith FEng, President of Oxford Engineering Alumni (OEA), congratulated her on "making us review our accepted understanding of some fundamental concepts, and turning them on their heads by thinking in a different way".

You can listen to Katya's talk at <https://podcasts.ox.ac.uk/jenkin-lecture-metamaterials-beyond-conventional>

OEA 4th Year Project Presentation Prize: Nanomaterials in Revolutionising Diabetes Diagnostics

Sam Attias (Magdalen College), winner of the first Oxford Engineering Alumni (OEA) –sponsored 4th year Project Presentation Prize, talked about his work on Nanomaterials in revolutionising diabetes diagnostics. Type 1 Diabetes accounts for 10% of the UK's 3.2 million diabetes sufferers and the NHS spends 10% of its annual budget every year diagnosing, monitoring and treating diabetes – monitoring of the condition is currently done through test strips, finger prick tests and continuous monitoring units. Many research groups are racing to produce a non-invasive, low-cost, high-accuracy solution. Sam's research in Professor Jin-Chong Tan's group investigated the monitoring of diabetes

through detection of acetone levels in the breath. The concentration of acetone in the breath is very low, in the parts per million or billion, and previously this has only been detectable using large pieces of expensive benchtop equipment. Now, MOF (Metal-Organic Framework) devices are being developed, with a nanoporous structure of a metal atom encased by organic linkers and ultra-high porosity. ZnO@OX-1, the patented material being developed at Oxford, exhibits a highly selective photoluminescence under UV when exposed to acetone in parts per million levels, producing a reversible colour shift which is visible to the naked eye. It is easy to synthesize and works at room temperature,



Sam Attias with Professor Rod Smith

unlike other materials on the market.

Professor Rod Smith commented, "Sam is clearly a very deserving winner, tackling a problem which is at the intersection of engineering and society".

Computer software excels at lip-reading

Researchers in the Department are developing a new computer software programme which has the potential to lip-read more accurately than people.

The research team, led by Research Student Joon Son Chung and Professor Andrew Zisserman FRS, developed Watch, Attend and Spell (WAS), a new artificial intelligence (AI) software system in collaboration with the company Google DeepMind. The AI system uses computer vision and machine learning methods to learn how to lip-read from a dataset made up of more than 5,000 hours of TV footage, gathered from six different programmes including Newsnight, BBC Breakfast and Question Time. The videos contained more than 118,000 sentences in total, and a vocabulary of 17,500 words.

The research team compared the ability of the machine and a human expert to work out what was being said in the silent video by focusing solely on each speaker's lip movements. They found that the software system was more accurate compared to the professional. The human lip-reader correctly read 12 per cent of words, while the WAS software recognised 50 per cent of the words in the dataset, without error.

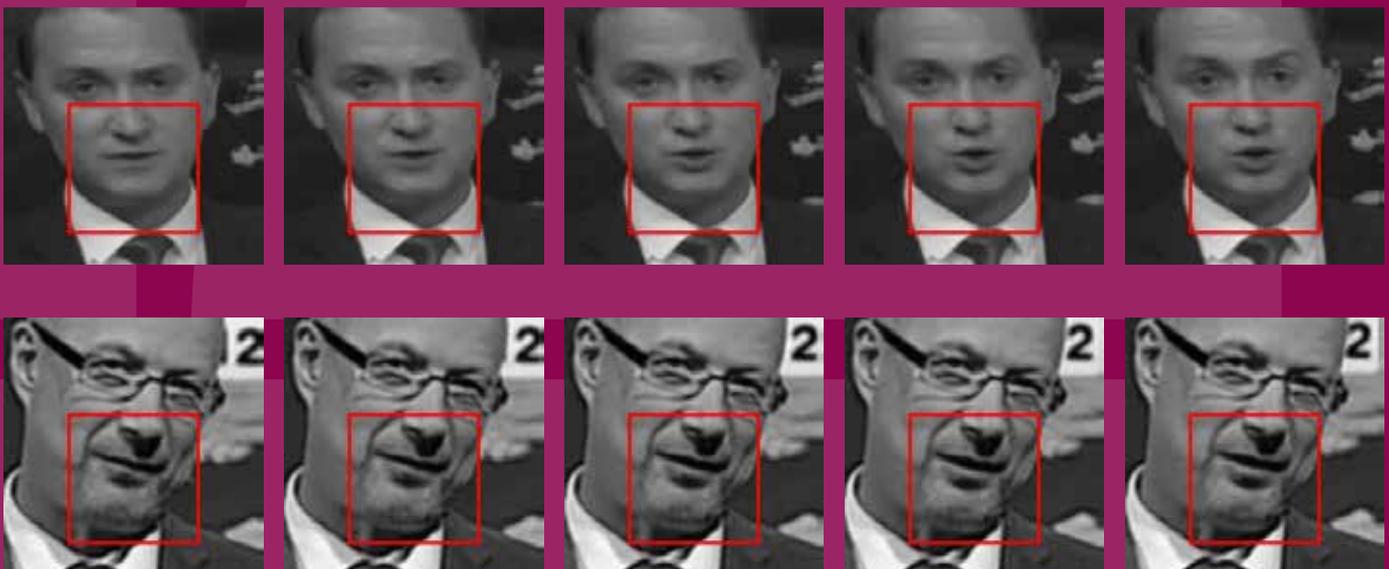
The software could support a number of developments, including helping the hard of hearing to navigate the world around them.

Joon Son Chung, lead-author of the study, said: *"Lip-reading is an impressive and challenging skill, so WAS can hopefully offer support to this task - for example, suggesting hypotheses for professional*

lip readers to verify using their expertise. There are also a host of other applications, such as dictating instructions to a phone in a noisy environment, dubbing archival silent films, resolving multi-talker simultaneous speech and improving the performance of automated speech recognition in general".

Professor Zisserman used the lip-reading software as an exemplar in his 2017 Royal Society Milner Award lecture, "How can a computer recognise people and what they are doing and saying in a video stream?" (see page 15).

A PDF download of the study 'Lip Reading Sentences in the Wild' can be viewed at <https://arxiv.org/abs/1611.05358>.



Above: The mouth motions for 'afternoon' from two different speakers. The deep learning neural network sees the areas inside the red squares.

Revolutionising UK car battery research

Departmental researchers are to contribute to a £42m programme of work announced by independent national battery research facility The Faraday Institution.

The investment comes at a key time in electric vehicle development and aims to revolutionise UK battery research by optimising battery life, reducing battery costs and enhancing safety.

Professors David Howey and Charles Monroe of the Department's Energy and Power Group will collaborate with researchers in Oxford and other UK universities on two of the programme's four projects - those focused on modelling and solid-state battery projects.

The modelling project, led by Imperial College London, will examine how to

simulate battery degradation and low-temperature performance, and how to bridge from molecular to continuum models, and from cell to system models.

Led by Oxford, the project on solid-state batteries will focus on addressing energy density, safety and cost issues to demonstrate a feasible device with performance superior to current technology.



Ground-breaking method preserves functioning organs at body temperature

Working closely with transplant surgeon Professor Peter Friend, Professor Constantin Coussios, Director of the Department's Institute of Biomedical Engineering (IBME), co-founded spin-out company OrganOx in 2008, to develop a ground-breaking method of preserving functioning organs at body temperature into a medical device that could be manufactured and translated into clinical practice. Professor Coussios received the 2017 Silver Medal of the Royal Academy of Engineering for this work.

The OrganOx metra[®] was first demonstrated in 2013 with the world's first transplant of a human liver preserved at body temperature. It has now completed trials with over 250 transplant patients in six countries across two continents,

demonstrating better organ utilisation and improved transplant outcomes compared to conventional cold storage. The OrganOx metra[®] can store a functioning liver outside the body for up to 24 hours, providing the opportunity to transport organs safely over far greater distances whilst also improving transplantation logistics for patients and clinicians.

Most importantly, the system monitors the organ while it preserves it, enabling surgeons to ensure it is functioning properly before transplanting it, essentially 'test-driving' the organ and reducing the risk of transplant failure.

The OrganOx metra[®] is already in use across the NHS, where it was used to perform over 10% of liver transplants in 2016. It is now approved for use in Europe and is being used in hospitals in Germany,

France, Spain, Belgium and Italy as well as the UK. It is already used by the two major transplant centres in Canada and is currently undergoing a second randomized trial controlled by the Food and Drug Administration (FDA) for introduction into the USA.

The next stage of the work is to extend the principle to other organs, such as kidneys. Professor Coussios says: "Kidney dialysis is very expensive and it is a tough and restricting regime. A transplant operation will free the patient from dialysis for ten years. If OrganOx can enable more kidney transplants to happen successfully, then we can make a real contribution to improving patients' quality of life whilst also reducing healthcare costs for the NHS".

The Waves at the Mulberry Harbours

A paper authored by Zoe Jackson and Professor Tom Adcock, with industry collaborators, was published in the Journal of Ocean Engineering and Marine Energy in August 2017, reporting on Professor Adcock's research on understanding the ocean environment and how this interacts with infrastructure. The paper came from Zoe's 4th year project research.

The Mulberry Harbours were used during WWII as part of Operation Overlord, the invasion of northern Europe by the Allies in June 1944. The harbours played an important role in the development of ocean engineering as a discipline, leading to the development of novel technology and new theory. Professor Adcock explains, *"The Mulberry Harbours interest me because they were novel and unusual structures deployed as an integral part of one of the most important operations in military history"*.

The lack of usable ports presented a major problem to the Allies in getting personnel and supplies across the channel. Their solution was to construct temporary port components in Britain and take them with them. The plan, codenamed Mulberry, was ambitious – to have two harbours, each twice the size of Dover Harbour installed within a fortnight of D-Day, one in the American sector and one in the British zone. Various novel breakwaters and roadways were designed and constructed and floated across to Normandy in the days immediately after D-Day on 6th June.

However a severe storm occurred soon after the harbours were deployed, causing the destruction of the American harbour and severe damage to the British one. Why did one harbour fail but the other survive; and should the engineers have anticipated the impact of the storm? To examine this the team "hindcast" the sea-state in collaboration with the European

Centre for Medium-Range Weather Forecasting and HR Wallingford. A hindcast assimilates point measurements such as atmospheric pressure and wind speed and direction into a model of the physics, which predicts how strong and persistent the winds were and how big the waves would be.

The researchers found that the waves were significantly more severe at the American harbour than at the British one, and that a storm of the severity of the 1944 storm would only be expected to occur during the summer once in every 40 years. Professor Adcock adds, *"We can gain technical insights from what worked and what failed, and learn important lessons by analysing the historical decisions that were made"*.

For the full article, visit: <https://link.springer.com/article/10.1007/s40722-017-0088-4>



Aerial view of the British Mulberry in operation (image taken by A.R.W. Adcock, Tom Adcock's grandfather, who worked on the harbours' design and construction)



Main image: Oil spills from tanker off Penang, Malaysia (Credit: NOAA). **Left:** Flooding in Malaysia. **Right:** The effects of drought in Ethiopia (© picture-alliance/dpa/J Robine).



Using satellite data to respond to environmental and natural disasters

The challenge of providing a rapid response to environmental disasters as varied as flooding, drought, earthquakes and oil spills is the focus of two projects in Malaysia, Ethiopia and Kenya, for the Department's Machine Learning Research Fellow and lead Dr Steven Reece. Both projects are supported through the UK Space Agency's International Partnership Programme.

Satellite data can quickly recognise small changes on the surface of the earth or sea that may be indicators of a larger problem. For example, a dark stain on water can provide evidence of illegal oil dumping, or a slight colour change in crops may show the early effects of drought.

The difficulty is how to organise and process this vast quantity of data and to combine it with other insights from

the earth's surface so that it can be used to inform decision-makers in the most effective way. This is where the Department's machine learning technology tools for automating and processing large quantities of satellite images are proving vital.

Dr Reece is working with UK industry and Malaysian government agencies to tackle flooding, oil pollution and illegal logging, all of which pose serious social and economic threats. In Ethiopia and Kenya the focus is on creating an improved understanding of flood and drought risk, thus helping to build local people's resilience to these natural disasters and alleviate poverty.

Dr Reece also collaborated recently with the Zooniverse citizen science platform and international disaster response organisation Rescue Global to enable a rapid and effective response to Hurricanes

Irma and Maria. The destruction wreaked posed huge challenges for crisis response teams, who needed to assess as quickly as possible the extent of the destruction on islands spread over thousands of square miles, and ensure that the right aid got to those in most need.

Zooniverse's Planetary Response Network mobilised thousands of volunteers from around the world to analyse 'before' and 'after' satellite images of the islands hit by Irma and Maria, identifying features such as damaged buildings, flooding, blocked roads and new temporary settlements.

Dr Reece's team then used a suite of sophisticated artificial intelligence tools to process the resulting data, quickly reconciling inconsistent responses, aggregating the data and integrating information derived from other crowd-sourced mapping materials. This analysis enabled the team to build impact 'heat maps' that identify the areas in need of urgent assistance, forming the basis for Rescue Global's aerial assessments and sharing of critical information with governmental and humanitarian partners.

Department spinouts

In November 2017, Oxford University Innovation (OUI), the research commercialisation company of Oxford University, announced the launch of the University's 150th spin-out company, 6Degrees. Not surprisingly, the new company was spun out from the research lab of an Associate Professor in the Department of Engineering Science. 6Degrees aims to harness smartphone technology and virtual reality headsets with an app that allows any smartphone user the ability to create virtual worlds.

In the previous twelve months, another 10 companies were spun out from Departmental research groups:

- **Brill Power:** Electrical and software controls for lithium ion battery storage
- **BreatheOx:** Novel asthma monitoring system
- **Opsydia:** Laser fabrication in diamond structures
- **OxMet:** Next generation of high-performance alloys
- **Oxonomy:** Maritime trade and transport simulation
- **Metaboards:** Ubiquitous wireless power and data using metamaterials
- **Proxisense:** Advanced sensors, diagnostics and optimisation systems to prevent equipment failure
- **Circadian Therapeutics:** Pharmaceutical and diagnostic platforms to modify the body's circadian rhythms
- **Iota Sciences:** New technologies to miniaturise fluid handling and accelerate drug discovery
- **OxSight:** Smart specs to help sight-impaired and blind people to navigate independently and avoid collisions.

The eleven companies spun out in a 12-month period cover a very wide range of engineering technologies. With a new company being spun out at nearly the rate of one a month, the Department is by far the most entrepreneurial department in the University.



Associate Head of Teaching Steve Sheard

Associate Head of Teaching Steve Sheard reports on new EEM pathway

The last cohort of the Honour School of Engineering, Economics and Management graduated this June, after more

than 25 years of collaborative teaching across three departments. The success of EEM at graduating students with the skills desired by industry and business is widely acknowledged. Now a new Engineering, Entrepreneurship and Management pathway is being taught as a set of options in years 3 and 4 of the MEng degree of Engineering Science.

The flagship component of EEM is the course developed and taught by Professor Thomas Hellmann called *Entrepreneurship*

and *Innovation*, which is delivered in Hilary term using the facilities at the Saïd Business School. Being included in the Business School community is one of the attractions for the Engineering Science students, as well as the competitive application process for the 16 places.

In the third year the Engineering Science students on the pathway undertake a group design project with an extended business plan. The group design project titles for 2016/17 were Affordable Wearable Technology for Disrupting the Prosthetic Limb Market; Design of a Solar Cooker; and Treating Internal Trauma at the Accident Site: Portable Ultrasound Device for Stopping Internal Bleeding. The EEM cohort performed well on the group project, obtaining an average mark of 71%. For 2017/18 the Design of a Solar Cooker option is being replaced with a project

on Virtual Reality.

The EEM pathway also includes a 24 week industrial placement option between years three and four. EEM pathway student Ioannis Stamatopoulos says of his placement, "My industrial placement with Siemens focused around battery connectivity and efficient management of energy storage facilities. My work was at the heart of the project and I was given the opportunity to contribute directly to the product development process. Throughout my placement, I collaborated with my team to develop algorithms for predicting the degradation of lithium-ion batteries through time. It was a unique learning experience and I was given the opportunity to work with amazing people from all over Europe. I've developed the ability to tackle a problem from various perspectives".

Landmark SRA to benefit millions of NHS patients

A five-year Strategic Research Agreement between Drayson Technologies, the University of Oxford and the Oxford University Hospitals NHS Foundation Trust was announced in July 2017.

Underpinned by research excellence and engineering expertise from Professor Tarassenko's group in the Oxford Institute

of Biomedical Engineering and the Trust's clinical validation, the ground-breaking agreement will create a pathway for the production of world-class digital health products, commercialised globally by Drayson Technologies.

Lord Drayson, Chairman and CEO, Drayson Technologies, said: "Chronic disease affects the lives of millions of people as well

as accounting for around 70% of NHS costs. Digital health technologies offer the potential to make a huge difference for these people and save money for the NHS. This highly innovative partnership will ensure that there is a pathway from invention to commercialisation for digital health products created in Oxford that will deliver benefits to patients and reinvestment back into the University and the NHS Trust".



Oxbotica wins Award for execution, risk-taking and results



CEO Graeme Smith at the FT ArcelorMittal Boldness in Business Awards, courtesy of FT Live

Oxbotica, a spinout from the Department's Mobile Robotics Group (now the Oxford Robotics Institute), is developing the next generation of autonomous vehicles, creating the software that makes them run.

This year the company beat five other nominees to win the 'Smaller Company' category in the FT ArcelorMittal Boldness in Business Awards. For this category the judges were looking for companies that took risks and entered uncharted markets, executed with precision and achieved bold results. In accepting the award, Oxbotica CEO Graeme Smith acknowledged the invaluable contribution of founders Professor Paul Newman and Professor Ingmar Posner to the company's growth, saying, "Four years ago we hadn't even met. Today we're a company with 30 of the best engineers and mathematicians in the UK, and are now acknowledged as the leading development company in the UK for self-driving technology. We have had to be bold in every single decision we have made. We have had to make some big audacious decisions. We had a very single-minded vision about what we are going to do and how we are going to get there".

Entrepreneurial hub and innovation space launched

New entrepreneurial hub and innovation space The Oxford Foundry was launched in October 2017. During the launch event, the Department's Professor Victor Prisacariu demonstrated his group's software for large-scale dense 3D reconstruction to special guest Apple CEO Tim Cook.

Running real-time on a mobile Apple device, it fuses depth from a backwards-facing sensor into highly realistic 3D models of the world, while providing users with unrestricted freedom of movement and instantaneous reconstruction feedback. Professor Prisacariu says, "These models can be used in a wide range of applications, from Virtual Reality memories to next-gen Augmented Reality interaction and visualisation techniques".

The Oxford Foundry is a large, accessible space available to all Oxford University students and includes a cafe and lounge area, and facilities for co-working, socialising, workshops and events.



Professor Prisacariu (pictured left) with Apple CEO Tim Cook



Oxford e-Research Centre

From Director Dr Wes Armour

The Oxford e-Research Centre joined the Department of Engineering Science at the beginning of August 2017. Since 2006, the Centre has developed and utilised innovative computational technology in both multi-disciplinary academic and industrial applications.

During 2017, the Centre was awarded a number of prestigious grants:

- Professor Susanna-Assunta Sansone is co-Investigator in 3 U.S. National Institutes of Health (NIH) FAIR Data Commons Awards, which will accelerate biomedical discoveries by making the

research data Findable, Accessible, Interoperable and Reusable.

- Professor David Wallom is leading the Centre's involvement in new project Cyberwatching.eu, monitoring cybersecurity and privacy initiatives throughout the EU.
- The £566,000 collaborative project Mapping Manuscript Migrations aims to add substantially to our knowledge of the history and provenance of Medieval and Renaissance manuscripts.
- A new climate modelling collaboration

with the Department of Physics, DOCILE, will quantify the impact of human influence on climate in Northwest Europe.

- A Knowledge Transfer Partnership with Horus Security Consultancy will support intelligence-led security decision-making using a scalable data storage system to quickly retrieve data.
- The OpenCitations Enhancement project has support from the Alfred P. Sloan Foundation to expand citation data and develop novel data visualizations and query services.

Oxford-Man Institute (OMI) of Quantitative Finance

From Director Professor Steve Roberts FEng

The last year has seen big changes; the OMI moved from being a free-standing Divisional Institute to become a Departmental Research Institute in Engineering Science. Alongside these changes, the OMI has re-focused its research on data science and machine learning, expanding its membership to some forty co-located researchers with three new faculty appointments and several postdoctoral researchers and graduate students.

The focus on intelligent data analysis acknowledges that advances in science and technology, as well as the day-to-day operation of successful organisations and businesses, are depending increasingly on insight extraction from an avalanche of information in real time. This year has seen the OMI disseminate its research very widely with high-profile publications and invited presentations, not only at key international conferences, but also at economic, banking and government policy

summits both nationally and internationally. The OMI continues to be a nucleus for financial data collection and curation, with summer interns revitalising algorithms and databases - forming a valuable archive for future researchers. Termly Machine Learning Workshops have been a resounding success, acting as a meeting point for the many active researchers in Oxford and beyond.

Oxford Thermofluids Institute (OTI)

From Director Professor Peter Ireland

This year saw continued growth in our aerospace thermofluids research activities. Since 2010, the size of the group has almost doubled and now occupies new offices in Osney, west Oxford. As part of this growth a new Associate Professor in Turbomachinery Computational Fluid Dynamics (CFD), Professor Luca di Mare, has been appointed to lead CFD research. His group is researching the numerical modelling of the high-pressure turbine stage of the gas turbine in jet engines.

In June 2017, one of the group's three major hypersonic flow wind tunnels, the High-Density Tunnel

(HDT), was commissioned and began researching boundary layer transition for hypersonic access to space vehicles. The hypersonics group, led by Professor Matt McGilvray, undertakes experiments to investigate the fundamentals of hypersonic flight for access to space, and has enjoyed visits this year from two international experts in high-speed flight, Professor Michael Smart (University Queensland) and Professor Andrew Neely (University New South Wales Canberra), to collaborate on scramjet aerodynamic experiments.

In October, the first International Advisory Committee meeting for a major Programme Grant in Transpiration

Cooling was held. The committee is chaired by the CTO of the Aerospace Technology Institute (ATI) Dr Simon Weeks and includes experts from the USA, Japan, Australia and Germany. In November, the ATI confirmed the 'Investment in Infrastructure' grant, which will increase the capability of two lead turbine facilities, and fund a new compressor house to provide much needed laboratory space for the growing research group.

Congratulations also to Dr Priyanka Dhopade, Senior Research Associate, who was voted one of the top 50 Women in Engineering in the UK (see page 15).

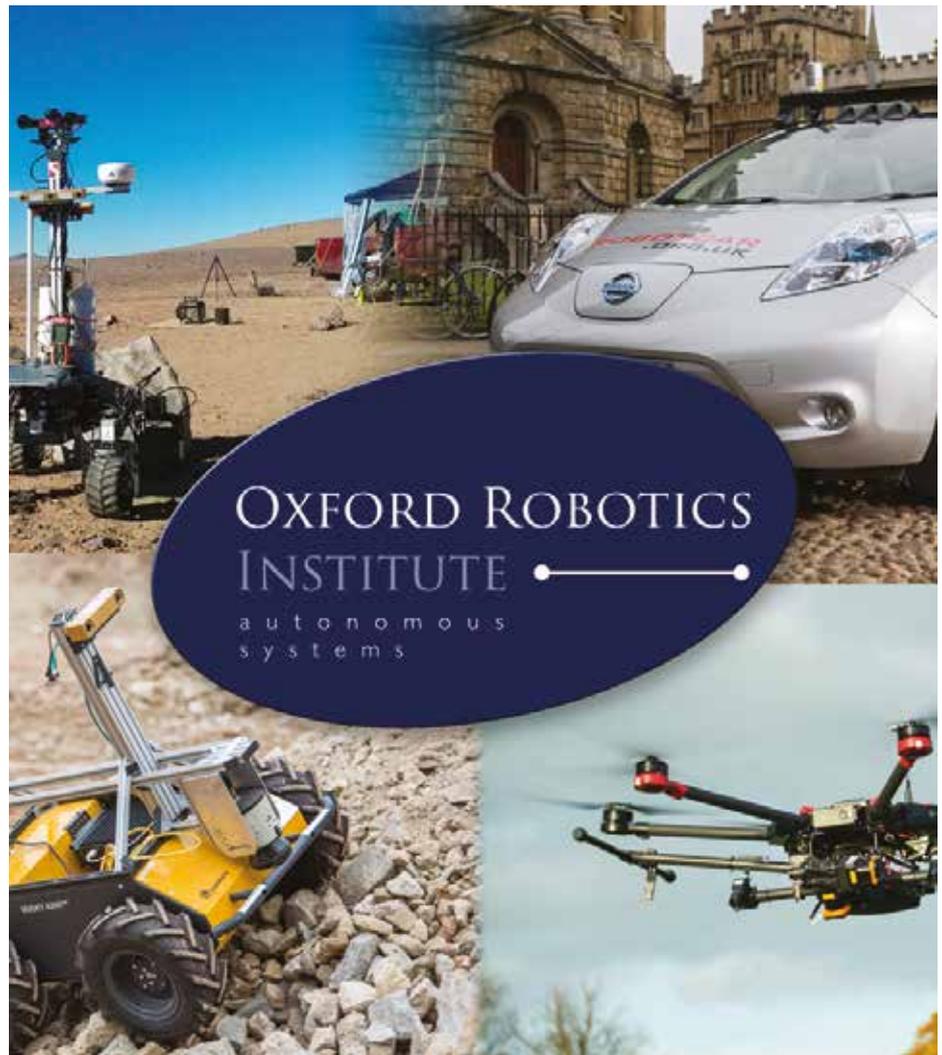


Institute of Biomedical Engineering

From Director Professor Constantin Coussios

The Institute of Biomedical Engineering (IBME), located adjacent to the Churchill Hospital, offers a world-class venue where engineers and clinicians work together to address unmet needs in the prevention, early diagnosis and treatment of major diseases and conditions across four focus areas: biomedical image analysis, mobile health (m-health) & e-health, regenerative medicine & biomechanics, and non-invasive therapy & drug delivery. Since its inception in 2008, the IBME has been the most prolific generator of new companies within the University, successfully launching 13 spin-outs, including most recently Circadian Therapeutics.

In 2017, Professor Alison Noble, Technikos Professor of Biomedical Engineering, was elected a Fellow of the Royal Society, whilst Professor Eleanor Stride was elected a Fellow of the Royal Academy of Engineering. IBME director Professor Constantin Coussios received the RAEng Silver Medal for contributions to organ preservation and therapeutic ultrasound. A new MSc in Nanotechnology for Medicine and Healthcare was announced, led by Prof. Bob Carlisle, along with the completion of a first-in-man trial of ultrasound-triggered targeted chemotherapy for liver cancers (TarDox). In the area of e-health, former IBME DPhil students received the RAEng Colin Campbell Mitchell Award for developing an innovative, non-contact health monitoring technology capable of observing a patient's vital signs via a standard digital video camera, and a Strategic Research Agreement (SRA) was signed with Drayson Technologies (see page 8).



Oxford Robotics Institute (ORI)

From Director Professor Paul Newman FREng

The Oxford Robotics Institute is about autonomy, mobile autonomy, be that driving, walking, running, flying, picking, placing and, perhaps, swimming. Doesn't even have to be on Earth, Mars is fine.

The ORI's origins were in the Mobile Robotics Group which produced the UK's first self-driving car, but has now grown and morphed, over a decade, to something even more exciting, ambitious and expansive. The ORI is an institute that invents the technologies that allow machines to ask and answer "Where am I?", "What surrounds me?", "What should I do?", "What should I share?". These four key questions underpin all that we do. They force us to confront fundamental questions in navigation, perception, machine learning and dynamic robotics.

The ORI is home now to five labs developing fundamental technologies that will underpin our future machines: Long Term Autonomy, Applied AI, Dynamic Robotic Systems, Space, and Systems and will soon be adding a flight lab. By early 2018 the ORI will have 7 faculty and 70 researchers including a specialist robotics engineering team to support and drive fabrication, development deployments and field trials.

Oxford has a proud heritage in robotics and the formation of the ORI is another stage in that journey. As part of Information Engineering in the Department of Engineering Science, the ORI will leverage and accelerate the breath-taking advances in machine intelligence. The machines are coming, and they are going to help.

Our Award-winning students (2016-17)

Our students regularly win prestigious awards and prizes, reflecting both the quality of teaching in the Department and the students' own exceptional academic credentials. Here are some of the awards presented in 2017:

- DPhil student **Matthew Ryder** (Balliol College) was awarded the prestigious British Zeolite Association's (BZA) Founders' Award for the most promising postgraduate scientist working in the area of micro/mesoporous science.
- Final year undergraduate **Mark Gowers** (Oriel College) was awarded one of five Salters' Graduate Prizes for excellence in Chemical Engineering. Mark graduated with a First Class degree, and is now working for Air Products.
- **Bo Zhang**, 2nd Year DPhil student (Kellogg College), won a Salters' Centenary Award in Chemical Engineering, which recognises and supports individuals starting out in their career and who have the potential to make an outstanding long-term contribution to the chemical and allied industries.
- Engineering Science students scooped two out of three prizes for best student posters at the Offshore Site Investigation and Geotechnics (OSIG) conference in London. **Stephen Suryasentana** won the top prize for his work on the design of suction caisson foundations. **William Beuckelaers** was joint runner-up for his poster on analysis of large scale pile tests. **Iona Richards** and **Toby Balaam** (Renewable Energy Marine Structures CDT programme) were also finalists in the competition.

Congratulations also to DPhil student **James Cook** (Keble College) and third-year undergraduate **Samuel Collier** (New College) who were part of last year's winning men's Oxford Boat Race team.

The Matthew Greenwood Award for exemplary outreach



A new award dedicated to the memory of Matthew Greenwood was established in 2017 for a 4th Year Oxford Engineering Ambassador.

Matthew, an Engineering Science undergraduate and committed Ambassador, died in December 2016 from cancer.

The award goes to an undergraduate who consistently goes above and beyond, to whom it is easy for young people to relate, and who always volunteers to help with

outreach initiatives. Last year, the award was given to Maruthi Malladi, who was a contemporary of Matt's in the Department.

Professor Lionel Tarassenko commented: *'The whole of the Oxford Engineering Science community was deeply affected by what happened to Matt Greenwood last year. As a Department, we wanted to honour his memory with an award which reflected his own passion for attracting school pupils into engineering.'*

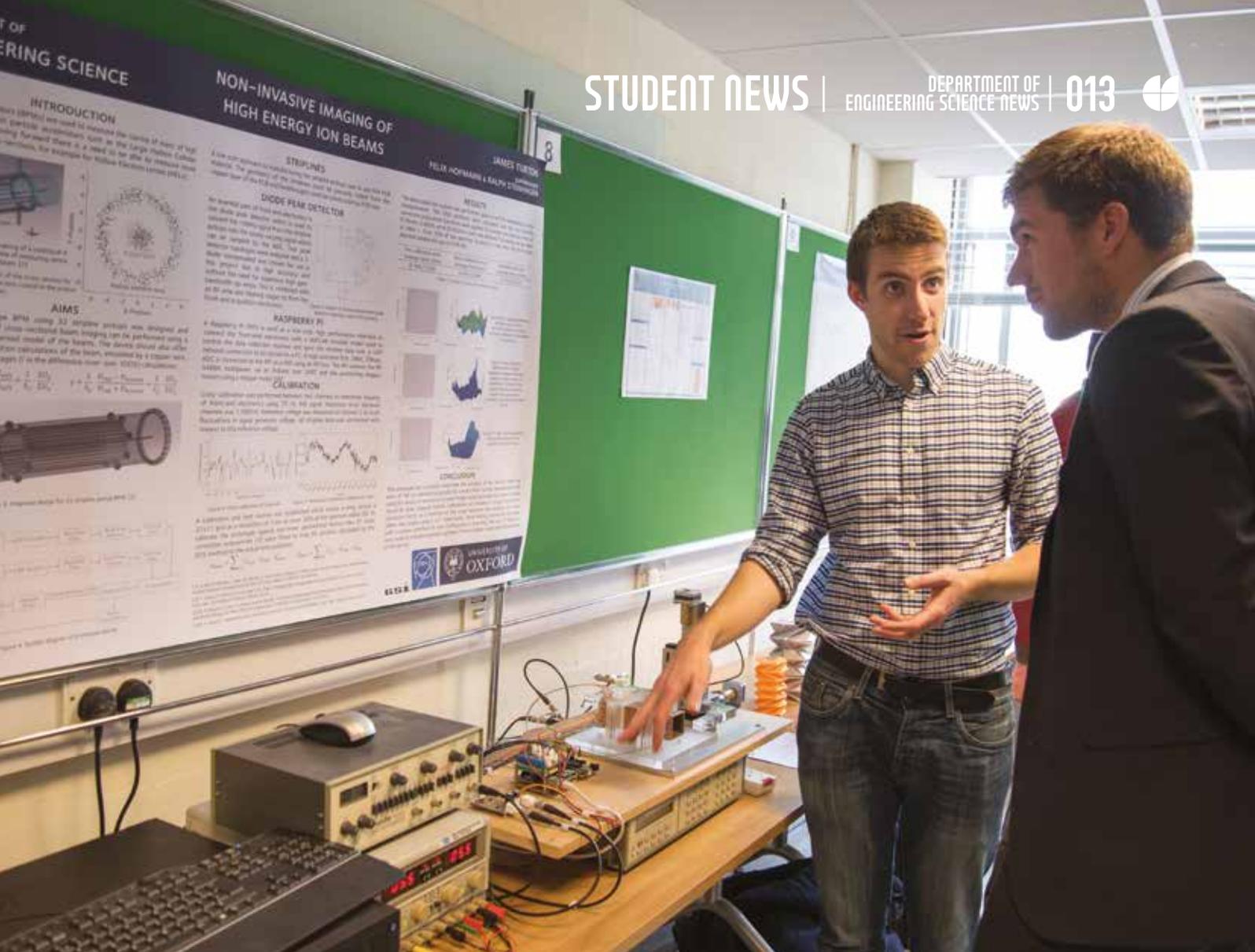
Lubbock Lecture and Project Exhibition

The 43rd Maurice Lubbock Memorial Lecture was delivered by Naomi Climer FREng on Wednesday 10th May 2017.

Naomi's career has been spent in the broadcast and communications technology industry including at the BBC, ITV and Sony. Over 290 alumni and representatives from industry, academia and government, as well as 30 pupils aged 15-18, listened to Naomi's presentation of the technical and social challenges still to be overcome and of the spectacular opportunities that 5G and the Internet of Things will create.



You can watch the lecture at <http://podcasts.ox.ac.uk/will-future-communications-technologies-lead-cyber-wars-or-better-world>



The Undergraduate Project Exhibition by 4th Year Students

2017's prizes for posters or hardware were awarded to:

- The **BP** prize for best chemical and process engineering exhibit **Student:** Sam Attias **Project title:** 'Nanomaterials in Revolutionising Diabetes Diagnostics'
- The **Ecrin Investments** prize for best information and control engineering exhibit **Student:** Sam Holt **Project title:** 'Dense Reconstruction from Flying Vehicles'
- The **GlaxoSmithKline** prize for best biomedical engineering exhibit **Student:** James Russell **Project title:** 'Curing Travel Sickness with Technology'
- The **IBEX Industrial Brushes** prize for best mechanical engineering exhibit **Student:** Rhiannon Heard **Project title:** 'Micromechanics of Pharmaceuticals'
- The **Jaguar Land Rover** prize for best energy engineering exhibit **Student:** Zach Jackson **Project title:** 'Heat-sink Components for Fusion Tokamaks'
- The **Osborne** prize for best civil engineering exhibit **Student:** Konstantin Goncharov **Project title:** 'How to evaluate local seismicity without recording earthquakes?'
- The **Rolls-Royce** prize for best thermofluids and turbo-machinery exhibit **Student:** Jamie Saw **Project title:** 'Gas Turbine Vane Film Cooling for Engine-Realistic Combustor Flows'
- The **Sony** prize for best electrical and electronic engineering exhibit **Student:** James Turton **Project title:** 'Non-Invasive Imaging of High Energy Ion Beams'.

The judges, all alumni of the Department of Engineering Science now working in industry, were: **Alex Brant** (Rolls-Royce); **Will Hancock** (Atkins); **Chris Needham** (Shell); **Ben Twiney** (Jaguar Land Rover); **Victoria Sanchez Zini** (Oxford University Innovation).

Oxford iGEM team wins Gold medal and Award for Best Diagnostics Project

The International Genetically Engineered Machine (iGEM) competition challenges interdisciplinary teams of students to spend the summer working on applying Synthetic Biology to address real world issues.

The 2017 Oxford University team (from Biochemistry, Engineering, Biology and Medicine) returned from the iGEM competition in Boston with not only a Gold medal but also the extremely competitive award for Best Diagnostics

Project in the Undergraduate category. In addition they were nominated for five further awards for best presentation, wiki, model, integrated human practices and best applied design.

Outreach



Young women visit the Department for International Women in Engineering Day, 14th June 2017

The Department strives to be a welcoming place for all students with an interest and aptitude for engineering. Our Outreach team has been working hard putting on events, engaging the engineering community, and coming up with the best strategies for interesting young people in engineering and STEM.

In 2017 the department spent time with just over 2500 secondary students from across the country. Events such as Headstart, UNIQ, and Dragonfly were run as before,

but the team has also been putting a lot of effort into getting new initiatives off the ground. One of the highlights of the year was an Engineering High Tea hosted by St John's College. Young women from secondary schools in Oxford explored the Department and had tea with Oxford engineering professors, researchers, graduate students, and undergraduates.

Another outreach highlight was working with Keble College to run engineering workshops in Birmingham. A team of undergraduate ambassadors

delivered workshops to 110 students from schools in disadvantaged areas.

The Engineering High Tea and Birmingham Workshops are only a small number of events in which the department is involved. In 2017 the Outreach team worked with students from organisations like the Social Mobility Foundation, Target Oxbridge, Teach First Futures, and the Engineering Development Trust. The team also works with other departments including Physics, Maths, Computer Science, Materials Science, and Statistics to put on large-scale events.

If you want to find out more about our outreach work or get involved, you can contact the Access and Outreach Officer through OxEngSciOutreach.com.

"My day at [the] Oxford Uni taster session was amazing! I had [a] large amount of support, which was helpful when tackling a challenge! I loved learning new things and getting an insight into engineering through further education. I also met new friends along the way. I look forward to studying engineering later on in life."

Year 10 student from Birmingham Workshops

Future Events

Professor Brian Bellhouse's memorial service

A memorial for Professor Brian Bellhouse, who died last year, will be held on Saturday 24th February 2018 (3pm), in Magdalen College Chapel. A scientific symposium in Professor Bellhouse's memory will be held the preceding afternoon (Friday 23rd February). Please see page 16 for more details and a tribute to Professor Bellhouse.

Artificial Intelligence @ Oxford – One Day Expo, 27th March 2018, Sultan Nazrin Shah Conference Centre, Worcester College

This joint event with the Department of Computer Science will showcase the University's artificial intelligence (AI) research, with briefings by experts from both Departments, panel Q&A sessions, technology and research demonstrations, and opportunities to talk one-to-one with the academics at the heart of the AI revolution. For the full programme and to register visit <https://www.ml.ox.ac.uk/>.

Women in Engineering Symposium, Wednesday 2nd May 2018, Venue tbc

Supporting women working in Engineering, or those interested in it as a possible career, is a key issue today and strongly supported by the Department. This half day event will provide a platform for female researchers and academics to hear about each other's work through a series of short presentations.

Lubbock Lecture, Monday 14th May 2018, Thom Building and Andrew Wiles Building, Oxford Mathematics

The 44th Maurice Lubbock Memorial Lecture will be held on 14th May at 5pm in the Mathematical Institute. This prestigious showcase event will this year feature Professor Timothy Leighton FREng FRS as the keynote speaker. Tim Leighton is Professor of Ultrasonics and Underwater Acoustics within Engineering and the Environment at the University of Southampton.

Alumni Weekend, 14th –16th September, Thom Building

The Department looks forward to welcoming back Alumni for the 2018 Meeting Minds Alumni Weekend on 14th-16th September. On the 15th September the Department's doors will once again be open for an update on recent developments and future plans, along with lectures providing an insight into the exceptional research being undertaken across the Department. This year Professor Byron Byrne will deliver the 2018 Jenkin lecture on offshore wind structures. We also hope to offer Alumni tours of the Department so you can see the undergraduate laboratories on the 4th and 5th floors of the Thom building, to show how engineering is taught in the labs.

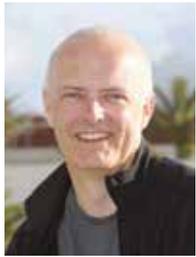
You will be sent further details of Alumni events in due course.



Academic Awards



Professors Eleanor Stride and Roger Reed were elected as Fellows of the Royal Academy of Engineering, a richly deserved recognition of their contributions to engineering. Professor Stride's main primary research achievements have been in the development of micro and nanoparticles for targeted drug delivery. Professor Roger Reed is a world leader in the engineering



and science of high-temperature alloys, particularly the design and processing of nickel super-alloys, which are ubiquitous in the aero-engine and power-generation industries.



Professor Alison Noble, Technikos Professor of Biomedical Engineering, has been elected as a Fellow of The Royal Society in recognition for her ground-breaking biomedical image analysis research,

which has advanced knowledge of how to automatically extract clinically-useful information from ultrasound scans.

Professor Nik Petrinic was appointed to a Rolls-Royce/Royal Academy of Engineering Research Chair in Impact Engineering with Digital Materials and **Professor Byron Byrne** to an Ørsted/Royal Academy of Engineering Research Chair in Advanced Geotechnical Design. The Research Chair scheme aims to strengthen links between industry and academia by supporting exceptional academics in UK universities to undertake research meeting the needs of industrial partners.

Professor Constantin Coussios won the Royal Academy of Engineering Silver Medal for work including a ground-breaking method of preserving organs at body temperature (see page 5), receiving his medal at the Academy Awards dinner in London in June.

Professor Andrew Zisserman FRS was awarded the 2017 Royal Society Milner Award in recognition of his exceptional achievements in computer programming, including work on computational theory and commercial systems for geometrical images.

Professor Martin Booth, Professor of Engineering Science, was elected a Fellow by the Board of Directors of The Optical Society (OSA), for 'innovative and pioneering research on dynamic optical methods and new approaches to adaptive optics and wave-front sensing, including applications in biomedical microscopy and laser material processing'.



Dr Priyanka Dhopade, Senior Research Associate, was voted one of the top 50 Women in Engineering in the UK. Priyanka received this prestigious award in recognition of her achievements

in CFD combined with an inspiring commitment to promoting Women in Science and Engineering.

Three researchers from Oxehealth (the spin-out company from Professor Tarassenko's research group) won the Royal Academy of Engineering Colin Campbell Mitchell Award, awarded for contribution to the advancement of any field of engineering. **Dr Oliver Gibson, Dr Simon Jones, and Dr Nic Dunkley** are developing, within the company, non-contact health monitoring technology capable of observing a patient's vital signs via a standard digital video camera. Drs Gibson and Dunkley both completed their doctorates in the Institute of Biomedical Engineering.

Professor Martin Williams has been appointed as Pro-Vice-Chancellor (Education) in addition to his post in Engineering Science. Martin is David Clarke Fellow in Engineering and a Tutorial Fellow at New College. He is a Fellow of both of the Institution of Civil Engineers and the Institution of Structural Engineers.

New colleagues

We would like to welcome...

The following colleagues joined the Department during 2017:

Professor Kristina Dahlin – Associate Professor in Engineering Science (Entrepreneurship). Shared post between Engineering Science (75%) and the Saïd Business School (25%).

Professor Nick Hawes – Associate Professor in Engineering Science (Robotics) and Tutorial Fellow in Engineering Science (Pembroke)

Dr Jan-Peter Calliess – Senior Research Fellow in Machine Learning (Oxford-Man Institute)

Dr Xiaowen Dong – Departmental Lecturer in Machine Learning (Oxford-Man Institute)

Professor Daniel Eakins – Associate Professor in Engineering Science

Dr Christopher Vogel – Senior Researcher (Tidal Energy Research Group)

And also the six Faculty members of the Oxford e-Research Centre, which joined Engineering Science in August 2017:

Dr Wes Armour (Centre Director, Scientific Computing)

Professor David Wallom (Advanced e-infrastructure & cloud and Energy and Environmental ICT)

Professor Susanna-Assunta Sansone (Life, Natural and Biomedical Sciences)

Professor Min Chen (Scientific Visualization)

Professor Janet B Pierrehumbert (Language Modelling)

Professor David De Roure (e-Research)

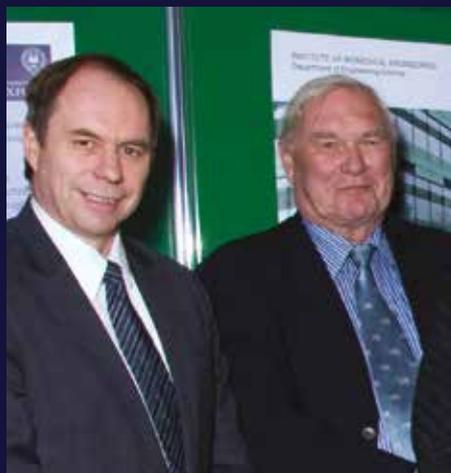
And we say goodbye to...

We bid fond farewells to **Professor Ron Daniel**, **Professor Tony Blakeborough** and **Professor David Nowell**, and to **Gerald Walker**, Principal Technician at Southwell, who has worked for the Department since September 1975.

Green Impact Award

Congratulations to staff at the Old Road Campus Research Building, which includes the Department's Institute of Biomedical Engineering, for winning a Silver Green Impact Award. The University's Sustainability Showcase recognises the work that has been done over the last year by staff and students under various schemes aimed at reducing the University's environmental impact.

Tribute to Professor Brian Bellhouse



Professor Bellhouse with Professor Tarassenko at the 2012 Oxford Medtronic Lecture

Pioneering engineer Professor Brian Bellhouse, who made an immense contribution to the Department from his DPhil in 1964 to his retirement in 2004 and beyond, has died at the age of 80.

Having read Mathematics at Magdalen College and subsequently obtained his DPhil in the Department of Engineering Science, Brian was appointed as a University Lecturer and elected as a Tutorial Fellow at Magdalen College in 1966. He became a Professor of Engineering Science in 1998. He went on to set up our highly successful Medical Engineering Unit, which he ran until he retired, when he was elected an Emeritus Fellow of Magdalen College.

Professor Bellhouse is best known for his invention of PowderJect, a device providing needle-free delivery of drugs and vaccines using compressed gas. This not only provided pain-free vaccinations for those with a phobia of needles but also allowed for fast drug delivery and improved immune responses. The technology underpinned PowderJect Pharmaceuticals, which he co-founded in 1993, one of Oxford's earliest and most successful spin-out companies.

The company went public in 1997 and was subsequently sold to Chiron Vaccines

for £542 million in 2004, one of the largest exits ever for an Oxford spin-out company. Professor Bellhouse became a major donor to local charities and the University, with a substantial gift towards the building of the Department's Institute of Biomedical Engineering on the medical campus. He also endowed the Oxford-Bellhouse Graduate Scholarship in Biomedical Engineering at Magdalen College.

Professor Lionel Tarassenko, says: 'I was deeply saddened to hear of Brian's tragic passing. I was pleased to count him not only as a colleague and mentor, but also as a friend. Brian encouraged several generations of undergraduates and graduates to pursue careers in biomedical engineering, and he will be sorely missed'.

Professor Bellhouse's memorial service will be held on Saturday 24th February 2018 at 3pm, in Magdalen College Chapel. There will also be a scientific symposium in Brian's memory on the afternoon of Friday 23rd February in the Magdalen College Auditorium. For details of the programme and to register for the afternoon please contact Caroline Brown, the Office Manager for the Institute of Biomedical Engineering (caroline.brown@eng.ox.ac.uk).

Thank you for your support

We would like to acknowledge the important role played by our individual and corporate supporters, and we thank them for the invaluable contribution they have made to the Department.

Find out more

To see more news about the Department, please visit our website www.eng.ox.ac.uk.

Please send us any news likely to be of interest to other Engineering alumni, for inclusion on the website, to alumni@eng.ox.ac.uk

You can also follow us on Twitter @oxengsci and on LinkedIn.

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Help current students

Could you help us to enrich the student experience at Engineering Science? If you feel you could offer any of the following, please contact Jo Valentine in the Faculty office at jo.valentine@eng.ox.ac.uk

- Offer student placements or internships at your company
- Act as a student mentor. We especially welcome female former students to mentor our growing number of female engineers
- Give a talk or arrange a site visit of engineering interest.

Email: comms@eng.ox.ac.uk
Website: www.eng.ox.ac.uk
Twitter: @oxengsci

Oxford Engineering Alumni (OEA)

The OEA comprises all Oxford Engineering graduates, as well as present and past members of teaching and research staff of the Department. There is a dedicated OEA page on the Departmental website: <http://www.eng.ox.ac.uk/alumni>. You can also join us on LinkedIn: <https://www.linkedin.com/groups/2696035/profile>

The OEA now sponsors a £500 prize for the best 4th-year undergraduate project presentation, awarded by a panel of alumni at the Department's Open Day in May. The prize winner then comes back (as an alumnus or alumna) to give a short talk on their project at the Alumni Weekend the following September – see page 3 for details of the first winner.

January 2018 Editor: Julie Meikle