



UNIVERSITY OF
OXFORD

Department of
Engineering Science

news

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Welcome

Welcome to the 2015-16 issue of "Department of Engineering Science News". I am delighted to announce that for the fourth year running this newsletter is being sponsored by BP, a British multinational oil and gas company that has operations in over 80 countries.

Published once a year, the newsletter brings to life the work of the Department to a broad range of audiences covering engineering science news, research, profiles and events.

I hope that you enjoy reading it and welcome your comments on the content. Please feel free to send contributions for next year's "Department of Engineering Science News" to: newsletter@eng.ox.ac.uk

Eva Williams
Editor

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Department
ranked best
in the UK



News from the Head of Department

There cannot be too many readers of this newsletter who have not heard this news yet, but it bears repeating: just before Christmas 2014, it was announced that the Department was ranked first out of the 62 General Engineering Departments in the UK, based on the Grade Point Average (GPA) score used to produce the main rankings in the national research assessment exercise. Cambridge Engineering was in second place, with Imperial College in fourth, and UCL in sixth. 84% of our impact case studies were rated as world-leading (Cambridge: 68%).

However, these outstanding scores mask a fundamental problem for the Department.

It is only ranked ninth for “research power” (GPA score multiplied by the number of Full-Time Equivalents).

It is in danger of falling below the critical mass required to maintain excellence in the long term and compete on an equal footing with other world-leading departments nationally, such as those at Cambridge and Imperial, and internationally, for example the MIT School of Engineering and the Stanford School of Engineering.

Cambridge has more than twice the number of academic staff that we have, Imperial more than three times.



each year, from 165 to 180. The news that we are re-starting the EEM course (but with Entrepreneurship replacing Economics) has been greeted with enthusiasm not only by current undergraduates but also by EEM alumni. As a result of a meeting with alumni hosted at McKinsey's in July, we have received more than thirty offers of help with the new course (for example, hosting internships, giving invited lectures or talks, or offering to join the EEM Advisory Board).

It is good to be able to finish this piece in the same way that I started, with further good news. It has just been announced that the Institute of Biomedical Engineering, our research institute on the medical campus, has been awarded a 2014-6 Queen's Anniversary Prize for Higher Education for “new research collaborations between engineering and medicine generating innovations for the benefit of patients”. This prize is the supreme accolade for a University Department or Institute. Oxford University has now won ten Queen's Anniversary Prizes for Higher Education, more than any other university, since the biennial prizes were first awarded in 1994. We are absolutely delighted to be the first Oxford winner of the prize in Maths, Physics, Chemistry or Engineering.

Professor Lionel Tarassenko

The Department has therefore begun another period of expansion, with more than ten new appointments made last year or scheduled for this academic year, including eight new Professorships funded by industry (Dyson, Google, MathWorks and Man AHL). We have also been given the go-ahead for a modest expansion in the number of undergraduates we admit

Student Achievements

Oxford's Boat Race winners make history

Oxford University won the 2015 men's race for the sixth time in eight years on the same day as the Oxford women's team won - a historic first staging of both the men's and women's races on the same course and day in the 186-year history of the men's competition. The original race started in 1829, with the first women's contest taking place in 1927.

Congratulations to the Department of Engineering Science MSc (Res) students, James Cook (St Cross College) and Samuel O'Connor (Christ Church), who were part of this year's men's winning Boat Race team. Many congratulations to Jennifer Ehr (Pembroke College), cox for the women's team, which also won its race.

James Cook said: “Everyone in the Department has been very supportive, especially my Supervisor, Professor Clive Siviour, for allowing me to balance my MSc (Res) project and my rowing. Maybe having an engineering and scientific background can play to the strengths of rowing – being able to analyse performances. I do think that engineering, being quite objective and fact based, can help in not getting carried away with emotions... just what is needed on a momentous occasion like the Boat Race!”



Photo: Hamish Root

Institution of Civil Engineers Student Prize for best performance in Civil Engineering

Iona Richards, St Catherine's College

Iona completed an excellent project on 'Time effects for driven piles under lateral loading'. This was a very impressive 4th year project covering a wide range of work. She designed, built and used a new experimental set-up for exploring lateral loading of piles in clay. Iona's examination performance in Civil Engineering was excellent.

Institution of Mechanical Engineers Project Award

Rangarajan Ramesh, Lincoln College

Rangarajan completed an excellent 4th year project on 'An analysis of complete and common edge contacts'. He used detailed material of analysis of contact problems using continuum elasticity theory. An exceptionally powerful candidate – three papers published and a fourth to come, this project provides original contribution to several aspects of contact mechanics theory.

“Rise of the Machines”



Hugh Durrant-Whyte FRS, Professor and ARC Federation Fellow at the University of Sydney, delivered the Department's 41st Maurice Lubbock Memorial Lecture, which was titled: “Rise of the Machines”.

Professor Durrant-Whyte talked about the development of the robotics industry in Australia, the science that has made this possible and the impact this is having in key industry sectors such as mining and agriculture. He highlighted the increasing use of data in these sectors, for predictive analytics and for decision making.

He said: *“Together sensor data fusion and predictive analytics are building a future of autonomous and remote operation of whole industries in Australia. This disruption is creating new businesses in robotics, data science and autonomous decision making – this will impact the future of the economy and society in Australia and internationally”.*

An Australian themed Lubbock Day marked the biggest turnout in its history attracting over 350 representatives from industry, academia, the University's alumni community, government, and schools from Oxfordshire. The Day also included mini-lectures, the 4th Year project competition, an exhibition on robotics, and a Lotus F1 car on display.

The mini-lectures

The audience was treated to two fascinating mini-lectures on the topics of “Development of the UK's fastest wind tunnel - a UK/Australia endeavour,” given by Professor Matthew McGilvray from the Department and Professor Richard Morgan from the University of Queensland, and “Splashing, sloshing and stealth - offshore hydrodynamics writ large,” delivered by Professor Paul Taylor from the Department.

The Department has embarked on developing the UK's fastest wind tunnel, T6, in collaboration with the University of Queensland. Once operational in late 2015, the facility will be capable of producing flows to test Earth re-entry vehicles from the Moon and beyond.

Professor Paul Taylor's collaborations with universities in Australia focused on the exploitation of oil and gas resources and the new design challenges that offshore platforms present.

Our special thanks to the Trustees of the Maurice Lubbock Memorial Trust for their continued support.



Seen here are (left to right): Professor Lionel Tarassenko, Professor Hugh Durrant-Whyte and the Hon. Lyulph Lubbock.

Project Exhibition

The Hon. Lyulph Lubbock, who represented the Lubbock Trustees at this year's Lecture, presented ten prizes to the following 4th Year Engineering Science students:

- ARM Ltd: The ARM Prize for Digital Technology**
Student: Sabrina Barrett (St Catherine's College)
 Project title: *“Acoustic Signal Processing to Battle Malaria-Bearing Mosquitoes”*
- BP: The BP Award for the best Chemical Engineering or Energy-related Exhibit**
Student: Kirill Titov (Balliol College)
 Project title: *“Electrospinning into the future”*
- The Department of Engineering Science Prize for the Best Energy-related Exhibit**
Student: Matthew Deakin (Christ Church College)
 Project title: *“A Fuel Cell Fault Diagnosis System”*
- GlaxoSmithKline: The GSK Excellence in Communication of Engineering Innovation Award**
Student: Rutej Mehta (St John's College)
 Project title: *“Quantification of Dispersion and Partial Volume Effects in Arterial Spin Labelling”*
- IBEX Industrial Brushes: The Ibox Industrial Brushes Mechanical Engineering Award**
Student: Rangarajan Ramesh (Lincoln College)
 Project title: *“An Analysis of Complete and Common Edge Contacts”*
- Laing O'Rourke: The Laing O'Rourke Best Civil and Construction Engineering Award**
Student: Rowan Callinan (Christ Church)
 Project title: *“The Royal Albert Bridge”*
- Osborne: OSBORNE prize for the project with the greatest practical application to civil engineering or structures**
Student: Jack Firth (Wadham College)
 Project title: *“Fluid Injection in Granular Materials”*
- Rolls-Royce: The Rolls-Royce Award for Innovation in Thermofluids**
Student: Krishan Chana (University College)
 Project title: *“Gas Turbine Combustor Swirl & First Vane Aerodynamic Interactions”*
- Sharp Laboratories of Europe: SHARP Prize for Best Electronics Engineering Exhibit**
Student: Harriet-Rose Noons (Hertford College)
 Project title: *“Switchable optical filters for sensor protection”*
- Sony: Sony Image Processing Prize**
Student: Nicola Milburn (St Hugh's College)
 Project title: *“Computer Vision: Tracking and Reconstruction of an Object”*



Our thanks to the judges of the Project Exhibition, all of whom were alumni of the Department of Engineering Science and are now working in industry. They were: **Dr Peter Bannister** (Alesi Surgical Ltd); **Dr Mark Catherall** (Catherall Consulting Ltd); **Thomas Griffiths** (Shell UK Ltd); **Dr Gillian Marshall** (QinetiQ).

With special thanks to the above sponsors for donating 4th Year Project Exhibition prizes.

REACH

Improving water security for the poor

© World Bank / Arne Hoel

A new global research project, titled REACH, led by the University of Oxford, involving Professor Ian Thompson and Dr David Clifton of the Department of Engineering Science, and backed by the British Government, will help hundreds of millions of people in Africa and South Asia to have reliable access to water. The seven-year research project, a collaboration with the School of Geography and the Environment, will receive a £15m grant from the Department for International Development.

A changing and variable climate, increasing demand for water, crumbling infrastructure, unaffordable bills and water contamination have caused a chronic lack of safe, reliable and clean water in the developing world. The initial focus of the programme will be on fragile states which face great water security risks. Some of the world's poorest and most vulnerable people live in fragile states, rural hinterlands, floodplains and rapidly growing urban slums where they have very low resilience to water shortages and the least capacity to cope.

The programme is being led by Dr Rob Hope, of the School of Geography and the Environment. The Department of Engineering Science, including the Institute of Biomedical Engineering (IBME), component of REACH will be looking at:

- Advances in water quality science and engineering to improve the detection and elimination of harmful water sources
- Novel approaches from Engineering Science will review and explore new techniques to determine the efficacy and acceptability of pollutant identification and remediation technologies

- Big data machine learning methods for estimating risk of water insecurity
- Health monitoring of water supply - including low-cost sensing devices on hand-pumps.

Dr Clifton said: *"This programme offers a fantastic opportunity to build on the rich body of expertise that exists at Oxford, both in terms of the modelling and understanding of water systems and in statistical machine learning methods for quantifying risk. Of particular significance is that the outcomes of this programme are not just academic in nature: its goals include improving water security for five million people in rural, poor regions. Research of this kind has a double benefit, in that it represents investment both in building scientific capacity in the UK, and in offering tangible improvement to the quality of life for people living in developing regions".*

The link to the REACH website is: www.reachwater.org.uk

International effort to understand the human brain

Academics from across Engineering, Mathematics and the Physical and Medical Sciences in Oxford and beyond are combining their experience and skills to understand the human brain, how it operates at the lowest scale and how that action affects its response to trauma and injury. The new International Brain Mechanics and Trauma Lab (IBMTL), based in Oxford, encapsulates that joining together of minds, recognising the absolute need for world-class institutions to collaborate on complex issues.

Professor Antoine Jérusalem, from the Department of Engineering Science, who together with Professor Alain Goriely from Oxford University's Institute of Mathematics is Co-Director of the IBMTL, said: "IBMTL will enable experts in different fields, across the globe, to share resources and generate new knowledge".

'One of the greatest challenges of our century'

Understanding the human brain was described by Professor Andrew Hamilton, Vice-Chancellor of the University of Oxford (from October 2009 to December 2015), as 'one of the greatest challenges of our century,' as he opened the 2015 Oxford Brain Mechanics Workshop.

The workshop introduced the burgeoning strategic partnership between IBMTL and Carnegie Mellon University's (CMU) 'Brainhub' project. This emerging collaboration, to develop shared research

into the study of brain function, injury and disease, welcomed guest speaker Dr Subra Suresh, President of CMU.

Attracting over 100 attendees, the workshop brought together speakers from the various disciplines of brain mechanics research represented under the IBMTL including representatives from CMU in the USA.

Understanding the brain, its pathologies, injuries and healing is no longer just a priority for clinicians but is a field where data analysis and mathematical modelling can work with clinical practice to further our understanding of the most complex of human organs.

For more on this story please visit: <http://www.brainmech.ox.ac.uk/>



Excellence in Biomedical Engineering



Outstanding Female Researcher in Medical and Biological Engineering

Professor Alison Noble OBE FEng, the Director of our Institute for Biomedical Engineering, was presented with the inaugural Laura Bassi award of the International Federation for Medical and Biological Engineering (IFMBE).

The Laura Bassi award is a new award of the IFMBE recognising a senior female biomedical engineer for outstanding research contributions in the field of medical and biological engineering.

Professor Noble received the award at the International Union for Physical and Engineering Sciences in Medicine World Congress 2015 in Toronto, Canada, where she also gave a scientific presentation entitled: "Machine Learning in Ultrasound Imaging".

Professor Noble comments: *"It is a great honour to receive this prestigious award; both to receive international recognition for my own achievements, but also the well-deserved recognition for the work of my research team and our collaborators"*.

Laura Bassi (1711-1778) was an Italian academic and lecturer, who is believed to be the world's first woman to earn a university chair in a scientific discipline. Her intellectual abilities were recognised at a very early age. In 1732, at the age of 20, she received a doctoral degree from the University of Bologna, Italy, and in the same year became a member of the Academy of Science of Bologna. She went on to become the first woman to earn a professorship in physics.

Tackling today's life-threatening diseases

Professor Eleanor Stride, a world expert in biomedical engineering from our Department, won the 2015 Institution of Engineering and Technology's A F Harvey Engineering Research Prize. Professor Stride argues that instead of inventing new drugs, making better use of the drugs we already have available by targeting them to the affected part of the body could hold the answer to tackling many of today's life-threatening diseases.

Professor Stride's research aims to revolutionise the treatment of major diseases by making drugs currently on the market work more effectively. This involves encasing drugs in ultrasound activated "bubbles" to increase the amount of drug delivered to a target site while diminishing unpleasant and dangerous side effects, such as nausea, hair loss and risk of infection.

The drug-loaded bubbles are injected into the blood stream so that the drug can be released at a particular part of the body 'on-demand' by exposing it to ultrasound from outside the body.

The £300,000 A F Harvey Prize will further Professor Stride's research in developing new techniques for fabricating bubbles with a very high degree of control.



Professor Stride said: *"We are still at a very early stage but our recent results suggest that we can vastly improve the way we deliver existing drugs – and that this could be far more effective in the long run than inventing new cures. Currently, when drugs are injected, for example in the treatment of cancer or stroke, only a tiny percentage actually reaches the site of the disease. The rest of the drug will affect healthy tissue and can lead to extremely unpleasant side effects. If we can maximise the amount of drug in the target area we can both drastically improve their efficacy and reduce these side effects"*.

Sir John O'Reilly, Chair of the IET's Selection Committee for the Prize, said: *"Professor Stride's research in drug delivery and biomedical ultrasonics is an excellent example of the innovation that can be achieved from the cross-fertilisation of engineering and biomedical science"*.

For more information, please visit www.theiet.org/harvey

Major collaborations

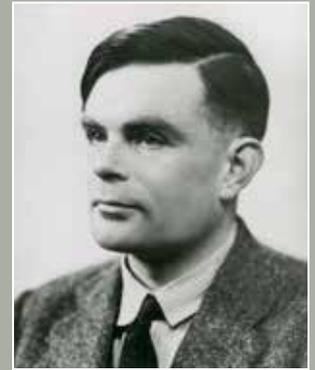
A key founder of the Alan Turing Institute

Oxford is one of five universities selected to play a key role in the creation and the activities of the Alan Turing Institute.

Oxford's involvement in the Institute will be led by five departments: Department of Engineering Science, the Mathematical Institute, Department of Computer Science, Department of Statistics, and the Oxford Internet Institute.

The new Institute will tap into world-leading strengths and achievements across these scientific disciplines. For example, Oxford Information Engineering, part of the Department of Engineering Science, is at the forefront of intelligent data analytics, with world-class expertise in machine learning, computer vision and robotics. Our algorithms can query all recordings ever made and held in the BBC archives, we have pioneered cars that can drive themselves, developed systems that can provide principled data analysis at a scale beyond the human and have transformed domains ranging from Astronomy to Zoology, from Finance to Healthcare and from Crowdsourcing to Social Network Analysis. We enjoy a breath-taking array of external engagement, providing innovations that are embedded at the heart of commerce and industry.

The Institute will build on the UK's existing academic strengths and help position the country as a world leader in the analysis and application of big data and algorithm research. Its headquarters will be based at the British Library in London.



Alan Turing, mathematician and computer pioneer.

The delivery of the Institute is being coordinated by the Engineering and Physical Sciences Research Council (EPSRC) which invests in research and postgraduate training across the UK. The Institute is being funded over five years with £42m from the UK government. The selected university partners will contribute further funding. In addition, the Institute will seek to partner with other business and government bodies.

For more information, please visit: <https://turing.ac.uk/>

New Centre for Doctoral Training

The new Engineering and Physical Sciences Research Council (EPSRC) Centre for Doctoral Training (CDT) in Renewable Energy Marine Structures (REMS) was officially opened at Cranfield University by Maria McCaffery, CEO of RenewableUK. This is a collaboration between the Department and Cranfield University.

The Centre, funded by a partnership between the EPSRC and companies from the energy and power industries, will train 50 graduate students, including a cohort of Engineering Doctorate students, who will study for four years each, over the next eight years.

Maria McCaffery, CEO of RenewableUK, said: "The Centre is opening its doors at just the right time, as the UK's world-leading offshore wind sector is expanding rapidly, with installed capacity expected to double by 2020 to meet our renewable energy targets, and a further trebling needed between 2020 and 2030. Meanwhile, the wave and tidal sector is about to see a step change as we move closer towards the deployment of the first commercial-scale arrays in British waters, marking the dawn of new industries. These are exciting times to be working in the field of offshore renewables, but we are well aware that if we're to maintain our global lead, we will need to attract more first-class engineers into the sector in the years ahead. That's why I'm immensely proud to have been invited to open this centre of excellence".

Professor Byron Byrne, Professor of Engineering Science and REMS CDT Oxford Director said: "We are extremely excited to be working with Cranfield University, and our industrial partners, to drive forward this new venture, delivering the next generation of technical leaders. The first cohort is already creating an impact, bringing focus and enthusiasm to their study of challenges faced by the renewable energy industry. Research by the Centre will be carried out collaboratively with industry, addressing real world design problems, to reduce the cost of energy from wind, wave and tidal".

Professor Philip Nelson, CEO of EPSRC, said: "Investing in tomorrow's scientists and engineers is vital if the UK is to have the right skills we need to address the energy challenges we face. This EPSRC Centre



Pictured from left to right: Professor Byron Byrne (CDT Director, Oxford University), Professor Feargal Brennan (CDT Director, Cranfield University), Maria McCaffery (RenewableUK), and Professor Sir Peter Gregson (Vice Chancellor, Cranfield University).

for Doctoral Training will be working closely with the energy and power industries. This means that researchers can be well informed by industry needs and likewise industry is plugged in to cutting-edge research".

EPSRC-funded centres bring together diverse areas of expertise from both academia and industry to train engineers and scientists with the skills, knowledge and confidence to tackle today's evolving issues and future challenges. They also provide a supportive and exciting environment for research students and create new working cultures, building relationships between teams in universities and forging lasting links with industry.

For more information, please visit: <http://www.rems-cdt.ac.uk/>

across the globe

New Technology Centre with China's Regenerative Medicine Industry

China Regenerative Medicine International (CRMI) and the University of Oxford announced the establishment of a new centre for engineering focusing on stem cell therapies and tissue regeneration. The £7.5m collaboration between CRMI and Oxford University will not only fund a new centre but also support 20 graduate studentships.

To mark the official long-term collaboration agreement to establish the 'CRMI Technology Centre at the University of Oxford,' a signing ceremony was held at the Department of Engineering Science. Professor Ian Walmsley, Oxford University Pro-Vice-Chancellor (Research), and Mr Dai Yumin, Executive Director of CRMI, signed the contract on behalf of each party. Mr Chen Futao, the Minister Chancellor of Science and Technology from the Chinese Embassy in London, also attended this special signing ceremony.

Guan Guoliang, Chairman of the Strategy Committee of CRMI said: *"We are delighted to have the opportunity to work with Oxford University. This signing ceremony marks the collaboration between western technology and Chinese industry. We aim to work together on regenerative medical technology that will have a significant impact on the quality of life of human beings. We believe that this long-term collaboration with the University of Oxford is an important milestone of the Company's business strategy to expand internationally"*.



Left to right: Professor Ian Walmsley, Mr Dai Yumin and Professor Zhanfeng Cui.

Professor Ian Walmsley commented: *"We are pleased to see our high quality research being recognised by industry worldwide. This is an important relationship for Oxford's Engineering Science Department and the University"*.

The founding of this new Centre will lead to enterprise-specific research projects under the leadership of Professor Zhanfeng Cui, the Department's Professor of Chemical Engineering and a Fellow of the Royal Academy of Engineering.

CRMI is a Hong Kong listed company principally engaged in research and development of bio-medical and healthcare products and medical techniques; the provision of the production and sales of tissue engineering products and their related by-products; as well as sales and distribution of medical products and equipment. CRMI launched the first China Food and Drug Administration approved tissue-engineered skin, "ActivSkin", in China's market.

Oxford University and CRMI are expected to enjoy a share of the medical market for years to come.

Teaming up with Google DeepMind

A team in the Department of Engineering Science has joined the artificial intelligence lab Google DeepMind, establishing new collaborations between the two institutions, which also involves Oxford University's Department of Computer Science.

The three Department of Engineering Science researchers, Dr Max Jaderberg, Dr Karen Simonyan, and Professor Andrew Zisserman, work on computer vision. They have been developing systems capable of recognising objects, actions, and text in images or videos of real-world environments. At the 2014 ImageNet competition, regarded as the most challenging and prestigious image recognition contest in the world, Dr Simonyan and Professor Zisserman developed one of the winning image understanding systems.

Google DeepMind has hired the three Engineering Science researchers, together with their colleagues from Oxford's Department of Computer Science - Professor Phil Blunsom, Professor Nando de Freitas, Dr Edward Grefenstette and Dr Karl Moritz Hermann - to continue research in computer vision and natural language understanding at Google. Professor Zisserman will hold a joint appointment with the Department of Engineering Science.



"It is exciting to be continuing to pursue the horizon of artificial intelligence at Google DeepMind", says Dr Max Jaderberg, who also did his undergraduate degree and DPhil in the Department of Engineering Science. "Our team's ambitions are to really take computer vision technology further, and working with Google DeepMind is the ideal platform to continue in this direction".

As a part of this collaboration, Google DeepMind has made a substantial donation to establish a research partnership with the Departments of Computer Science and Engineering Science at Oxford University, which will include funding postgraduate studentships, a programme of student internships, and a series of joint lectures and workshops to share knowledge and expertise.

For more information, please visit: <http://tinyurl.com/nd5jxyc>

Oxford Engineering Alumni (OEA)

Oxford Engineering Alumni is the new name adopted by the Society of Oxford University Engineers. It comprises all Oxford Engineering graduates, and present and past members of teaching and research staff of the Department. If this applies to you and the Department has your contact details, you are already a life member. If the Department does not have contact details for you, or if you are unsure, you are very welcome to join... simply e-mail: alumni@eng.ox.ac.uk There is no membership fee.

The Department is keen to continue to develop its links with former students and staff. There are many opportunities open to members of OEA to interact with the Department and its current activities - from attending OEA's annual Jenkin Lecture and associated events (part of the University's Alumni Weekend each September), to helping students find internships or providing them with careers advice and mentoring (women undergraduates in particular).

Alumni could also support the costs of graduate study, which can deter UK students from continuing their education at Oxford. Research undertaken by graduates in the Department tackles problems of major importance to society including energy, health, communications, transportation, and water resources.

Do get in touch if you would like to contribute in any way, or have ideas to share – we would be delighted to hear from you. More details are given on the new OEA web-page: www.eng.ox.ac.uk/alumni

My story: Simon Turner Alumnus, Lincoln College (1984-1992)

Inspired by lectures on artificial intelligence and computer vision by Professor Sir Michael Brady (then Dr Mike Brady, recently arrived from MIT), I embarked upon postgraduate studies in computer vision. This did not lead to the expected DPhil, because I was more drawn to programming and UNIX system management, and ended up as a research assistant running the Robotics Group's network of SUN workstations and writing nifty bits of software (while also giving tutorials and revision classes in solid mechanics to undergraduates, and even typesetting maths finals papers!)

Everything changed in 1992 when I was offered a job with Simtek, a small motor racing consultancy. Here I worked on wind-tunnel data analysis; capture, display and analysis of on-car data logging and real-time telemetry; on-car systems including semi-automatic gearbox control; high-performance graphics libraries; vehicle lap simulation; and various projects for the FIA (motorsport's governing body), from performance analysis to random selection of cars to be called into scrutineering at F1 races.

With this range of experience I became self-employed, and in the past 20 years I have worked for numerous clients, mostly in motorsport but also in robotics, and even work-rate analysis and stock control for a garden furniture company.

I have maintained links with the Department as a volunteer on the committee of the Society of Oxford University Engineers (now Oxford Engineering Alumni) in various capacities for the past 20 years – highly rewarding!



Simon (pictured on the right) received a certificate from Professor Lionel Tarassenko for his sterling 20 year contribution to the Department as a volunteer.



Prototype driverless pod.

The 2014 Jenkin Lecture: The Oxford RobotCar

Paul Newman (Balliol College, 1991) is Oxford's BP Professor of Information Engineering. In delivering the 2014 Jenkin Lecture he provided a riveting glimpse of a world where cars drive themselves. He showed how this world is being realised right now, right here in Oxford. The key to success of this major research effort is the practical use of image acquisition and analysis tools developed within the Department.

Paul explained how the Oxford RobotCar knows where it is, to a resolution sufficient for safe operation, without relying on GPS or any fixed infrastructure. Images are continually captured of the world around the car, and compared with information from a 'prior', from previous imaging at the same location. Latest developments even take account of changing weather and lighting conditions. The team's hardware and software have been implemented in commercial electric vehicles (the Nissan 'Leaf'), and have already been trialled, with official authorisation, on a local public road.

He revealed that they will soon be put to the test in a very public showcase: the autonomous passenger-carrying pods to be launched in Milton Keynes in 2016. He was, however, careful to point out practical constraints. He did not envisage fully autonomous vehicles on public roads any time soon. Considerations such as safety and insurance would always mean that cars will be autonomous only when it is safe and practical: as he put it - for some people, some of the time, in some places. However it is clear the work of Paul and his colleagues means this will be achieved sooner than we might have imagined.

Paul's Jenkin Lecture is available to view on-line via this link: <http://tinyurl.com/pjbb6vz>

Oxford Engineers at the Royal Society Summer Science Exhibition

Members of the Department of Engineering Science were involved in the 2015 Royal Society Summer Science Exhibition, an annual display of the most exciting science and technology in the UK.

Biological materials, such as bone and skin, can regenerate after damage, but until recently such self-repair was almost unknown in man-made materials. Run in collaboration with colleagues from the University of Reading, the exhibit 'Materials that repair themselves' showcased research into self-healing polymers.

The display explained how polymers can be designed to contain complementary molecular surfaces that will reconnect to repair damage. Self-healing polymers could vastly improve the durability and safety of critical components in cars and aircraft.

Oxford's research in this area focuses on the mechanical properties of the polymers, and is led by Professor Clive Siviour, whilst the development of the chemical structures which allow healing is performed at Reading. The two universities are currently working on a joint EPSRC-funded project to understand better the relationship between molecular structure and mechanical response in these materials.



Meet Engineering Science's First Access Officer

Meet Gabrielle Bouchard, one of the Department's newest recruits. Gabrielle holds a Bachelor of Engineering from McMaster University in Canada. In addition to working in industry, she has spent more than four years in outreach roles, the latest of which was working to raise the aspirations of Canada's indigenous population, encouraging them to study science and engineering. Gabrielle has the experience to make a positive impact as the Department's first access officer.

When Gabrielle explains her role to prospective undergraduates she meets, she says 'no matter where, with whom, or what gender you were raised, I am going to work hard to help you reach your potential, which will ideally include a successful application to Oxford's Engineering Science programme'.

Gabrielle's post is part of a University-wide initiative to improve the quality of applicants and widen access to Oxford. To achieve these aims Gabrielle will focus upon under-represented groups. As with most subjects in Oxford this will mean reaching out to disadvantaged students, and as with most engineering courses throughout the UK, it also means reaching out to female students.

Gabrielle said: "When I arrived I found that we have very motivated academics and students who have been doing great work. The aim this year will be to refine existing events like Headstart and UNIQ, whilst also creating new, meaningful initiatives and building collaborations with other organisations". Gabrielle has spent the summer developing a strategy to allow the Department to expand on what is already being done so that more students can be reached in the future.

Getting involved in access and outreach can be an extremely rewarding and enjoyable experience. If you are able to speak to students, offer a site visit or student placement, consider a financial contribution to one of our events, or would like to start your own initiative, please get in touch with Gabrielle via e-mail: gabrielle.bouchard@eng.ox.ac.uk.

With special thanks to Mr Michael Hill (St Edmund Hall, 1985-9) who has generously funded the post for the Department's first Access Officer.

World-class research, real-world applications

The Department of Engineering Science has long been active in turning the world-class research it undertakes into real-world applications that industry wants to commercialise and investors wish to support. In 2015 the Department worked with Oxford's new £320m investment company, Oxford Sciences Innovation plc (OSI) and Isis Innovation, the research and technology commercialisation company of the University of Oxford.



Department spin-out benefits from first investment

Oxford Flow, a developer of precision engineered products, was spun out of the Department and secured the first investment from Oxford Sciences Innovation plc.

Its initial product, a valve that regulates the flow of gases and liquids in industrial processes, is 80 per cent lighter than existing products and can handle over 10 times the volume with a high degree of precision and control. The initial £750k investment from OSI will ensure the business can take the valve to market and develop further high-performance products for gas distribution networks and the water industry.

Founder and Technical Director, Professor Tom Povey from the Department of Engineering Science, identified the need for the valve while researching jet engines for companies such as Rolls-Royce: "I was working with high flow rates of compressed gas that, for reasons of efficiency and safety, needed to be regulated. Regulators available on the market were not precise enough so I devised a completely new method of controlling gas and developed a series of products based on this technology".

Oxford Flow CEO, Simon Hombersley said: "We expect these valves to be a game-changer in the \$3bn pressure regulator market, and a platform for a series of industrial control products. This first investment by Oxford Sciences Innovation recognises the strength of the market-ready technology and the scale of opportunity in engineering innovation for industrial processes".

Left to right: Tom Povey, Simon Hombersley and Matt Collins.

Oxford Flow is now internet-enabling the platform technology so that its products will be able to provide real-time monitoring of the flow of liquids and gases in industrial and everyday settings and become a key component of the "Internet of Things".

For more information, please visit: www.oxford-flow.com

Spin-out targets new frontiers of robotic technology

A new spin-out from the Department of Engineering Science and Isis Innovation is targeting new opportunities in robotics and autonomous systems. The firm, Oxbotica, has been founded by Professor Ingmar Posner and Professor Paul Newman - leaders of the Department's internationally acclaimed Oxford Mobile Robotics Group (MRG).

Current MRG projects include robotic survey systems for roads and railways, low-speed driverless pods for urban transport, the RobotCar autonomous vehicle, and robotic rovers for use on Mars. Oxbotica will commercialise MRG's robotics and autonomous systems technologies.

Executive Director of Isis Innovation, Linda Naylor said: "Robotic technology has the potential to transform the fabric of our everyday lives and Oxbotica will be a key part of this".

Professor Ingmar Posner, from the Department, said: "We believe that Oxford University's robotics expertise can transform a wide spectrum of application domains. Our intended markets range from devices that survey our roads, buildings and chemical plants to autonomous systems for warehouse logistics and, of course, autonomous driving".



Professor Paul Newman (left) and Professor Ingmar Posner.

The Department's BP Professor of Information Engineering, Paul Newman, added: "Transport remains an important application for robotic technology but we are thinking bigger than any single application. In collaboration with partners, we can help to realise the Government's vision of robotics as one of the UK's 'Eight Great Technologies'".

The company is led by Dr Graeme Smith, an automotive engineering executive with extensive experience in developing autonomous vehicle technology. Dr Smith said: "Oxbotica will manage and expand the extensive and rapidly growing intellectual property portfolio created by MRG to realise the tremendous market potential of robotics and autonomous systems in the UK and globally".

For more information, please visit: www.oxbotica.com



The Department of Engineering Science and Isis Innovation have produced a new brochure, which has been funded through the University of Oxford's Knowledge Exchange and Impact Team.

The brochure illustrates some recent successes in moving new technologies developed in the Department into society. These technologies have either been licensed to established companies or are being developed for use within an investor-backed spin-out company.

For more information on the Department's spin out companies, please visit: <http://www.eng.ox.ac.uk/about/spin-out-companies>

Shake, Rattle and Roll...

Oxford-BP machine vision research opens the door to improved rock cut data during well construction

During oil and gas drilling the rock cut by the drill bit is carried back to surface by drilling fluid. Accurate measurement of the quantity of rock (cuttings) returned provides valuable information to the operation around the efficiency of removal, as well as the quantity of material still present in the well. By analysing the shape and size of cuttings returned to surface it is possible to detect and quantify instances of 'wellbore instability' – effectively a localised collapse of a section of the hole. Furthermore, if variations in the flux of cuttings to surface are tracked and correlated against drilling practices, there is a significant potential to tweak the drilling process to allow optimal solids transport in the well.

The state of the art – counting buckets and skips

Conventionally when drilling fluid (mud) reaches the surface it is passed through a device called a shaker – in essence a vibrating set of stacked screens designed to separate out the rock from the drilling fluid. The rock cuttings are captured for disposal while the drilling fluid is returned to a holding tank for further use.

If done at all, the measurement of these cuttings and cavings is usually quite imprecise and sparse. Typically, cuttings are collected in skips at the well site and shipped back to shore for processing. When a skip is emptied, its content is weighed and the measurement recorded and plotted. However, such measurements can be separated by many hours. In more advanced installations cuttings are caught at the shakers in a mechanised bucket which periodically empties, recording the mass of cuttings.

Opening our eyes – applying machine vision technology in real time

Recognising the capability of Oxford University's Visual Geometry Group, BP has worked with Dr Andrea Vedaldi, Associate Professor in Engineering Science, to determine whether machine vision technology could be applied to this problem. BP proposed using image recognition technology to make measurements of the



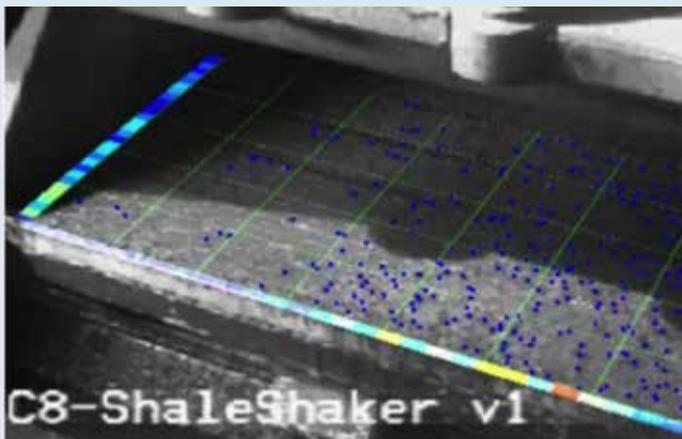
material flux passing over the shaker screens, something untried in the industry previously. Initial results derived from low resolution sample video were promising enough to warrant further exploration and, subsequently, a scaled-up trial and further data gathering was organised at a manufacturing plant in Aberdeen where several tonnes of basalt gravel progressing over a shaker was recorded using various sensors. The analysis of these results is currently ongoing.

It is expected that this research project will open the door to the potential of low cost sensor packages that could significantly enhance our ability to monitor and draw conclusions from drilled rock returned to surface during these operations. The quality and granularity of data generated is unprecedented in the industry today.



"In Oxford we develop technologies such as computer vision and deep learning that are revolutionising entire sectors, from Internet search to autonomous driving. Our collaboration with BP constitutes a unique opportunity to port this transformative technology to a strategic area such as the one of oil and gas. We are looking forward to discovering how modern artificial intelligence (AI) can help BP, and eventually other operators, to boost safety, reliability, and efficiency in their activities".

**Andrea Vedaldi, Associate Professor,
Department of Engineering Science**



Networks

The University of Oxford's

Alumni Office provides a range of opportunities for alumni of the University to come together. Throughout the year there is an exciting mix of social and professional networking events, presentations by leading academic speakers, as well as the chance to get involved in student recruitment and outreach activities. To find out more please visit:

<http://www.alumni.ox.ac.uk>

or e-mail:

enquiries@alumni.ox.ac.uk

The Oxford University Engineering Society (OUEngSoc)

- this is one of the largest undergraduate societies in the University. It promotes the engineering profession within the University and provides students with a wider overview of the profession that is otherwise outside the scope of the degree course. Talks, debates and trips as well as socials and networking opportunities are offered to undergraduates. To find out more please visit:

<http://www.ouengsoc.org>

The University of Oxford Careers Service

is for life. The dedicated alumni careers adviser, Dr Mike Moss, is also the key Careers Service contact with the Department of Engineering Science. He offers 30 minute Skype appointments for alumni all over the world; these can be booked on-line on the Career Connect portal. Alumni can also post job vacancies, offer internships and volunteer to be mentors. To find out more please visit:

<http://www.careers.ox.ac.uk/>

or e-mail:

alumni@careers.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.



Tributes to...

Professor Terry Jones (1939 - 2015)

Professor Terence Valentine Jones was an inspirational leader, a compulsive innovator, an inventor of genius and a brilliant all-round teacher. He had boundless enthusiasm and a genuine warmth appreciated by all who knew him. He was acknowledged throughout the world as one of the legends of high speed flow and heat transfer.

Terry graduated as a physicist from Oxford. The rigor and scientific enquiry fundamental to this subject stood him well throughout his career. He joined the Department of Engineering Science at Oxford as a doctoral research student. In 1968 he and his DPhil supervisor, Don Schultz, realised that the short duration wind tunnels and innovative heat transfer instrumentation used to study hypersonic flow could be profitably applied to gas turbine heat transfer and aerodynamics. They convinced Rolls Royce that Oxford had much to offer and started a partnership with the company which prospers to this day. Terry invented the first of many new wind tunnels, the Isentropic Light Piston Tunnel, or ILPT. He and Don encouraged the University to buy the old Oxford Power Station which became the first Osney Laboratory.

The Osney Turbomachinery Group prospered and in 1975 they built a large ILPT, to Terry's design, to test turbine cascades. This became the Oxford Rotor and is still in use. This was so successful that the National Gas Turbine Establishment (later to become QinetiQ) commissioned the research group to build a larger ILPT. This operated on the Pyestock and Farnborough sites for about twenty years. Recently, when QinetiQ closed down their turbomachinery research, Rolls Royce financed the tunnel's return to Oxford, where it continues as the Oxford Turbine Research and is testimony to Terry's innovative skills.

After Don Schultz died in 1987, it was appropriate that Terry should take over the leadership of the Osney group. In 1988 Terry was elected as the first Donald Schultz Professor of Turbomachinery. He moved from St Anne's college to a Professorial fellowship at St Catherine's. He continued to expand the group adding more facilities and researchers.

Terry was the first to see that thermochromic liquid crystals could be used to measure heat transfer and this flowered into new techniques, now in use world-wide. As well as turbomachinery, Terry worked on innovative measurement techniques, industrial air coolers and cooling towers, molecular beams, shock waves and hypersonics. He published over 200 academic papers. He supervised 50 research students, instilling his rigorous methods and sense of discovery.

Terry was a gentleman, in every sense of the word. He shared his ideas generously, and always gave his time freely to all who sat with him in his "power station superintendent's office". Of course, this also meant that his meetings often finished late, as he continuously enthused over new concepts and ideas.

His fundamental approach to research problems won him great respect and affection from all who worked with him. His considerable achievements were recognised in the wider world. He led a team which was awarded the 1996 Royal Society Energy award, complete with Gold Medals! He was a Fellow of the Royal Aeronautical Society, a Fellow of the Royal Academy of Engineering and an Associate Fellow of the AIAA. In 2011, he was awarded the prestigious Silver Medal by the Royal Aeronautical Society for his lifetime contributions to aerospace. And as recently as 2014 he was awarded a lifetime achievement award by the Mathematical, Physical & Life Sciences Division at Oxford.

The last decade was not kind to Terry, as he battled illness. He showed remarkable fortitude, remained cheerful of spirit and continued to participate in research projects, helping many of the latest generation of students. He will be sadly missed.

Professors Peter Ireland and Martin Oldfield

Professor Peter McFadden (1951 - 2015)

On Tuesday 23rd June, many of us attended a packed service in Jesus College Chapel, during which we said good-bye to Peter McFadden, who had been a University Lecturer (and then Reader) in the Department and a Tutorial Fellow at Jesus College since 1986. During the service, both Richard Stone and Will Moore spoke movingly, but not without humour, about Peter and his many contributions to the life of the Department and of his college.

Professor Lionel Tarassenko



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