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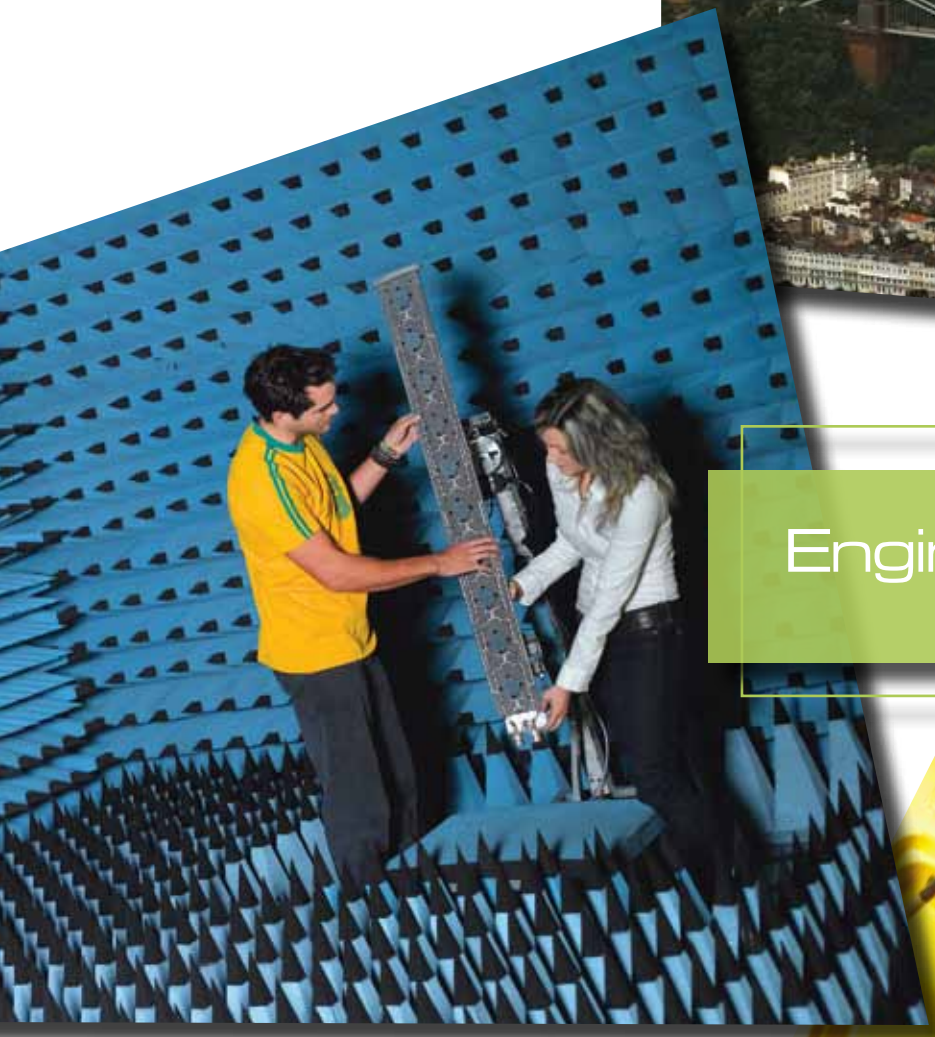

Engineering at Bristol

Martin Chainey

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Timo Kunkel

Dean's message

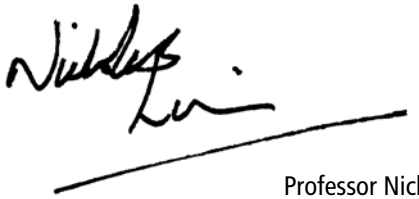
Andy Stevens

So what makes Engineering at Bristol special?

This booklet is designed to answer that question by giving you some key information about our Faculty. But I think that what sets us apart is the fact that we combine world-class engineering achievement with a supportive and friendly environment in which to learn to become an engineer.

If you ask our students why they chose to study here, they will tell you it was because we are consistently rated by external organisations as one of the very best places to study engineering, or because they'd heard about some of our cutting-edge, world-changing research. But when I talk to current students about what they enjoy about being here, they most often mention the small-group teaching - something we believe in passionately - or about their appreciation of the support and guidance they personally receive from some of the best engineers in their field. We believe that excellence thrives in a positive and friendly academic culture - that is what makes this relatively small engineering community a special one, and that means some of the most promising engineers choose to study here.

I hope you enjoy reading about Engineering at Bristol. Please feel free to get in touch with us if you want to find out more.



Professor Nick Lieven
Dean of Engineering

"We believe that excellence thrives in a positive and friendly academic culture - that is what makes this relatively small engineering community a special one"

Engineering at Bristol

The Engineering Faculty is more than the sum of its parts - together, its six departments form a centre of engineering excellence that is unique.
www.bris.ac.uk/engineering

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Reasons to choose Bristol for engineering

Engineering excellence

- The City of Bristol has been at the centre of many major modern engineering achievements. Concorde was built in Bristol, and made its final flight over the city; the giant Airbus A380 was also partly built in Bristol, and made an early test flight here (see cover photo).
- Bristol Engineering has prestigious links with national and international engineering companies including: GE Aviation, Rolls-Royce, BAE Systems, Airbus, Toshiba, Orange, Hewlett Packard and British Energy.
- Bristol also has a venerable engineering heritage. In particular some of the most remarkable work of Isambard Kingdom Brunel centred on Bristol and his dramatic Clifton Suspension Bridge is still the symbol of the city.

Teaching and Industry

- Much of our research and teaching is done in collaboration with engineering industry, and many companies invest in teaching equipment and provide visiting lecturers on our undergraduate and postgraduate programmes.
- One example of this is Engineering Design, an exciting, five year multidisciplinary MEng degree programme. It prepares very able students for future leadership roles in industry. It is closely supported by the Royal Academy of Engineering and a partnership of fifteen industrial companies. It focuses on good communication skills, teamworking, a wide understanding of engineering but with deep specialisation, and placement for projects in industrial companies.
- Our industrial links are also highlighted by our three doctoral training centres: the Advanced Composites Centre for Innovation and Science; the Bristol Centre for Complexity Sciences; and the Industrial Doctoral Training Centre in Systems. These multidisciplinary centres provide doctoral-level training in areas identified by the government as crucial for Britain's future competitiveness, equipping students with the skills and knowledge to lead and to forge lasting links with industry.
- The Faculty also has a suite of Masters programmes designed to prepare graduates for a career in research or in engineering industry. The MSc in Advanced Microelectronic Systems Engineering, for example, was set up to serve the needs of Bristol's world-leading semiconductor design industry. See www.bristol.ac.uk/prospectus/postgraduate/2011/
- As a result of this deep industrial engagement in our teaching, Bristol engineers are extremely employable, and go on to excellent careers.


Stephen Morris

Research culture and investment

- Our Engineering research is world class, as is shown by high scores in the 2008 RAE (Research Assessment Exercise).
- Bristol's research facilities in Engineering are outstanding. An example is the world class Bristol Laboratory for Advanced Dynamics Engineering (BLADE), opened by HM The Queen in 2005. In the past five years the Faculty of Engineering has attracted over £80 million in industrial and governmental research awards, and has spent over £25 million on infrastructure and laboratory equipment. Looking ahead, the Cabot Institute will be an interdisciplinary research hub dedicated to environmental systems and technologies.
See www.bristol.ac.uk/brite
- The Faculty of Engineering sits within a comprehensive university internationally renowned for its commitment to high-quality research.
See www.bristol.ac.uk/research

A rich student experience

- We are hugely proud of the achievements of our students. In 2010 we were again jointly top in the Royal Academy of Engineering Leadership Advanced Awards, with six of our students winning these prestigious prizes worth £5000 each.
- The student experience at Bristol is second to none: the university is located in the heart of one of the most attractive, exciting and safe cities in the UK. Bristol students have, on their doorstep, a rich cultural experience: some of the best theatres and art house cinemas in the country; the City Museum, which holds international travelling exhibitions as well as a significant permanent collection of art; and an array of pubs, clubs, restaurants, cafes and shops. Bristol's architectural glories - from the Georgian splendour of Clifton to its medieval Cathedral and churches - provide the perfect backdrop for this student life.

The world class Bristol Laboratory for Advanced Dynamics Engineering (BLADE), opened by HM The Queen in 2005


Martin Chainey

- Bristol is a university covering most subject areas, so offers a diverse student population and experience.
- Bristol Engineering has a very good staff-student ratio - this means that our students receive a great deal of individual attention. Staff operate an 'open door' policy for students.
- The University of Bristol guarantees university accommodation to all its first year students. This is one example of the network of support services in which the University takes great pride - these include student health and counselling services, and dedicated international student advisors.
- The University has one of the most active student unions in the country, with an extraordinary array of clubs and societies.
- The University has superb sports facilities, including a 33 metre pool on campus and large, state-of-the-art indoor and outdoor sports complexes that cater for all sporting interests.

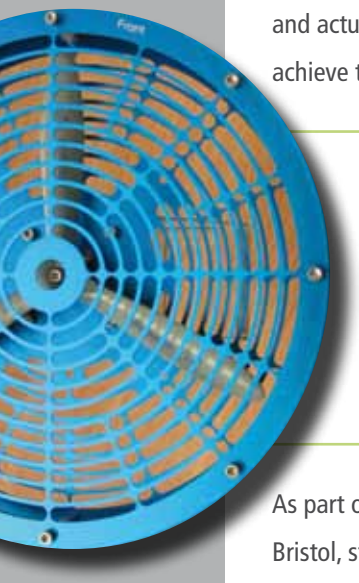
Dispatches from the engineering departments

The following stories give a sense of day-to-day life in each engineering department

Aerospace Engineering www.bris.ac.uk/aerospace

Flight Control Research at Bristol

Modern flight vehicles are complex, potentially unstable systems which may have the operator either onboard as a pilot or remotely based when the vehicle is unmanned. A key component of any flight vehicle is the control system, which is responsible for interpreting the operator demands and actuating the control surfaces in order to achieve the desired response.



This equipment enables students rapidly to design and test control architectures on an indoor test rig, such as the Quanser (left), and examine the physical implications of their design

As part of the undergraduate course taught at Bristol, students are encouraged to develop their control system understanding through experimental use of a three degree of freedom helicopter. This equipment enables students rapidly to design and test control architectures on an indoor test rig, such as the Quanser (above left), and examine the physical implications of their design. This three degree of freedom experimental helicopter has also been used for postgraduate research and the study of real-time vision-based navigation. Target tracking algorithms have been developed using this equipment and will be tested on the SR20 autonomous helicopter, operated by this department.

Past undergraduate flight control projects have looked into areas such as pilot induced oscillation, handling qualities at high angles of attack, control algorithms for small Unmanned Aerial Vehicles (UAVs) and real-time vision-based control. A current Avionics project is developing laser-based sensors for use with the SR20 when in close proximity to objects in confined areas. Another student working in this area has just won a prestigious Science, Engineering and Technology Student of the Year award (2010). Alexey Likhoded received the Airbus Award for the Best Aeronautical Engineering Student for his project entitled 'Vision Based Recovery of a Rotary Wing UAV'. Alexey said: "the helicopter used a video camera to recognise a target of a pre-determined shape and calculate the 3-translational and 3-rotational displacements to the target. The project was a perfect way to complete my degree, since it allowed me to apply the theoretical knowledge acquired from my degree to a practical problem. The four years of my degree has fully prepared me for a career in engineering and I could have not imagined a better way to start my graduate programme at GE Aviation than receiving the Airbus Award". With the rapid development of unmanned systems and a diverse range of

applications, flight control research will continue to grow and be an exciting area for years to come.

Bleeding composites that can self-heal

"Throughout my research career I have had a fascination with the design and performance of materials in nature and how we can use them for inspiration. The ability of nature to produce damage tolerant structures that can self-heal is something that engineering, especially aerospace, would dearly love to have available", says Ian Bond, Professor of Aerospace Materials at the Advanced Composites Centre for Innovation and Science (ACCIS) at Bristol. Composite materials can be designed to be as strong and stiff as equivalent metal parts but far lighter. For aircraft, weight is everything, and significant weight reductions lead to lower emissions. One of the challenges in exploiting composites is to make them tolerant to damage. Fibre reinforced polymer composites offer an opportunity to build in functionality such as self-healing. Research at Bristol to develop and characterise hollow glass fibre reinforced polymer composites has been underway for some time. The obvious next step was to use the hollow cavity within the fibres to add another form of functionality such as a repair agent - rather like the circulatory system in living organisms. The concept of self-repair is that a damaged structure is repaired by materials already contained within it, as is the case for living organisms. The key is that no external action is required, unlike conventional repair. The technology must sense and respond to damage, restoring the material's performance without affecting the overall properties of the system. Building from results and experience acquired during earlier research efforts to develop self-healing composites, and funded by the European Space Agency and the UK's Engineering and Physical Sciences Research Council, Professor Bond is now pushing the work forward to consider the incorporation of vascular networks. This will facilitate the circulation and replenishable supply of a healing medium throughout the lifetime of a structure, like the blood flow in the human body.

"The ability of nature to produce damage tolerant structures that can self-heal is something that engineering, especially aerospace, would dearly love to have available"

Ian Bond

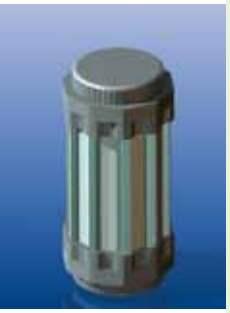

LM Wind Power

Aeolus Wind Powered Car Race

Staff and students from the Department of Aerospace Engineering have been working on the wind turbines for the Aeolus wind powered car, especially the aerodynamic shape of the blades and how to manufacture them from lightweight composite materials. You can read more about Aeolus on page 11. Researchers in the Department's ACCIS group also work with Vestas, a major manufacturer of wind turbines, on the development of composite blades.


Stephen Morris

Civil Engineering www.bris.ac.uk/civilengineering



● **Royal Academy of Engineering Leadership Advanced Awards**

The Department is proud to announce that second year students Alex Bradford and Joe Smith have won Royal Academy of Engineering Leadership Advanced Awards this year. This prestigious scheme makes just 30 awards nationally in all disciplines. The £5000 awarded to each winner helps aspiring engineering leaders to undertake an accelerated personal development programme. Alex (left, top) and Joe both have ambitious plans for their awards including visiting Japan to develop knowledge of Seismic design and exploring the impact engineers can have on the developing world.

● **Water and Health Research Centre - AQUATEST Research Programme**

The Department of Civil Engineering continues to lead the Aquatest programme in collaboration with the Universities of California, Berkeley, Cape Town, Surrey, and Southampton, as well as Aquaya Institute, PATH and the Health Protection Agency. This programme aims to deliver a low-cost water test that can be used in developing countries by non-experts. Aquatest will be a small, single-use device for testing microbial water quality. It will be used in the field, without electricity or skilled technicians. It is being designed for use in developing countries at a target manufactured cost of less than one US dollar. Additional components of the Aquatest system include an incubator and cell-phone based data acquisition. The incubator will be a low cost reusable device, working completely independent of electricity, costing around $20. It will allow the Aquatest device to give reliable, repeatable results across the different climatic conditions that exist in developing countries. A high level of portability is a feature of the Aquatest incubator; it will be about the size of an ice bucket and weigh no more than 1.5kg. This matches the size of the Aquatest device which is cup-sized and hand-held. More details at: www.bristol.ac.uk/aquatest

● **The Worshipful Company of Engineers - The Fiona and Nicholas Hawley Award for Excellence in Environmental Engineering 2010**

Robert Matthews, a postgraduate engineer conducting research for the Aquatest Research Programme received this award for developing a low-cost, portable incubator that does not rely on electricity. The incubator design supports reliable microbiological testing of water sources where electricity supply is unpredictable and is part of a water test kit that will provide greater confidence in the safety of drinking water where technical resources are limited.

● **Undergraduate research projects - Innovative Hybrid Structures**

A novel, environmentally friendly hybrid floor system comprising limecrete slabs connected to glulam timber beams via timber stud connectors is being built and tested to failure in the lab. Timber stud connections between slabs and beams, and also

slabs incorporating lime, both have relatively low embodied energies but have received little attention to date, hence this work. The test results suggest that this might be a feasible structural form. Funding for the project (including personal spending money for the project students) comes from the Institution of Structural Engineers, with materials donated by industry. The project is led by Dr Wendel Sebastian (above), who also leads research into innovative hybrid structures formed when fibre reinforced polymers (FRPs, or composites) are used to strengthen existing structures or as the basis of new structures such as lightweight bridge decks made of glass fibre matting embedded in polymer resin.

● 'Seismic Wallpaper'

The Earthquake Engineering Research Centre has developed 'seismic wallpaper' which can be used to protect non-seismically designed unreinforced masonry infill panels from earthquake damage. Out-of-plane collapse of masonry walls is an important issue for many older buildings and also in the seismic safety assessment of structures such as nuclear power stations. By sticking glass fibre matting to the surface of the walls their strength can be significantly improved to such an extent that some walls have survived every earthquake they have been subjected to on the shaking table at Bristol.

● Flood Risk Management Research Consortium

Approaches to limit disruption and damage from flooding have changed significantly in recent years. Worldwide, there has been a significant move from a strategy of flood defence to one of flood risk management. Flood risk management includes the use of flood defences, where appropriate, but also recognises that more 'managed flooding' is essential to meet goals for biodiversity and to sustain good ecological status in river and coastal systems.

In future, society will come to appreciate and value the positive benefits of the river and coastal 'flood pulses', while simultaneously developing improved coping strategies that will make communities resilient to the negative impacts of flooding. However, the success of this approach depends on integrating enhanced defences and warning systems with improved understanding of the river system and better governance, emergency planning and disaster management actions.

In future, society will come to appreciate and value the positive benefits of the river and coastal 'flood pulses'

Within the context of this vision of the future of flooding in the UK, the aim of the Flood Risk Management Research Consortium, with this department at Bristol as an active member, is to undertake an integrated programme of research to support effective flood risk management. This research will develop tools and techniques to support short term improvements in flood risk management in the United Kingdom and the training of the next generation of flood risk management professionals.

More details at: www.floodrisk.org.uk

Computer Science www. cs.bris.ac.uk

New £7 million Super computer facility opens

A new supercomputer facility, known as 'BlueCrystal', that will revolutionise research in areas such as climate change, drug design and aerospace engineering has just opened at the University of Bristol.

BlueCrystal is one of the fastest and largest computers of its kind in the UK, able to carry out more than 37 trillion calculations a second. The state-of-the-art system, provided as a result of collaboration between various companies including ClusterVision, IBM and ClearSpeed, enables researchers from a wide range of disciplines to undertake research requiring either very large amounts of data to be processed or lengthy computations to be carried out.


Timo Kunkel

'BlueCrystal' will revolutionise research in areas such as climate change, drug design and aerospace engineering

Dr Ian Stewart, Director of the University's Advanced Computing Research Centre, said: "Serious research in many disciplines can no longer be undertaken without High Performance Computing (HPC) and the University has recognised this through its investment in BlueCrystal. HPC-based research contributes significantly to University research income and will play an increasingly important role in teaching."

Dave Turek, WW Vice-President of Supercomputing at IBM, said: "The new supercomputer facility at the University of Bristol is an exciting development and we are delighted that the University has chosen to work with IBM to create this leading-edge infrastructure. Bristol is a world class facility with researchers leading work in some of the most significant areas of modern research."

Student final year project set to revolutionise the way we shop

A pioneering undergraduate from the Department of Computer Science is set to make finding exclusive and elusive fashion items easier, thanks to her innovative new website, Snap-Fashion. Jennifer Griffiths (right) has won the University's annual New Enterprise Competition 2009 with her eBay-meets-Facebook venture. Jenny is one of a long line of Bristol students to take the content of their final year project and form a new company from it.

Consumers will be able to visit the website www.snap-fashion.co.uk and upload an image of an item of clothing or an accessory that they wish to find. They will define the region of the image that they are interested in and the website will apply a number of image processing techniques to the picture in order to find approximate matches for the item of clothing. The website will act as a pictorial search engine for the latest fashions on the Internet.

Wired for sound

Lee Arromba, an undergraduate in the Department of Computer Science, has designed a computer controlled gesture recognition system to enable a live music performance that is driven by full body movement. He was inspired by a Bristol street performer to undertake a final year project that explored the potential for modern body-worn sensor technology to replace existing pedal and mixer systems to enhance a musician's live performance through real-time gesture recognition and control. The system combined the creation of bespoke capture hardware constructed from an array of worn accelerometers (the same digital technology found in the Nintendo Wii) which respond to full body movements with novel gesture-mapping and control software to manipulate audio output in real-time and add a new dimension to live music performance.

Beyond being an inventive and experimental undergraduate project the work posed a number of significant technical challenges in sourcing and creating the capture hardware and interfacing the sensor output to enable real-time capture and processing of audio streams. Lee first started working on midi manipulation using modern sensor technology, but as the project progressed, real-time input to the system became his focus and as a keen guitarist and musician, directed the work toward a live performance model - highlighting the potential for real-time sensor feedback to capture an artist's whole performance.

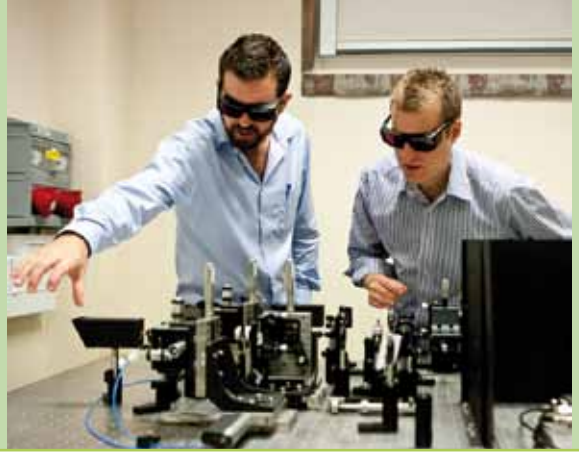
Lee entered the University's 2010 New Enterprise competition with the company Accelormatix and won £7,500 to develop the idea with a patent from Withers and Rogers LLP. Since graduating from the Department in July, Lee has now returned to Bristol to pursue his business and has recently created a marketable product from the research gathered in his thesis. Lee has also been recording using his system, and the results are exciting. Lee now hopes to develop his system so that he can make it readily available to performers and musicians. He is looking to collaborate with people with a passion for music and technology to help him take this idea forward. His goal is to enable musicians to become more expressive by capturing their entire performance and so to evolve a new style of music production.

Lee entered the University's 2010 New Enterprise competition with the company Accelormatix and won £7,500 to develop the idea with a patent from Withers and Rogers LLP.

Department wins bid to host High Performance Computing conference in 2011

The University of Bristol's Computer Science Department is to host Europe's largest high performance computing conference focusing on the emerging technologies of many-core parallel processors and reconfigurable computing.

The 2011 Many-core and Reconfigurable Supercomputing Conference (MRSC) will be chaired by Simon McIntosh-Smith, a world-expert in many-core parallel processing technologies and Senior Lecturer in the Computer Science department.



Electrical and Electronic Engineering www.bris.ac.uk/eeng

Carmel King

First-ever calculation performed on optical quantum computer chip

A primitive quantum computer that uses single photons travelling through a silicon chip has performed its first mathematical calculation. This is the first time a calculation has been performed on a photonic chip and it is a major step forward in the quest to realise a super-powerful quantum computer. The work, reported in the world-leading journal Science, was undertaken by a multidisciplinary team - including members of the Department of Electrical and Electronic Engineering - from the University of Bristol's Centre for Quantum Photonics. The Centre is housed in the new Nanoscience and Quantum Information (NSQI) building, which has levels of vibration amongst the lowest achievable anywhere in the world.

The chip takes four photons that carry the input for the calculation, and then implements a quantum program (Shor's algorithm) to find the prime factors of 15, and outputs the answer - 3 and 5. "This task could be done much faster by any school kid", said PhD student Alberto Politi who, together with fellow PhD student Jonathan Matthews (above, right, with Professor Jeremy O'Brien), performed the experiment, "but this is a really important proof-of-principle demonstration".

The team coupled four photons into and out of the chip using optical fibres. On the chip the photons travelled through silica waveguides that were brought together to form a sequence of quantum logic gates. The output was determined by which waveguides the photons used to exit the chip. By detecting the photons at the output of the device the researchers confirmed high-performance operation of the quantum algorithm.

Finding prime factors may seem like a mathematical abstraction, but it lies at the heart of modern encryption schemes, including those used for secure internet communication. The ability of quantum computers to simulate quantum systems may also prove to be a powerful tool in the development of new materials or pharmaceuticals.

Professor Jeremy O'Brien, Director of the Centre and research lead said that "this approach results in miniature, high-performance and scalable devices. The realisation of a quantum algorithm on a chip is an extremely important step towards an all-optical computer. The really exciting thing about this result is that it will enable the development of large-scale quantum circuits for photons. This opens up all kinds of possibilities". Alberto Politi expanded on these possibilities: "as well as quantum computing and quantum metrology, 'on-chip' photonic quantum circuits could have important applications in quantum communication, since they can be integrated easily with optical fibres to send photons between remote locations".

Bristol University's first entry into the international Aeolus Wind Powered Car Race

In June 2009, Garrad-Hassan (a leading wind energy consultancy firm based in Bristol) challenged the Faculty of Engineering to design and build an entry for the 2010 Aeolus International Wind-Powered Vehicle Race. This entry is the first ever submitted from a UK university team. Each competitor in the race must build a vehicle that can drive into the wind, extracting all of the energy used to drive it from that wind via a rotating turbine. Bristol students put together a design that is both novel and challenging.

The Electrical and Electronic Engineering department is internationally renowned in many research areas, including electric generators and motors - and the power electronics which are required to make them run efficiently. The design put forward for Bristol's Aeolus race vehicle proposed an all-electric drivetrain. Electric generators are coupled via an intelligent energy-management system and modern power electronics to high-efficiency electric motors. The combination of the electric generator and motors means that the vehicle effectively has an infinite and continuous range of gear ratios (or continuously variable transmission, CVT) linking the wind turbine to the driven wheels. The intelligent energy-management unit, based on micro-controllers, algorithms and power electronics designed and built by the students, selects the optimum gear ratio continuously, ensuring that the wind turbine always runs at its most efficient speed under the prevailing wind conditions.

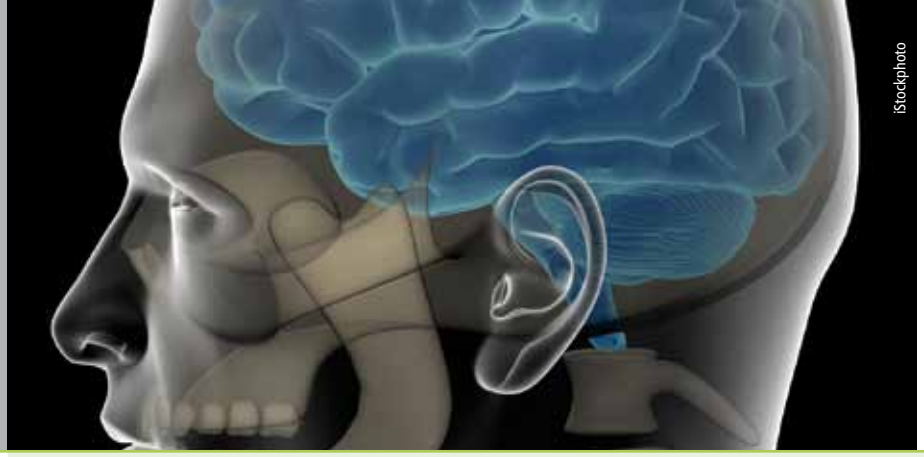
The Faculty of Engineering is very proud of this student-centred project. It was designed and largely built by a team of dedicated students from various departments across the Faculty, working alongside staff. This reflects one of the University of Bristol's strengths - interdisciplinary engineering.

"The Aeolus project is a fantastic example of students from different engineering disciplines working together to create something outstanding, and it is typical of our innovative students that they recorded two competition firsts: a twin rotor design, and a working electrical transmission system"

Professor Nick Lieven

The vehicle made its debut in the Aeolus race in September 2010 in Denmark. For more details and to find out how our car got on, visit: www.teambr1stol.co.uk.

Aeolus 2010 will provide the basis for many future teaching and research projects, whether it be future entries into the race, individual research projects in advanced control methods for efficient renewable energy generation, or as integrated features of other taught modules within our degrees.



Engineering Mathematics www.enm.bris.ac.uk

Mathematics for the 21st century

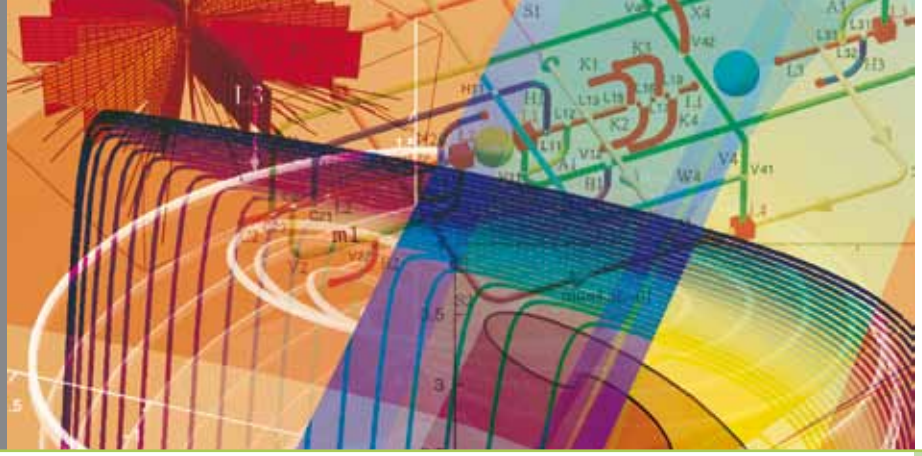
How can we predict when a patient is going to have an epilepsy attack and understand how to prevent it? Can we change the way traffic is managed and reduce accidents whilst at the same time increase traffic flow? Is it possible to predict where rivers will flood and save lives by optimally targeting emergency services? Engineering Mathematics graduates have the knowledge and problem solving skills needed to answer questions such as these, questions that have a direct impact on people's lives.

Engineering Mathematics graduates have the knowledge and problem solving skills needed to answer questions that have a direct impact on people's lives.

Engineering Mathematics is the development and application of advanced mathematical and computational techniques to modern engineering, science, information technology, management and finance. Mathematics lies at the core of all these fields, from the modelling of mechanical components to the analysis of genetic networks. As the complexity of technology increases we are learning that systems that seem straightforward at the design stage exhibit unpredictable and unstable behaviour when built. If we can apply mathematics at the early stages we can modify the design and suppress the undesirable characteristics. The key to meeting the technology and environmental challenges of the 21st Century is a detailed understanding of fundamental systems in the physical and life sciences combined with the application of state-of-the-art mathematical techniques.

The Engineering Mathematics Department is committed to teaching its students the very latest engineering and mathematical problem solving skills. Crucial to this success is the Department's focus on world-class research, which feeds directly into its courses and keeps them at the cutting edge of technological advances. In addition the department has extensive links with industry, which inform many aspects of its degree programmes. For example, all students take part in case studies that challenge them to use their own skills and knowledge to solve current engineering problems. This approach has been proven by members of the department being rated 3rd out of 46 Applied Mathematics groups in the UK (by Grade Point Average) in the latest Government Research Assessment Exercise. All students are taught by passionate and enthusiastic researchers who are world experts in their fields.

Engineering Mathematics graduates are also superbly employable. With highly marketable and transferable skills not always afforded by standard mathematics degrees our graduates are sought after by leading employers and pursue rewarding careers in industry, information technology, and academia. Over the past five years, every one of our graduates looking for work was employed within six months of leaving the university. More details at: www.enm.bris.ac.uk



● **Engineering Mathematics student scoops £1000 award**

For the second year in a row, a first year Engineering Mathematics undergraduate student has won the prestigious University of Bristol Alumni Academic Achievement Award.

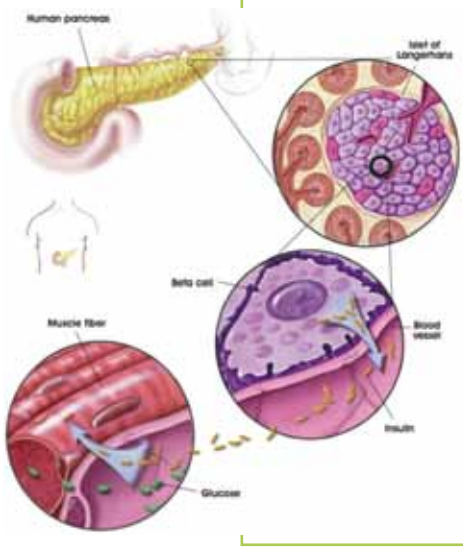
Following on from the success of Lars Knoop in 2009, Mini Lehmann was awarded the prize as one of the top two first year students (of over 500) in the Faculty. The Alumni Academic Achievement Award is a merit-based award, using funds donated by alumni and friends of the University, and is designed to reward academic excellence and help Bristol to retain the best students.

● **Engineering Maths student Gwendoline Huret reflects on a great summer project…**

"Having spent one of my 2nd year units working on the Hodgkin-Huxley neural cell model, I was excited to receive an EPSRC summer bursary. It meant I could dedicate two months to a project that would apply my modelling, mathematical, and biological skills, to something cutting-edge: modelling insulin secretion in pancreatic cells.

Why was this project so exciting? It was new, and I was working with specialists in the field. My supervisor, Dr Krasimira Tsaneva-Atanasova, was fantastic: we met almost every day to discuss my results and direction of the project, and she guided me whilst still letting me follow my intuition. She managed to make me feel like an equal, and encouraged creativity.

These two months involved reading as many journal papers as I could get my hands on, attending seminars on mathematical modelling in biology, getting my hands dirty by writing computer programs to calculate cell voltage or calcium concentration, and getting one-on-one advanced sessions on 3rd year topics that I needed to progress in my research. I thoroughly analysed several model systems, trying to reproduce the effects of a clamped voltage experiment. Finally, and most rewardingly, I successfully created a model whose results fitted real, recently published biological data. The great part is that I created equations that might one day play a role in the treatment of diabetes. These are the kind of conclusions one cannot reach in the classroom. Projects like the EPSRC summer bursary are what give students real working knowledge of their field".



iStockphoto

Mechanical Engineering www.bris.ac.uk/mecheng

The springboard to an array of great careers

The undergraduate (BEng and MEng) degree programmes in Mechanical Engineering are not just stimulating and challenging, they also provide a great launch-pad for careers in many spheres, including automotive, bio-medical, aerospace, chemical and process engineering, as well as less obvious areas such as information technology and management consultancy. Teaching blends the theory of engineering science with hands-on practical work, combining rigorous analysis with creative design and project work. We are proud to be one of only nine mechanical engineering departments in the UK to be rated as 'Excellent' for teaching.

Mike Lawn

Ben pursued a career in this area in the film industry, and won an Oscar in 2008 for his work on the hit film 'The Golden Compass'

Our one-year taught masters degree in Advanced Mechanical Engineering allows students to build on their first degree in two ways. Firstly, employers recognise the benefits that come from an increase in specialist knowledge. It also gives students an insight into research opportunities offered in the Faculty.

A great example of a Mechanical Engineering student from Bristol putting their skills to interesting use is Ben Morris. Ben was awarded funding by Jim Henson's Creature Shop production company for a final year project on the control of animatronic puppets. He pursued a career in this area in the film industry, and won an Oscar in 2008 for his work on the hit film 'The Golden Compass'.

A research-intensive Department

Research in mechanical engineering earns the department over £5 million each year, and numerous prestigious awards. The Department ranked in the top six in the 2008 Research Assessment Exercise.

The Design & Process Engineering Group

is developing a new pipe-cleaning technology based on 'ice-pig' slurries, working on a novel micro air vehicle and a dental simulator dubbed 'Dento-Munch' (see full story opposite), which has been reported in New Scientist.

The Dynamics & Control Group

has expertise in robust adaptive control algorithms and nonlinear dynamics. The group combines advanced analytical techniques with experimental testing to understand the dynamics of systems such as helicopter transmission and morphing wings.

The Solid Mechanics Group is pioneering work on the measurement of residual stresses in large complex components - this is especially important

in the power generation industries. The group is developing the 'total focusing method' for ultrasonic arrays that has allowed significant improvements in defect imaging in engineering components.

Dr Kazem Alemzadeh writes about his research in biomechanics

Many aspects of biological systems are mechanical in nature. Studying biological systems gives me an understanding of biomechanics and leads to ideas for new products, development of better diagnostic procedures and improvement of medical and rehabilitation devices. Dentistry is one area of medicine where the biomechanics of a human (e.g. chewing) can be studied to improve patient care. The UK spends £2.5 billion each year on dental materials to replace or strengthen teeth. Lack of an adequate method of field testing is hindering dental development.

Despite the frequent use of metals, polymers and ceramics for tooth restoration, properties such as modulus of elasticity, flexural strength, hardness, wear and fatigue are often poorly understood. Without this knowledge the likely long term performance of the materials cannot be judged. Randomised clinical trials are time-consuming and expensive, and by the time a new material has been evaluated the market has often moved on. Current laboratory simulators utilise only 2-3 degrees-of-freedom (DOF) and are unable to reflect true clinical performance. Indeed, results from different simulators are often inconsistent. I therefore invented a Dental Robotic Testing Simulator called "Dento-Munch" to act as a surrogate mouth with 6-DOF to emulate the human neuromasticatory system, which via feedback control of the robot actuators, will accurately replicate the forces and dynamics sustained by the teeth in-situ.

"The design inspiration is based on a human skull (for the structure), a spider (for the general look) and an aircraft simulator (for the dynamics and control of chewing)"

Kazem Alemzadeh

It was necessary to study and analyse the biomechanics of human mastication in order to design a bio-robot that could accurately mimic human chewing. The design inspiration is based on a human skull (for the structure), a spider (for the general look) and an aircraft simulator (for the dynamics and control of chewing).

The potential and merit of the Dento-Munch is reflected by a patent in the US, publications in New Scientist and Medical Engineering Journal, and inclusion in the Royal Society Summer Science Exhibition in London (July 2009).

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