UNIVERSITY OF CAMBRIDGE
Department of Engineering

Newsletter

Issue 9 | Spring 2010

Professor Dame Ann Dowling the new Head of Department

Ann Dowling was previously Head of the Energy, Fluid Mechanics and Turbomachinery Division here at the Department and Director of the University Gas Turbine Partnership with Rolls-Royce.

Professor Dame Ann Dowling was the UK lead of the Silent Aircraft Initiative, which gained a high international profile. This was a collaboration between researchers at Cambridge and MIT who have released the conceptual design of an ultra-low noise and fuel efficient aircraft, SAX40. Ann works primarily in the fields of combustion, acoustics and vibration and her research is aimed, in particular, at low-emission combustion and quiet vehicles. She has held visiting posts at MIT (Jerome C Hunsaker Visiting Professor, 1999) and at Caltech (Moore Distinguished Scholar 2001).

Ann is a Fellow of the Royal Society, Royal Academy of Engineering (Vice-President 1999–2002) and is a Foreign Associate Member of the US National Academy of Engineering and of the French Academy of Sciences. She serves on a number of industry and government advisory committees, and chaired the EPSRC Technical Opportunities Panel (2003-06), the Royal Society/Royal Academy of Engineering study on nanotechnology and the Engineering Panel in the UK 2008 Research Assessment Exercise. She was appointed CBE for services to Mechanical Engineering in 2002 and DBE for services to Science in 2007.

Ann is looking to the future and says, "The world faces an unprecedented set of challenges. It must: regenerate its economies; mitigate climate change; and build resilience to the effects of climate change and a wide array of other threats. Engineering is critical to success in all these areas. My predecessor, Professor Keith Glover, led the Department for seven years though a period of strong growth and tremendous academic success. My aim is to use our position as a global hub for engineering excellence to maximise the impact of our academics and our students in addressing the major challenges with engineering solutions. This means winning investment in these difficult times for building capacity, infrastructure and global connections."

In this issue

An integrated engineering department founded on core strengths spanning all engineering disciplines and also cross-connected by three strategic themes:
- **Cognitive Systems Engineering**
- **Engineering for Life Sciences**
- **Sustainable Development.**

www.eng.cam.ac.uk

Pilkington Prizes honour teaching excellence

Twelve of the University's very best teaching talents have been honoured at the annual Pilkington Prizes awards ceremony.

This year's leading lights include pioneers of visual and oral archive as historical sources and developers of fresh and acclaimed new courses and qualifications. One of the winners is Dr Matthew Juniper, Senior Lecturer in the Department of Engineering Energy Group. A gifted and dedicated teacher, he's been at the forefront of adopting new technology to animate his lectures on fluid mechanics. It's largely due to his efforts that the popularity of fluids as a specialist area for students has grown significantly in recent years. He developed a new type of online resource to supplement his lectures and clarify difficult aspects of the course.

This year, as part of the University's 800th anniversary celebrations, all winners of the first Pilkington Prizes were invited to join the 2009 nominees for a dinner at Murray Edwards College, along with Cambridge Foundation Trustees past and present, students, University representatives and members of the Pilkington family.

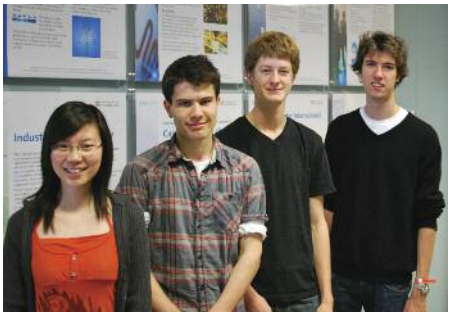
The Vice-Chancellor, Professor Alison Richard awarded the prizes.

The Pilkington Teaching Prizes were established in 1994 by businessman and alumnus of Trinity, Sir Alastair Pilkington during his term as Chairman of the Cambridge Foundation. The aim is to ensure that excellence in teaching at the University is given proper recognition.

Dr Matthew Juniper, back row, first from left, with the other Pilkington Prize winners.

Winners of 'Engineer in Society' essay competition

Prizes have been awarded to four first year engineering students to acknowledge the very high quality of the essays submitted for this year's 'Engineer in Society' module.



Winners of 'Engineer in Society' essay competition

Nominations for prizes were put forward by the Department's PhD students and teaching assistants who each year mark the c300 essays submitted. The large number of nominated essays were then filtered by the course lecturer, Tim Minshall, to pick the four best essays. Amazon tokens were awarded to Menglin Wu, Matthew Graham, Felix Sampson and Harry Tayler who had submitted essays regarded as outstanding by the markers.

- Felix Sampson: What do the current challenges facing Formula 1 teach us about the governance of engineering organisations?
- Harry Tayler: How do the Global Economic Conditions Affect the work of Practising Engineers?
- Matthew Graham: How can governments and engineers work together to address the challenges of environmental sustainability?
- Menglin Wu: Ethics and Engineering Lessons from the Repair of Citigroup Center and the Challenger Disaster

An additional prize was awarded to the winning and runner-up essays on Formula 1. Tony Purnell (former head of Jaguar F1 and Red Bull F1, now consultant to the FIA and visitor to the Department) took them out to lunch to discuss the current challenges facing F1.

PDFs of the winning essays can be downloaded at: www.eng.cam.ac.uk/news/stories/2009/ essay_winners/

For more information, contact Tim Minshall: tim.minshall@eng.cam.ac.uk

Department of Engineering working in partnership with e-Go aeroplanes LLP

Two fourth year students at the Department of Engineering are working with e-Go aeroplanes LLP to create an aircraft that pushes the boundaries of design; not only high performance, but also very low weight and good fuel economy.

The Engineering Department is a centre of excellence in aeronautical engineering, in particular, aerodynamics. Both students are working on the aerodynamic qualities of the design as their fourth year project.

Tom Shearn of Fitzwilliam College is being supervised by Dr Holger Babinski.Tom is using the low speed wind tunnel to test a quarter-scale model to look at stall effects at low speeds with the aim of creating an aircraft that is very safe.

Mark Wolfenden of Churchill College is being supervised by Professor Bill Dawes. Mark is working in parallel with Tom using the most advanced computer techniques to analyse the same design. Both students are then comparing their results which gives them a direct comparison of the two approaches as well as helping to improve the overall design of the aircraft in the future.

"Tom and Mark at the Engineering Department have provided us with vital data on the aerodynamics of e-Go that has helped us improve its design. They've made a very significant contribution to the project," said e-Go creators Tony Bishop and Giotto Castelli.

e-Go was started by Giotto and Tony who both live in Cambridge and work with a group of volunteers who are helping on the project. It was started as the result of a new deregulated class of aircraft announced by the Civil Aviation Authority, and won a design competition run by the Light Aircraft Association. It is a single seater aircraft that weighs less than 115kg, but flies at over 115mph.

The stabiliser is at the front, which prevents stalling and minimises weight. The two projects optimised the aerodynamic interaction between the canard and the wing.

More information about the e-Go project, including ways in which you can get involved, is available on the company website: www.e-go.me/

Best turbomachinery paper award

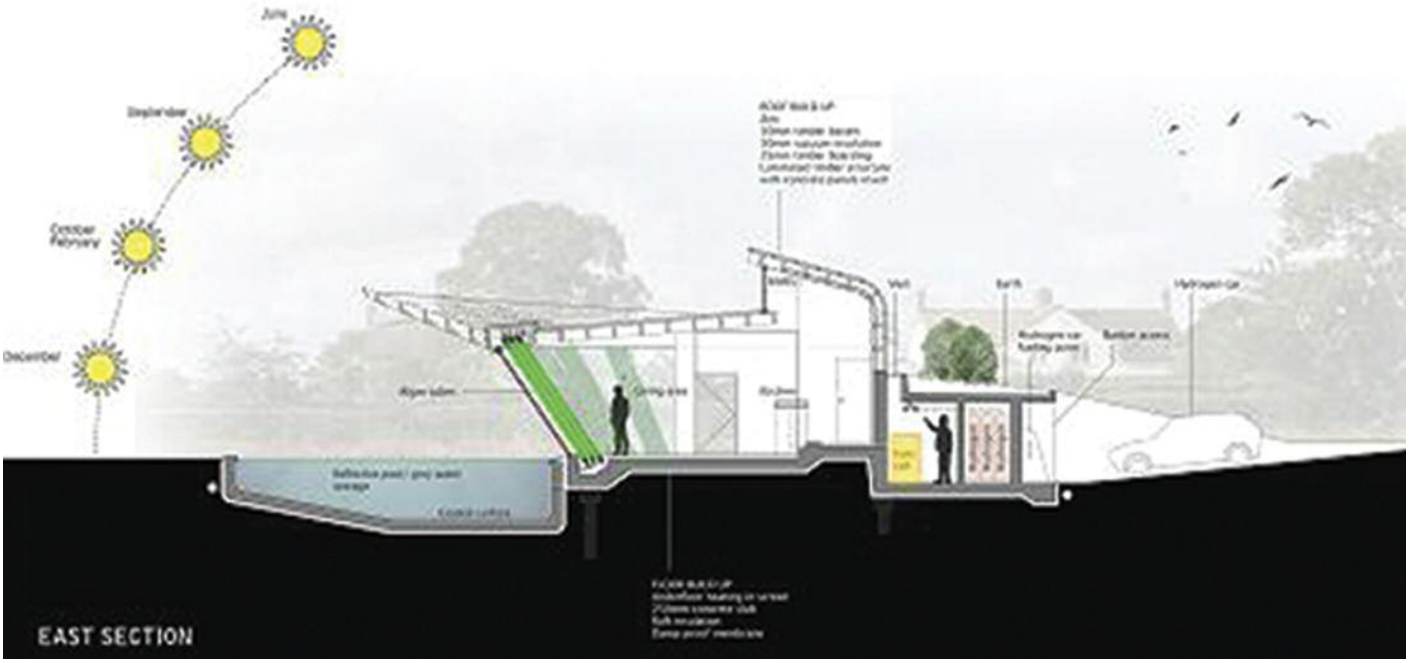
A 2008 best paper award of the American Society of Mechanical Engineers (ASME) and the International Gas Turbine Institute (IGTI) Turbomachinery Committee has been made to Dr Jonathan Ong and Dr Robert Miller.

Dr Ong is a Senior Research Fellow and Dr Miller is Reader in Energy Technology at the Department's Whittle Laboratory. The work was undertaken as part of Dr Ong's PhD thesis supervised by Dr Miller. The winning paper is entitled "Hot Streak and Vane Coolant Migration in a Downstream Rotor". The paper can be found on Robert's webpage: http://cambridge.academia.edu/RobertMiller

The aim of the project, sponsored by Mitsubishi Heavy Industries, was to increase the efficiency and durability of the industrial gas turbines used in power stations. Higher efficiency can be achieved by increasing the operating temperature of the turbine by improving the effectiveness with which the turbine blades are cooled. In the project an improved cooling effectiveness was achieved by exploiting the unsteady flow within the machine to carry coolant directly to high temperature regions of the blade surface. The originality of the work lies in the fact that it represents the first time that cooling air ejecting from a stationary blade row has been used to specifically target high temperature regions of a downstream rotating blade row. Exploitation of this understanding was then subsequently used to design a new cooling configuration which achieved the same cooling effectiveness as the original design while using one sixth of the cooling flow.

Students' "Algae House" wins international design competition

A design for a house powered by living algae, drawn up by students at the University of Cambridge, has won a prestigious international competition.



A larger version of this image can be found on the team's poster at: www.eng.cam.ac.uk/news/stories/2009/algae_house/SASBE%20poster_submitted_pg1&2.pdf

The student team included two students from Engineering; Ben Sheppard and Oliver Hudson along with students from the Department of Architecture; Karuga Koinange, Chris Bowler, David Valinsky and Daniela Krug.

The project is part of the Architectural Engineering module, a joint course wherein final year and graduate engineers and architects work together in multidisciplinary teams to develop innovative, sustainable, low-energy designs for buildings. The module is taught by Allan McRobie from Engineering and Michael Ramage from Architecture.

The "Algae House", which it is believed could provide a model for future energy-efficient living, would use the hydrogen and bio-mass created by the cultivation of algae as a renewable source.

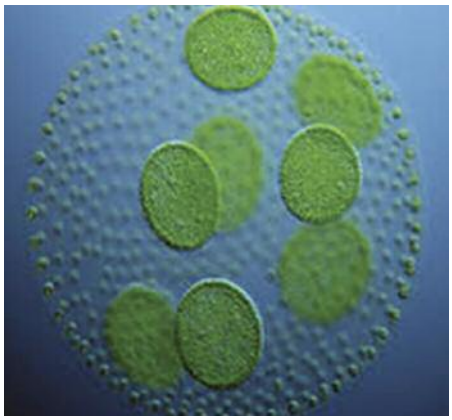
The house design was awarded first prize in an international design competition run by the 3rd CIB International Conference on Smart and Sustainable Built Environments. A great result from multidisciplinary work.

The competition challenged students to propose a concept of a small home that produces enough sustainable energy to equal out energy consumption.

The winning team, called "Algaetecture", created the blueprint for a house using in-built algae tubes, and a photo bio-reactor, to generate hydrogen. A glazing system and water pool are incorporated into the design to mitigate – reflect and cool – the sunlight the algae need to thrive. It is estimated that the house would produce 4100 KW/h of hydrogen and bio-mass per year – enough to drive an electric MINI E car from London to Beijing and back twice over.

"Algae and people may not present themselves as obvious bedfellows, but through this project we hope to show that the integration of algae as an energy generator within a house is not only feasible, but that it opens up many exciting architectural possibilities for green living," Karuga Koinange, from the Department of Architecture, said.

The competition, held at Delft University of Technology in the Netherlands, was organised and sponsored by the International Council for Research and Innovation in Building and Construction

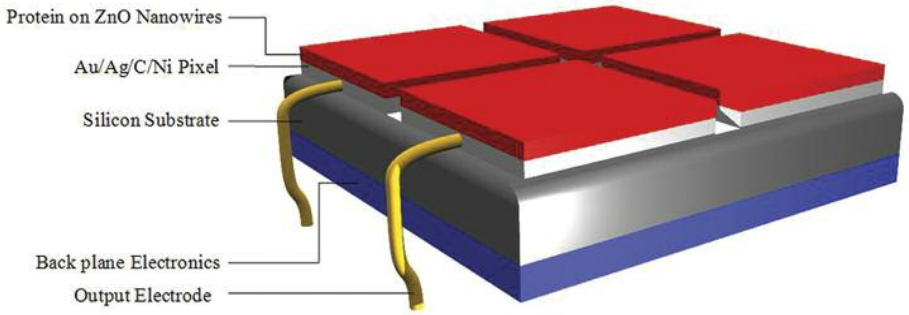


(CIB), the Passive and Low Energy Architecture association (PLEA) and the International Initiative for a Sustainable Built Environment (iiSBE). The students presented their work throughout the week-long proceedings to a variety of conference attendees, including the Dutch Crown Prince, Willem Alexander, who highly commended the concept.

For more information on the winning 'Algae House' design please visit www.algaetecture.com.

A Sensory World. Novel Sensor Technologies

Ranjith Rajasekharan and Aron Rachamim from Electrical Engineering and Justin Pahara and Safwan Akram from the Institute of Biotechnology are winners of the first round of an Innovation Competition run by CamBridgeSens. Awards of up to £5000 are offered to teams of interdisciplinary researchers to make the first steps in putting together or trying out novel ideas in the area of sensor research, ideas that will shape the future of sensing technologies.



Schematic representation of the proposed sensor

Electrical sensors are devices that convert a physical parameter such as room temperature, blood pressure or wind speed into a signal that can be measured electrically. They are used in everyday objects such as touch-sensitive lift buttons and lamps which dim or brighten by touching the base. There are also innumerable applications for sensors of which most people are never aware. Applications include cars, machines, aerospace, medicine, manufacturing and robotics.

From self-parking cars to diagnostic tools for cancer, sensor technology is shaping our future. Indeed, some claim that sensors will change our world in this decade in the way microprocessors did in the 1980s and the Internet in the 1990s. Sensors are big business.

The award-winning team summarise their project: "We propose a novel sensory technology to detect light using proteins integrated with suitable conducting micro- and nano-structures. Presently, commonly used sensory technologies rely on non-biological components as these are more predictable and can be reproduced easily. Although using biological components is a challenge, the potential advantages are that they have higher sensitivity and specificity.

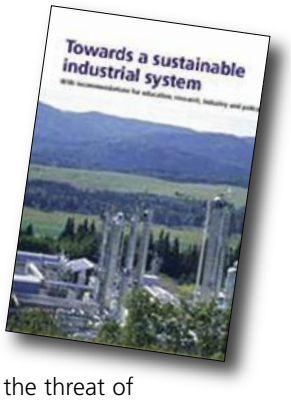
"Use of high quality micro- and nano-structures as electrodes will allow us fully to exploit the potential for increased sensitivity of these protein sensors because of their small size and high surface to volume ratio. There is a ready-made market for photo-detection technology in products from mobile phones to digital cameras to solar panels. Enhancing sensitivity in photon detection will improve the quality of these products.

"By implementing protein-based photon absorption, we can potentially decrease pixel sizes to nano meter range which is far less than the current 6 x 6 µm pixels. The protein that we are using is capable of harnessing light and converting that energy to electron movement. Similarly, using the same electrode design but with different protein species, we can begin to image chemical reactions in two dimensions on electrodes. The proposed project is to generate truly novel sensory technology, which when successful, can also be used to generate clean energy. In this technology we are essentially harvesting electrons from proteins in order to "sense" our environment. Perhaps by optimizing and increasing the size of the device we can harness large amount of electrons very efficiently and thus use this technology for renewable energy.

Ranjith Rajasekharan is under the supervision of Dr Tim Wilkinson, Aron Rachamim is under the supervision of Dr Andrew Flewitt all from Electrical Engineering, and Justin Pahara and Safwan Akram are under the supervision of Professor EAH Hall from the Institute of Biotechnology.

Call to drive the next industrial revolution

Industrialists, academics and government should join forces to drive a new industrial revolution which would help tackle climate change, says a new report.



The authors of Towards a Sustainable Industrial System are calling for an industrial equivalent of the human genome project in order to help business address the threat of global warming. Some of the world's leading manufacturing experts have combined to produce the report, published by the Department's Institute for Manufacturing (IfM).

The ambitious venture aims to understand how essential elements of industrial systems – resources, processes and organisation – could be integrated to reduce environmental impacts while maintaining acceptable standards of living without damaging the planet.

A global co-operative research effort would provide an opportunity to pool expertise in industrial design, production research and regulation.The project would help speed change through the rapid sharing and application of environmentally-sound manufacturing practices as well the systematic development of new green technologies and approaches.

The report's authors are Professor Mike Gregory of the IfM, Professor Steve Evans of Cranfield University, Professor Margareta Norell Bergendahl of the King's Technical School, Sweden and Professor Chris Ryan of the University of Melbourne.

The report is designed to highlight the benefits and opportunities which can flow from a more integrated approach to industrial sustainability. It can be downloaded at: www.ifm.eng.cam.ac.uk/sis/

Cambridge Manufacturing Engineering Design Show 2009

Manufacturing Engineering students at the Department's Institute for Manufacturing held their 2009 Design Show at the end of the summer term, displaying a range of new products that they have developed as part of their course.

Over the last year teams of three or four students have completed a major design project to develop a new product with real business potential. Having first identified a customer need they have researched the market, developed original design concepts and created a full business plan.

The Design Show is held each year for an invited audience of local industrialists and designers. Students put together displays to explain the technical and business ideas behind the products, together with design details and prototype models of the products themselves.

Design projects

The Pod – a rocking chair with sensory-limiting technology to calm autistic children.

The Pod has been developed with input from the Cambridge University Autism Research Centre (ARC) and a special autism school in London. Approximately one in 100 people in the UK experience autism. The Pod induces calm via a relaxing rocking motion and by limiting external sensory stimuli. The Pod is fully insulated and uses a careful dome-shaped design to limit peripheral vision and lower noise levels.

Pod Team: Harry Bullivant, Clare Stevenson, Camilla Winfield

The Pod is primarily designed for use in schools. By calming the children they will be more receptive to teaching methods. The Pod has the potential to revolutionise the teaching environment: traditional classroom layouts result in a sensory overload. This offers a calming retreat for children with Autistic Spectrum Disorders (ASD). The Pod results in a more dynamic and flexible learning environment for the benefit of both staff and students.

ARK-Angel – an avalanche rescue kit that dramatically increases an avalanche victim's chance of survival.

Ark Team: Gosia Cholast, Phil Deakin, Pan Demetriou

ARK-Angel is designed for use by skiers caught in an avalanche and provides a method for breathing and being located once trapped under the snow. This dual rescue function, coupled with low cost of ownership, positions it uniquely in the off-piste skiing equipment market. Its integration into a rucksack allows the user to carry other complementary safety kit – such as shovel and probe – while the simplicity of the mechanical mechanism makes it suitable for transport by air.

EazyFeed – a device for lowering and raising pet feeding bowls.

The EazyFeed is an automated device for lowering and raising food and water bowls for cats and dogs. It is targeted at the many thousands of elderly and disabled people in the UK who find the task of feeding their pet a challenge. EazyFeed attaches onto a kitchen unit, and at the push of a button, transports a food and water tray from counter height to floor

EazyFeed Team: Ben Wilson, Sophia Wardley, Kathryn Fox

level, and back again. It prevents the user from having to bend down to provide food and water to their pet, yet allows them to retain some independence in caring for the pet. The tray can be easily detached to facilitate cleaning. EazyFeed has been designed for ease of manufacture, with considerable attention paid to the design detail, materials and number of components.

SolarStore – Solar-powered cold storage for hot places without mains electricity.

The SolarStore is a novel cold storage solution for off-grid locations. It differs from traditional refrigeration systems in that it uses the sun's energy as a power source. Millions of households throughout the world lack grid electricity and would benefit from the ability to store perishable items without connecting to the grid. This product offers a sustainable and economical means of keeping food cold, preserving its life and reducing waste.

The SolarStore refrigerator is powered by a solar collector which concentrates the sun's electromagnetic radiation to heat a pipe of water. The boiling water then drives

SolarStore Team: Gareth Keeves, Anna Spinks, Lucy Browning

an ammonia diffusion absorption refrigeration cycle, cooling the unit. With minimum running cost and low maintenance requirements due to a lack of moving parts, we expect the product to be a success, particularly in developing countries.

ShoulderPad ™ – A safety system to encourage motorists who break down on motorways to leave their vehicle.

Annually there are over one million breakdowns on the UK motorway system, with up to 250 serious injuries or fatalities whilst stationary on the hard shoulder. ShoulderPad ™ could help to prevent this by encouraging motorists to leave their car.

Developed in consultation with the The Highway's Agency, Survive and the Transport Research Laboratory,

ShoulderPad ™ Team: Clement Lau, Georgina Rose, Shiv Sama

ShoulderPad ™ is a hard shoulder safety system that aims to create a comfortable environment, away from the dangers of the motorway, giving the driver more incentive to leave their car. It includes equipment required to provide warmth, shelter, visibility and protection from the dangerous motorway environment. The key element is a pop-up shelter – a temporary base for the motorist, deployable in seconds.

Sanditiser – An economical solution to providing clean water in developing countries.

Sanditiser Team: Alex Slinger, Amanda Scott and Ying Jiang

More than a billion people do not have adequate access to clean water and this contributes to the extremely high rates of infection and disease in parts of Africa and Asia. The Sanditiser is a slow sand filter that cleans water collected from rivers or other sources and removes slime, sediment, pathogens and microorganisms. It consists of a column of sand and containers for both dirty water and clean, post-filtered water. It works due to a natural bacterial layer that forms on the surface of sand (called Schmutzdecke). This layer attacks bacteria in the water, removing 100% of most pathogens, and leaving the water substantially cleaner.

The Sanditiser is a step towards helping to solve the global water problem. It provides an economical solution, unique from competitors due to its flat-packable design (considerably reducing transportation costs), ease of on-site assembly, and development of locally sourceable components, enabling repairs and maintenance. If distributed to the place of need the Sanditiser could save and improve many lives.

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gym-arm – an exercise prosthetic for amputees.

Both cosmetic and functional upper limb prosthetics are readily available to amputees from their local prosthetics centre. However, none of these is suitable for exercising effectively. Alternatives do exist in the form of high performance or tailored prosthetics but these are all too often prohibitively expensive.

Amputees rely on their local centres to 'botch something together' in order to meet any special needs or requirements. Current options include strapping sandbags on to their residual limb as a substitute for weights, or using a paddle-like attachment to go swimming. In both cases, since the loads applied are limited, they perform high repetition exercises that are generally associated with muscle definition instead of development.

This design for an affordable prosthetic

Gym-Arm Team: Stefan Kouris, Livia McBride, Rupert Wingate-Saul

arm enables trans-radial amputees to use conventional gym equipment. It provides a functional prosthetic limb to allow upper limb amputees to perform a range of exercises in a standard gym, in order to combat muscle wastage on the side of the body with the amputation. It offers a secure interface with gym equipment and transfers forces comfortably for effective exercising.

For further information contact:
Rob Halden-Pratt
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Institute for Manufacturing
Tel: 01223 748266
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Electric aircraft take to the air

On the 1st of March 2009, a pair of electric aircraft had simultaneous maiden flights at Sywell Aerodrome near Northampton.

Test pilot Paul Dewhurst (left) with Dr Paul Robertson, who designed and built the electric propulsion system for the Lazair microlight. Photo credit David Bremner, editor of Microlight Flying magazine

These are the first electric aircraft to fly in the UK under the recently introduced sub-115 kg regime, which allows single seat, lightweight aircraft to be developed and flown without the administrative burden of the airworthiness approvals process applied to larger aircraft. This class was introduced to encourage innovation in light aviation in the UK.

The electric propulsion system for the twin-engine, fixed-wing Lazair airframe of Canadian origin was designed and built by Dr Paul Robertson of the Engineering Department, in collaboration with Paul Dewhurst of Flylight Airsports Ltd, a Midlands based manufacturer and importer of microlight aircraft. The hang-glider (flex-wing) based Dragonfly trike unit, made by Flylight, was powered by an electric motor system being developed in Germany. The electric aircraft have flown for around 30 minutes on a single charge, reaching an altitude of 1700 ft.

The E-Lazair propulsion system comprises a pair of 10 kW peak, brushless electric motors, weighing less than 2 kg each, with direct drive to carbon fibre propellers. The motors are each powered by a stack of 12 large capacity (40 Ah) Lithium Polymer (LiPo) cells, giving a total stored energy capacity of 3.2 kWh. A bespoke Battery Management System (BMS), charger unit and avionics were developed by Dr Paul Robertson to monitor the energy capacity and temperature of the LiPo cells, control the motor power and temperature and provide the pilot with a 'fuel gauge' to indicate remaining capacity. Each of the 24 LiPo cells are individually monitored and charge balanced to maintain optimum capacity and cell lifetime.

These developments are the first steps towards a new class of leisure aircraft offering low operating costs, high reliability and low environmental impact – on both carbon footprint and noise issues. Observers on the ground commented on the very low noise levels and the pilots noticed a significant decrease in both noise and vibration, when compared to petrol engine alternatives.

Flight tests using the existing Lazair airframe will continue, to characterise and develop the electric propulsion system, although substantial increases in the flight duration and range can only be achieved through a custom-built airframe, encompassing the new design opportunities available through electric propulsion. These will include such factors as being able to distribute the mass of the propulsion units and energy storage around the airframe – there is no longer a need for a relatively large, heavy engine in one location, with its attendant structural bracing adding yet more weight. The potential of hybrid fuel options are also being considered. A flight duration of 2 hours and a range of 100 miles are being targeted and sponsorship is being sought to help achieve these objectives.

The E-Lazair electric aircraft and the E-Dragonfly hang-glider, low level flypast in formation at Sywell Aerodrome. Photo credit David Bremner, editor of Microlight Flying magazine

For further information please contact Dr Paul Robertson: par10@hermes.cam.ac.uk

Helen Makey has won a 6 month internship with Renault F1

Helen Makey a graduate in Mechanical Engineering won a competition for a six month internship working at the Renault F1 factory and joined the F1 team for her placement in September.

Helen was a team leader in Full Blue Racing for the Formula Student competition and has a passion for karting and road rally events. Fittingly, her Masters project was in collaboration with the Fédération Internationale de l'Automobile (FIA) and dealt with moveable aerodynamics.

The final of the 2009 Altran Engineering Academy (AEA) competition took place at the ING Renault F1 Team's Technical Centre in Enstone, England. 22 year-old Helen crossed the finish-line first with her project aimed at enhancing energy efficiency using moveable aerodynamics.

Following in the footsteps of her predecessors from the UK, Spain, Sweden, the Czech Republic and Brazil, Helen will commence her placement working in the Research and Development department of the Renault F1 Team under Dr. Robin Tuluie, the department head. Salary, accommodation and a Renault company car will be part of the well-earned prize offered by Altran, Total and ING Renault F1 Team.

After hearing her name called out as the winner, Helen said: "To win this competition is a dream come true. The chance to be part of the Renault Team is very special and provides me with an excellent opportunity to put my studies into practice in the dynamic world of Formula One. I'd like to thank Altran, Total and or course the Renault F1 Team for giving me this chance."

Helen Makey

The eight other candidates from Brazil, Czech Republic, France, Germany, Italy, Netherlands, Spain, and Switzerland also impressed the jury.

After announcing the winner, Robin Tuluie confirmed his heartfelt support for the AEA: "After six years I continue to be impressed by the quality and the level of thought these young engineers bring to the competition. Their passion and ideas are inspiring and I am proud some of them will have the opportunity to fulfil their dream with Renault F1 Team."

Philippe Girard from Total commented: "It has been inspiring to see the commitment of all participants. Young talent is essential to the science of energy and it is encouraging to know that we can count on such quality and enthusiasm for the future of our research."

Founded in 2004, the Altran Engineering Academy is a unique initiative with a clear goal: giving young talent a chance. Formula One is a notoriously closed world where it is often extremely difficult for talented young engineers to get their break. In line with the ING Renault F1 Team's commitment to open up Formula One at all levels, and underlining Altran's commitment to engineering talent, the AEA was founded as a 'star academy' with the goal of giving young engineers the chance to prove themselves at the highest level. The result has been a runaway success, with more than 1000 young engineers entering detailed technical projects in the competition since 2004. Helen Makey is the sixth winner of the AEA.

Helen with the eight other candidates

Altran Engineering Academy's website: www.altran-academy.com

Nokia demonstrate new technology at the Department

Matt Johnson, a PhD student (2004-2008) who was supervised by Professor Roberto Cipolla, now works for Nokia Point & Find.

Point and Find barcodes

Roberto invited Matt back to the Department earlier this year to demonstrate the Nokia Point & Find product. Matt demonstrated a realtime, fully working implementation and demonstration of an algorithm that he and Roberto had developed in 2004 which is now commercially deployed on Nokia handsets. Matt said 'I really enjoyed presenting our product to the students and discussing some of the underlying concepts behind mobile computer vision, and was encouraged by their enthusiasm for the material.'

Roberto said about the day, 'the students really enjoyed seeing the theory of the course they were being taught being brought to real life by Matt's realtime demo.'

The Nokia Point & Find is a new way to connect with information and services on the go, the service marries the digital world with the physical world. The new platform enables businesses to engage with consumers in real time with relevant content. Point & Find enables people on the move to access relevant information and services on the internet, simply by pointing their mobile phone camera at real-life objects. A beta version of Nokia Point & Find, focusing on movies, is now available in the UK and US. Capabilities will later expand into other services and countries. "We believe that this first Nokia Point & Find-based service for movies will add something special to the cinema experience. Simply by pointing their camera phone at a poster for a new movie, people can watch the trailer, read reviews, and find the closest cinema where it is playing," said Philipp Schloter, General Manager, Nokia Point & Find.

Nokia Point & Find is an open service platform on which other companies can build customised experiences for their potential customers.

Nokia Point & Find uses advanced real time image processing and recognition technologies to link the user to digital content and services. It also recognises bar codes, integrates GPS positioning technology, and supports category-specific text-entry search. When the phone is pointed at an object, Nokia Point & Find uses a variety of the phone's capabilities including the camera, internet connectivity, and GPS positioning to evaluate the object. Then, by rapidly searching through a database of virtually tagged items, the system identifies the object and returns a set of links to associated content and services.

The origins of the Point & Find technology: www.eng.cam.ac.uk/news/stories/new_scientist.shtml and www.wtn.net/2004/bio378.html
The Point & Find website: http://pointandfind.nokia.com

Violin makers at the Department

A week-long conference and workshop at the Department in September 2009 brought together scientists and violin makers to explore the ways in which science can help with understanding, documenting and enhancing the performance of violins.

The meeting was attended by makers (most of them seen in the photograph) from the UK, USA, Sweden, Iceland, France and Germany. The participating scientists covered a similarly wide range of countries, and also of disciplines: departments of mechanical and electrical engineering, computer science, physics, mathematics, psychology and music were all represented, together with medical hearing specialists and scientists from industry. Very intense and rewarding discussions, presentations and experimental sessions filled the week.

The meeting was organised by Professor Jim Woodhouse, who commented: "This meeting highlights the multidisciplinary nature of musical acoustics, and also a culture change which has happened over the last 30 years. Back then, the violin world was much more secretive and the instrument makers who engaged with scientists were regarded as being on the fringes. This time we had some of the world's leading makers in attendance, and we heard top-class research presentations from makers as well as scientists, in roughly equal numbers. Although it has become very hard to attract funding for academic research in this subject, there is a lot of exciting work going on and we all look forward to a follow-up meeting in a year or two."

Professor Jim Woodhouse: www2.eng.cam.ac.uk/~jw12/
email: jw12@cam.ac.uk

Full Blue Racing return with Silverware

Full Blue Racing, the Cambridge University Formula Student team, have returned from the Formula Student event in Hockenheim, Germany.

Despite technical complications on the track, the team secured 2nd place overall in the cost event at the competition out of 89 entrants.

After successfully passing all the scrutineering from the judges, the team then struggled with an engine that did not want to start. Progress was hindered by one of the team's tuning experts getting stranded in Belgium! Whilst dynamic events continued to cause headaches, the team took the opportunity to shine in the static events where business, manufacturing and budgeting skills are tested by panels of judges.

Amongst an exceptionally strong field the team was pleased with 39th place in the business event (a Dragon's Den style pitch to investors, of the team's plans to sell the car as a weekend racer), and overjoyed to achieve 2nd place in the cost event.

The cost event tests the team's ability to design, manufacture and assemble a racing car on a budget. Judges look for consideration of batch manufacture and mass assembly from the design phase right through to the assembly stage, with the teams entering a comprehensive dossier of costs associated with every part of the car – from the CNC machined aluminium uprights to every last nut, bolt and washer. At the competition the team discussed the dossier with the judges, using the actual car for reference, before presenting on a 'deep dive' topic – normally relating to cutting costs or considerations of moving to mass manufacture.

The team returned on the 11th August and immediately work started on the 2010 car. This is now well into the conceptual design stage, with suspension kinematics and packaging to be developed into the new term.

As part of the drive to make another step in 2010, Full Blue Racing is looking for new partners to support the development of the team and car over the next year. If you are interested, please visit: www.fullblueracing.co.uk or email: getmore@fullblueracing.co.uk

Multi-million pound grant boosts Ink-jet research

Industry could soon be producing complex electronics and hi-tech gadgetry simply by pressing the print button.

A consortium, led by the University of Cambridge, has been awarded a multi-million pound grant to investigate how ink-jet print technology could revolutionise manufacturing processes. The group, headed by Professor Ian Hutchings of the Department's Institute for Manufacturing (IfM), has been awarded £5m by the Engineering and Physical Sciences Research Council (EPSRC). The consortium comprises collaborators from two other Cambridge departments, the Universities of Durham and Leeds, and a group of nine companies which include the major UK players in the ink-jet sector.

The £5m award, with additional funding from industry, will support a five-year programme of research to study the formulation, jetting and deposition of specialist printing fluids, and develop an overall process model. This work will improve the robustness of industrial ink-jet printing and help companies develop new applications for the technology. Ink-jet technology involves the generation, manipulation and deposition of microscopic drops of liquid under digital control.

The speed and quality of its printing have allowed ink-jet to dominate the home PC printing market, and the fact that the process can be 'scaled up' means it is moving into the professional printing sector too.

What makes ink-jet so fascinating is that the same technology that is used for printing pictures and text can also be used to manufacture high-value, high precision products such as flat-panel displays, printed electronics, and photovoltaic cells for power generation. But as Professor Hutchings, head of the IfM's Production Processes Group, explained, these exciting possibilities may only be fully realised if we have a better understanding of the science.

"In many ways the development of ink-jet technologies for industrial applications has moved ahead of our understanding of the basic science, and that is what the new research programme will tackle.

"By extending the existing benefits of ink-jet methods to attain the speed, coverage and material diversity of conventional printing and manufacturing systems, we can transform inkjet from its present status as a niche technology into a group of mainstream processes, with the UK as a major player.

"But in order for this transformation to happen, we need a much better understanding of the science underlying the formation and behaviour of very small liquid drops at very short timescales, and to widen the range of materials which can be manipulated in this way." Cambridge was the home to some of the earliest work on ink-jet printing at Cambridge Consultants in the 1970s, and the East of England now contains a cluster of world-class companies exploiting this technology.

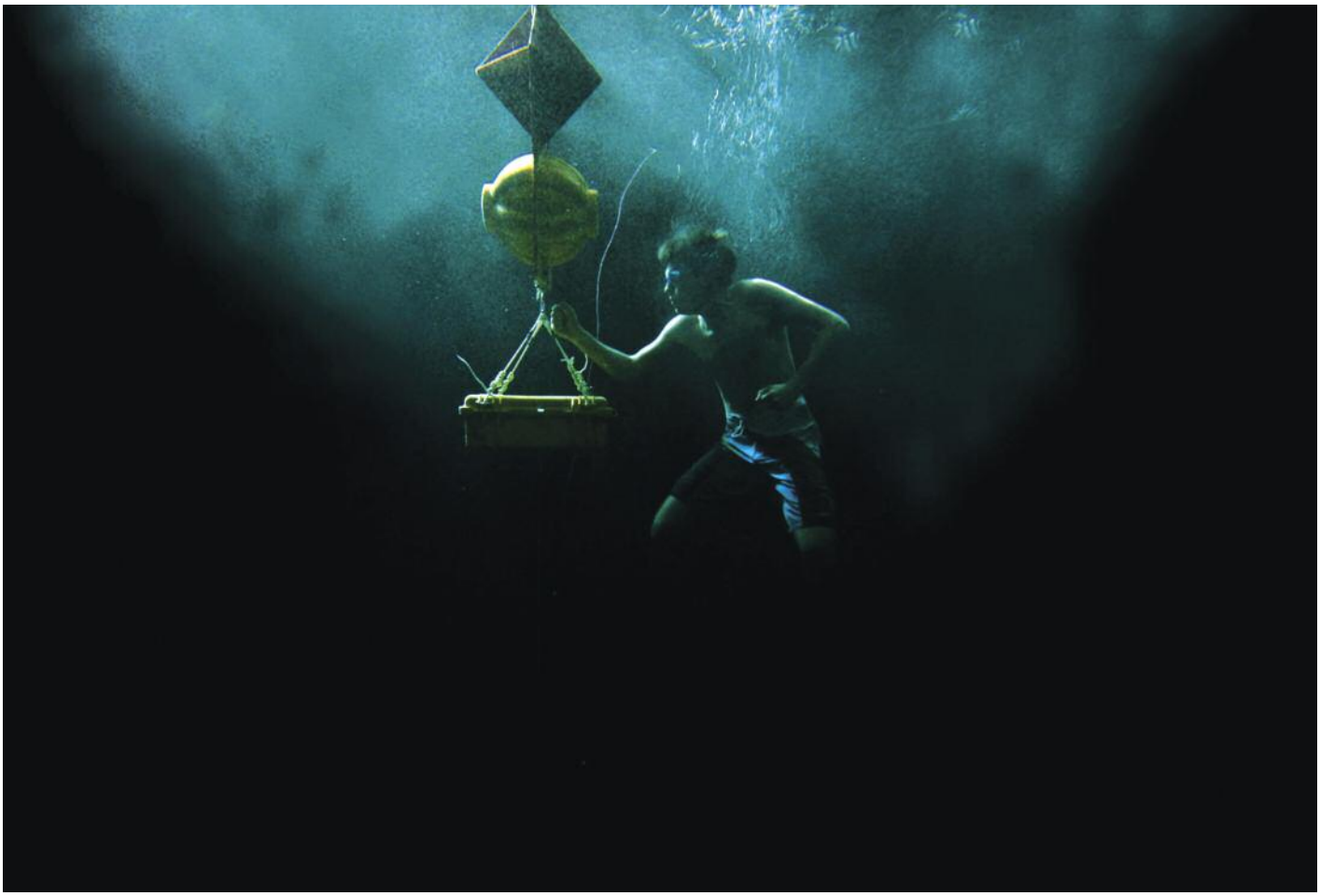
The city also houses the Inkjet Research Centre which was set up in 2005 within the IfM to study generic scientific problems of ink-jet printing.

For more information please visit: www.ifm.eng.cam.ac.uk/pp/inkjet/default.html

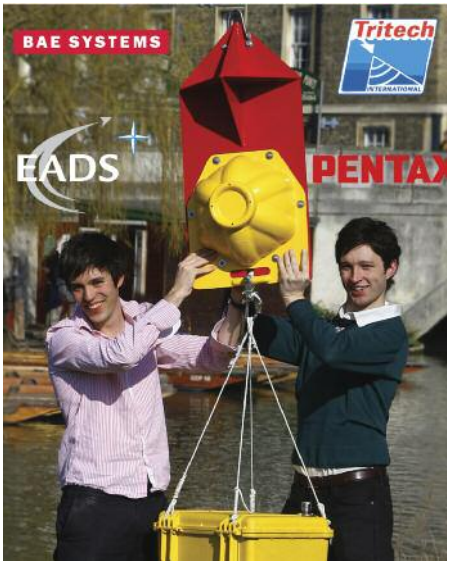
Nokia Photography Competition at the Department of Engineering winning images

First prize

Ben Sheppard and Robert Howshall
Project Pebble



The winning photo: Project Pebble



Ben Sheppard and Robert Howshall with Pebble

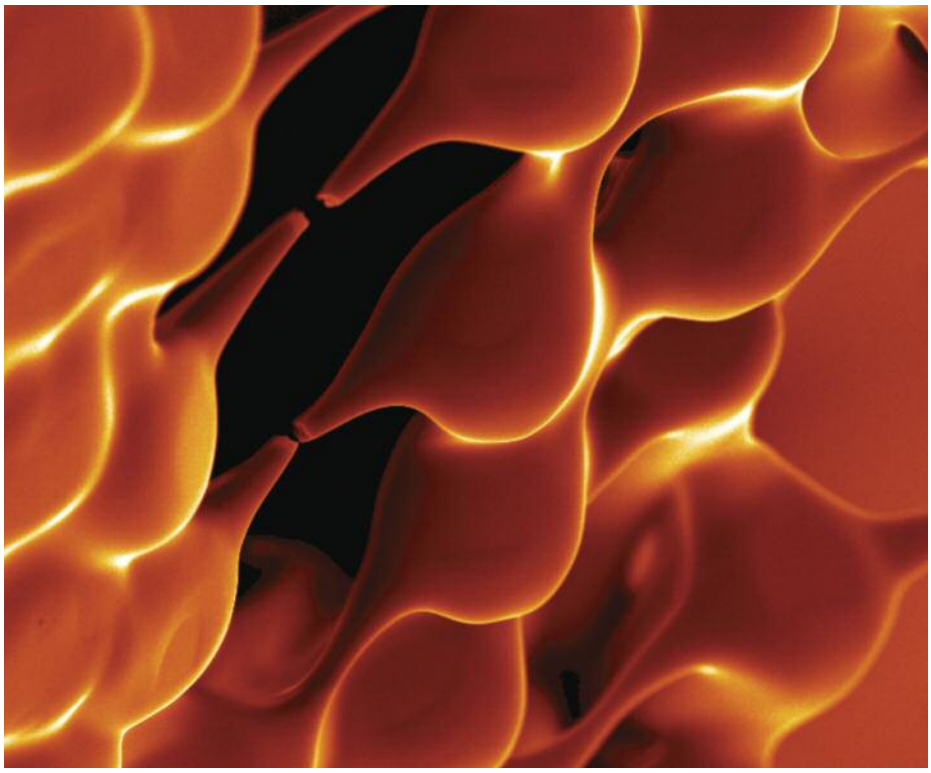
The winning image in the Nokia Photography Competition recently held at the Department of Engineering, was taken by Ben Sheppard and Robert Howshall, who graduated last summer. They received the first prize of a Nokia N95 8GB phone that was generously donated by Nokia.

In 2009 a small team at the Department of Engineering designed and built a low-cost, deep-sea photographic vessel. This photograph shows "Pebble" undergoing pool trials at Cranfield University. Whilst deep-sea photography has been done before, Pebble differed in one key respect. Cost. Pebble was built for £1800, making her tens of times less expensive than comparable deep-sea craft. This was achieved by using off-the-shelf components, almost no moving parts, and a pressure-balanced design. It is planned that subsequent years of Cambridge undergraduate engineers will improve the design and reduce the cost to less than £1000, making deep sea photography more affordable than ever before. Project Pebble was sponsored by BAE Systems Submarine Solutions, and supported by Tritech International, EADS, and Pentax.

More information on the project along with a gallery of photos can be found at: www.projectpebble.co.uk

Second prize

Ivan Minev and Rami Louca
Synapse



The second prize photo: Synapse

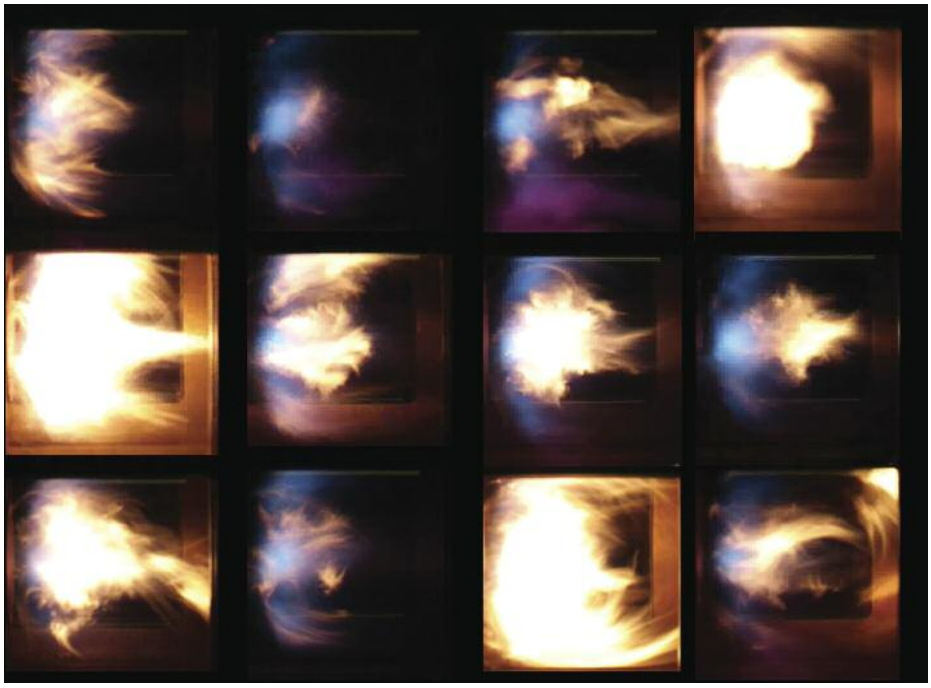
The photo that won second prize, was taken by Ivan Minev and Rami Louca, PhD students at The Nanoscience Centre. They received the second prize of a Nokia 5800 touchscreen phone.

In his research Ivan uses techniques developed by the semiconductor industry and applies them to soft materials that can be flexed and stretched. This novel approach will help to bridge the gap between rigid electronics and that of soft, living matter. Ivan will explore applications in prosthetics and tissue engineering. This Scanning Electron Microscope micrograph illustrates an experiment where Ivan fabricated a matrix of micro features. The features are small enough for biological cells to detect and interact with. This would enable Ivan and his team to study how the surrounding environment influences the many decisions a cell needs to make during its life cycle. The image invokes analogies with a neural circuit. You can see several 'neurons'; their cell bodies are large and round. They even project axons which join together in a synapse, the site where the electrical signal from one neuron jumps to the next.

For more information contact:
Ivan Minev email: irm33@cam.ac.uk
Supervisor Dr Stephanie Lacour

Third prize

Isil Ayranci Kilinc
Rumble



The third prize photo: Rumble

The photograph that won third prize was taken by Dr Isil Ayranci Kilinc, a Research Associate in the Energy, Fluid Dynamics and Turbomachinery Division. She received a Nokia 5310 that comes With Music edition, generously donated by Nokia.

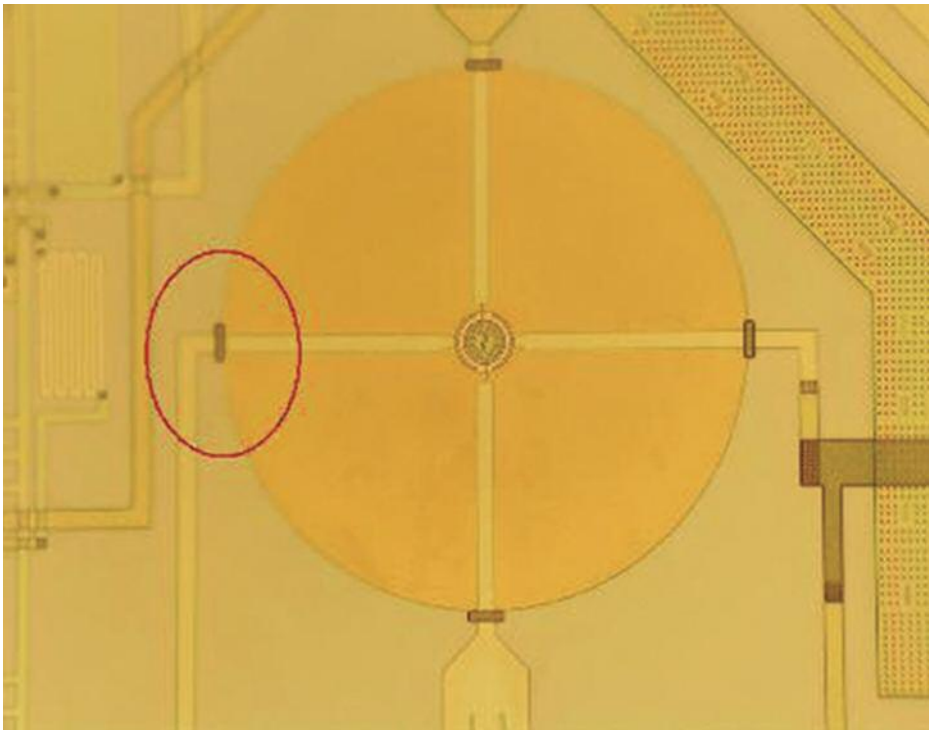
The array of images shows an aero-engine gas turbine burner flame oscillating due to self-excited combustion instabilities at low frequency, which is a state termed as 'rumble'. The flow direction is from left to right and flame is observed to oscillate between a blue/violet lean premixed combustion mode and a brushy turbulent diffusion flame characterized by bright yellow soot incandescence. The frames were captured from a digital video recorded at Cambridge Intermediate Pressure Combustion Facility (CIPCF) during experimental investigation of combustion instabilities on a prototype low-NOx lean direct injection (LDI) burner. LDI technology offers a strong potential to reduce aircraft pollutant emissions but lean burn conditions are prone to combustion instabilities which have to be eliminated as they may damage engine parts by inducing acoustic resonance. CIPCF is funded by EPSRC and Rolls Royce plc.

For more information contact:
Isil Ayranci Kilinc email: ia262@cam.ac.uk
Supervisor Professor Simone Hochgreb

Other entries in the Department's 2009 photo competition can be seen at www.eng.cam.ac.uk/photocomp/2009/

Cambridge CMOS Sensors Limited: A new spin-out from the Department of Engineering

Gas sensing technology start-up, Cambridge CMOS Sensors Limited (CCMOS), has secured funding from Cambridge Enterprise Seed Funds.



Photograph showing an SOI microhotplate (large circle) with a small micro-heater (12 micron radius) and integrated tempertaure sensor. DC power consumption is a few milliwatts at 300 C and tens of microwatts when operated in a pulsed mode. Red ellipse indicates very accurate back etch with alignment mark.

The company is a spin-out from the Electrical Division of the Department of Engineering and has licensed technology from the University of Warwick, and aims to commercialise CMOS-compatible gas sensors.

Dr Nick Slaymaker, Investment Manager at Cambridge Enterprise Seed Funds, said: "By using CMOS technology, which is used in microprocessors and other digital logic circuits, gas sensors can be developed based on a miniature heating element (micro-hotplate) design which is fully compatible with CMOS. By using this technology gas sensors can be miniaturised, produced at higher volume, cheaper and retain good thermal behaviour. I am especially pleased that one of the founders, Professor Florin Udrea is also a co-founder of CamSemi, one of our most successful investments, and he has come back for investment in a brand new spin out".

The CMOS sensors employ high-temperature tungsten MOSFET heaters embedded in a silicon on insulator (SOI) membrane. These effectively form a micro-hotplate that heats the sensing material, allowing it to react with gas molecules. Crucially, CCMOS's MOSFETs can be fabricated in a commercial SOI-CMOS process and therefore can be fully integrated with the associated drive/detection circuitry. CCMOS expects its technology to significantly improve upon existing gas sensors, which tend to be high cost, due to their semi-automated manufacturing methods, and consume more power than is ideal for portable instrumentation.

Current applications for gas sensors include smoke alarms, laboratory analysis, medicine, automobiles, and industrial safety. However, the company envisages many more applications for silicon-based micro-gas sensors as a result of their small size and lower manufacturing cost. For example, the constant and accurate monitoring of aeroplane cabin air quality, especially on long haul flights, is challenging. The airline industry wants to continue improving passengers' flight experience. CCMOS's sensors can test very accurately for carbon monoxide, which is colourless, odourless and very toxic.

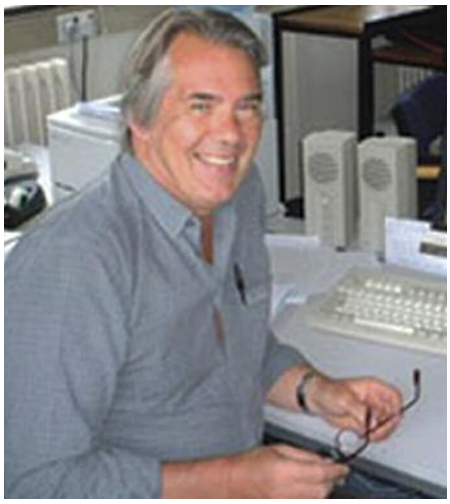
The company's founders are Professor Florin Udrea, also a co-founder of CamSemi; Professor Julian Gardner, a Professor of Electronic Engineering at Warwick University; and Professor Bill Milne, Head of the Electrical Engineering Division here at Cambridge University and Director of Centre for Advanced Photonics and Electronics. The three academics have worked together for 15 years and have a successful record of transferring research to industry. They have carried out collaborative research and development projects in the area of microsensors and nanotechnology with many companies and have previous start-up company experience.

Professor Gardner commented: "We are very excited about the potential of Cambridge CMOS micro-hotplate technology. Our devices can heat up from room temperature to 700 degrees celsius in just a few milliseconds and have ultra low power consumption suitable for battery-operated devices – sub milliwatt when driven in AC mode and at 400 degrees. We envisage numerous applications of our micro-hotplates (with integrated circuitry/readout) ranging from chemical micro-sensors (eg toxic gases) to physical sensors (eg infra-red cameras). The technology is ideal for high volume and low unit cost products and will help drive forward the emerging field of ubiquitous sensing." Asked what the next step is, Professor Gardner said: "We will develop prototypes, find commercial partners and licence technology."

Cambridge CMOS Sensors Limited founders (Left to right): Professor Bill Milne, Professor Julian Gardner, Professor Florin Udrea

Electrical Engineering Division receive awards

Congratulations go to Professor Bill Milne, Mr Sabesan Sithamparanathan and Mr Ruilin Pei all members of staff in our Electrical Engineering Division who have received Institution of Engineering and Technology (IET) awards.



Professor Bill Milne

Sabesan Sithamparanathan

Ruilin Pei

The annual IET Ambition and Achievement Awards Ceremony provides an opportunity to celebrate the best in the world of engineering, from those just starting out to those at a more advanced stage in their career.

The JJ Thomson Medal for Achievement in Electronics went to Professor Bill Milne. Bill has been an outstanding researcher for the past twenty years, in addition to making significant contributions to electrical engineering at Cambridge and elsewhere. He has helped shape many UK engineering departments and has created a successful Electrical Division here, with a steady growth in research output, student numbers and teaching quality. He is well respected in the Far East and has managed large research contracts from many industries and countries; the most recent being a large contract between Cambridge and the Korean Government. In addition, he has demonstrated entrepreneurial spirit via his involvement with a number of successful spin-out companies in the areas of TFTs, CVD machines and CMOS devices. Bill has raised many tens of millions to build the new CAPE building and was responsible for much of its design details and content.

Mr Sabesan Sithamparanathan has been awarded the Hudswell International Research Scholarship for his doctoral research on 'Radio Frequency Identification (RFID) for Intelligent Airports'. Sabesan is currently a 2nd year PhD student, conducting research on passive RFID under The Intelligent Airport (TINA) project under Professor Ian White's supervision. He was previously with the successful Cambridge University spin-off company ARM (www.arm.com), as a student IP electronic engineer, and was awarded the Sir William Siemens Medal in 2006. The main aim of his research is to improve efficiency and security at airports through the active tracking of passengers and staff using RFID tags combined with advanced high-definition digital CCTV. The system aims to facilitate real-time location of individual passengers within the airport, and the analysis of both mass traffic and individual behaviours. The system will also enable the location of checked-in passengers who are either missing or late, and thus reduce passenger induced delays and speed up aircraft turnaround.

Mr Ruilin Pei has been awarded the IET Postgraduate Scholarship for his doctoral research on 'Superconducting Machine with its AC Loss'. Ruilin is a final year PhD student under Dr. Tim Coombs's supervision in Electrical Engineering. Ruilin has over 20 journal papers, 18 conference papers and 1 patent. He has won many prizes including IEEE Life Member Graduate Study Fellowship. His research is designing and fabricating a superconducting machine for the analysis of AC losses. Ruilin employs high temperature superconducting (HTS) tapes to develop, manufacture and sell state-of-the-art wind-power electric machines which are lighter, smaller, more efficient and ultimately cheaper than their equivalent conventional counterparts. These improvements perfectly complement the requirements for scaling wind turbines to larger sizes. Ruilin is motivated to create a business team to commercialize a new type of compact HTS wind turbine electric machines without gearboxes. The HTS machines are able to provide high speed and excellent reliability compared with the conventional counterparts.

Summer 2009 Industrial Work Experience Feedback

Over the summer, I worked for RES Offshore, helping to write a paper which was presented at the European Offshore Wind conference in Stockholm. The placement helped me understand which parts of the industry I might be interested in working in later in life. Carrying out the research also gave me an insight into a new area, little researched before.

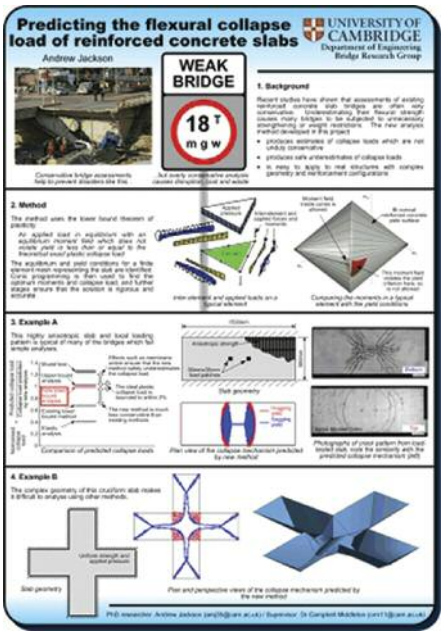
I really enjoyed the opportunity to meet people with similar interests, not only in renewable energy but also a large number of cyclists and outdoor enthusiasts. It was nice to have more freedom to structure my own time, to the point of setting my own deadlines, and having to take the initiative a lot more to get things done.

Above all, I enjoyed my time working at RES, and it's helped me to decide that this is the sector I want to work in.

Joe Hobbs

A method to avoid bridges being incorrectly assessed as too weak

Andrew Jackson, a PhD student in the Structures Group, won the poster category at the Institution of Structural Engineers Young Researchers Conference 2009.



Andrew's prize winning poster

Andrew's poster, entitled 'Predicting the Flexural Collapse Load of Reinforced Concrete Slabs', described a method that he has developed to show that some bridges which other engineers believe to be dangerous are stronger than expected, allowing existing structures to be retained and saving the cost of replacing them. The method uses traditional plasticity theory, developed in the Department in the 1950s and taught to all Engineering undergraduates, combined with modern computational methods.

Andrew's supervisor, Dr Campbell Middleton, says: "I am extremely impressed with Andrew's work as I think it represents a significant advance by providing a generally applicable solution scheme for predicting the flexural strength of concrete slabs, something researchers have been attempting to derive for decades. It is difficult to speculate on how many structures Andrew's analysis method might be applied to. However earlier work in the group resulted in a novel collapse analysis program which we estimate has resulted in tens of millions of pounds in savings for bridges alone; so Andrew's solution, which has wider applicability than just bridges, has the potential to have a very significant impact in the field."

Andrew commented: "I was delighted to win this award, and greatly enjoyed the chance to see and hear about research being carried out into structural engineering all around the country. Congratulations to everyone who presented, and thanks to the Institution of Structural Engineers for organising the event."

Institution of Structural Engineers: www.istructe.org
Andrew Jackson: www2.eng.cam.ac.uk/~amj35
Dr Campbell Middleton: www-civ.eng.cam.ac.uk/struct/crm/

Young researcher wins award for his work on air quality

Prashant Kumar, who recently finished his PhD in the fluid mechanics group, has won a 'Young Researcher Bursary Award' to present his research at this year's 7th International Conference on Air Quality – Science and Application in Istanbul, Turkey.

Prashant Kumar PhD research student

This award is given by the World Meteorological Organisation for the most innovative papers, to encourage outstanding young researchers. Prashant's paper is entitled 'street-scale modelling of nanoparticles using a simplified approach and an operational model'.

Prashant has been working with the Engineering Department's Professor Rex Britter on 'measurements and modelling of the dispersion of nanoparticles in the urban environment'. The research is very topical as regulatory authorities strive to measure and reduce pollution in urban areas. The findings may also be used to validate and improve existing methods used to disperse air pollution and help in predicting air pollution in the future.

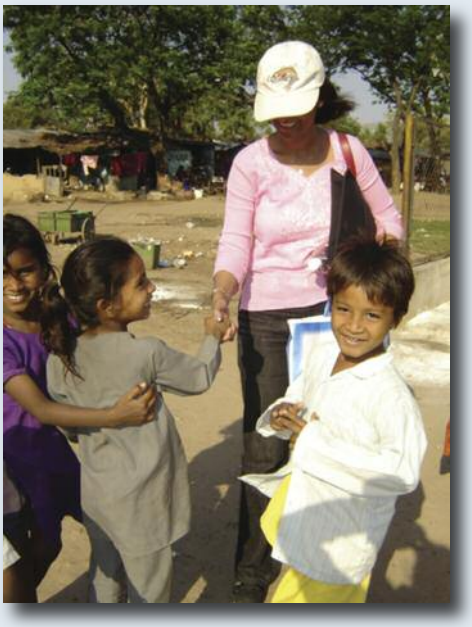
Prashant has already published his research finding in the top journals and academic conferences, and has also won the 'Best Poster Presentation Award' at the 11th International Conference on Harmonisation within Atmospheric Dispersion and Modelling for Regulatory purposes (Cambridge, UK) in July 2007, 'Young Researcher Bursary Award' at the UK Aerosol Network Workshop (Reading, UK) in June 2007, and at the 6th International Conference on Urban Air Quality (Limmassol, Cyprus) in March 2007.

Prashant gratefully acknowledges the funding of the Cambridge Nehru Scholarship and Overseas Research Scholarship Award for his PhD, and the travel grants received from the University's Engineering Department, Pembroke College and Cambridge Philosophical Society.

For further information please contact Prashant by email: pp286@cam.ac.uk
Prashant's presentation form the Urban Air Quality conference can be downloaded as a 4.5 MB PowerPoint presentation at: www.eng.cam.ac.uk/news/stories/2009/Air_Quality/

Alumni Feature: Dr Priti Parikh

The role of engineering in international development



Dr Priti Parikh completed her MPhil at the Centre for Sustainable Development here at the Department of Engineering from 2004–2005. Priti now works for Arup where she has launched ASPIRE. ASPIRE is a sustainability and poverty reduction assessment tool developed jointly by Arup and Engineers Against Poverty. Below she tells how she reached this point.

"My father (Professor Himanshu Parikh) works in the slums and villages of India and has changed the lives of half a million people in Indore through water and sanitation provisions using a concept called Slum Networking. This inspired me to become an engineer. After graduation I started my career as a structural engineer designing retaining walls, beams, columns and domes for a five star hotel in Rajasthan. I then went on to working on infrastructure projects in slums and villages in India, realising that the social impacts of engineering can be best achieved in those environments. The results emerging were so powerful and contrary to conventional wisdom that 5 years ago I decided to do my masters and doctorate in the Centre for Sustainable Development in Cambridge under the supervision of Allan McRobie, to analyse those findings.

"During my doctorate I managed to carry out 700 socio-economic interviews in the slums of India and townships of South Africa to better understand the benefits of engineering interventions, like water-sanitation infrastructure. Setting up the interviews, managing the logistics, finding the right team and analysing the evidence collected from the interviews was a big challenge and I learnt a lot during my field trips. My travel was supported by travel grants from the Department of Engineering, Newnham College, the Commonwealth Trust and the Institution of Civil Engineers. I also conducted semi-structured interviews which, although full of humour, nevertheless clearly highlighted the lack of basic services and the gap in engineering services in developing countries.

"My research demonstrates a few key points. First, there is no cheaper, faster or better way to alleviate poverty in slums than by providing clean water and proper sanitation. My research shows that a one-time expenditure of £100 per family on water and sanitation infrastructure had directly increased literacy rates of poor children (particularly girls) from 30% to 60%, reduced infant mortality and had almost doubled the incomes of the poor (particularly women) in 5 years, something India has been unable to achieve in the last 30 years.

"Secondly, I asked 700 families to prioritise their needs and they all came back with a single, clear response that water and sanitation is their top priority.

"Thirdly, it was noticeable that 5 years after the provision of water and sanitation infrastructure, the communities had rebuilt their huts into houses at an average investment of £1000–1500 per family coming entirely from their own savings and family support. This was 10–40 times the initial investment by government on water and sanitation. The community cited the initial water and sanitation investment as the main catalyst for their own subsequent investment in housing.

"I am currently based in Arup where I have launched ASPIRE. ASPIRE is a sustainability and poverty reduction assessment tool developed jointly by Arup and Engineers Against Poverty through a two year collaboration. ASPIRE acknowledges the critical role of infrastructure in poverty reduction, which is a prerequisite to achieving sustainable development in developing countries. I have also contributed to cutting-edge thinking in Arup in relation to urban slums and low income housing.

"I was invited to be a panel member for the All-Party Parliamentary Group for Engineering and Information Technology where I gave a speech about the role of engineering in international development. My speech discussed the impacts of engineering interventions on health, education, income and housing in developing countries and has been described as inspirational."

If you are interested in finding out more, please contact Dr Priti Parikh by email: priti.parikh@cantab.net
More information on ASPIRE the new software-based tool for the integrated appraisal of the poverty reduction and sustainability performance of infrastructure developments can be found at: www.eng.cam.ac.uk/news/stories/2010/alumni_feature_Priti_Parikh

Where are they now?

Former Engineering for Sustainable Development MPhil students return.

Together with the current students on the MPhil in Engineering for Sustainable Development, 24 alumni of the programme from 10 countries gathered in the Department recently to share their experiences since graduation. 13 short presentations were delivered covering work ranging from international development to the siting and construction of offshore wind farms. The students talked about their current roles and how these related to the MPhil programme, with all but one of the 6 cohorts of graduates to date represented.

Since the MPhil in Engineering for Sustainable Development was launched in 2002 it has produced 195 successful graduates and is expecting to boost this to nearly 250 in the coming year.

Students have been drawn from all parts of the globe, with 46 countries being represented over the last 7 years. Many of these students have remained in touch with each other and the Centre for Sustainable Development, forming a unique and vibrant international community continually sharing ideas and experiences about best sustainable practices they are encountering. In addition to the students mentioned below, others have gone on to work for the United Nations, the World Bank, the UK Civil Service, NGOs in the aid and development sector, the US military, city governments in places such as Trieste and Vancouver, as well as taking roles as sustainability managers in a range of engineering consultancies and other organisations. Others have completed PhDs and have now embarked on successful research careers.

The alumni who returned to give their presentations included Nick Wordsworth (2003) currently working in offshore wind for Noble Denton, Roger Middleton (2004) a water manager with Black and Veatch, Simon Lamb (2006) who is working for Targetfollow (a commercial property developer), and Jennifer Bitting (2006) who has recently joined the Logistics Management Institute in Washington and described her work on low impact developments. Gareth Haslam (2007) opted for a research career and is currently working on his PhD on the topic of fuel cells, whilst Nitin Tanwar (2007) has been involved in carbon trading with CFI Futures.

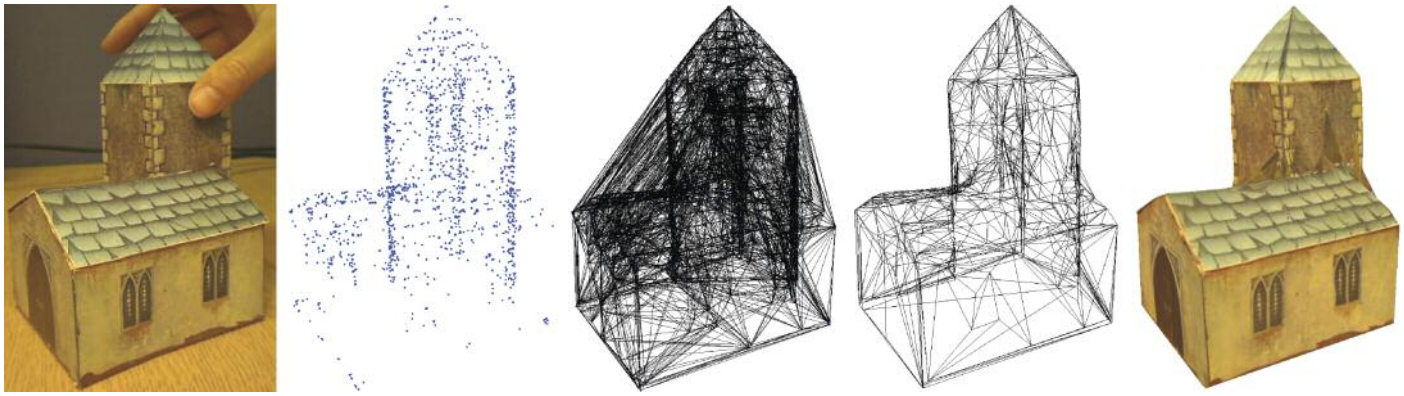
Several students from the 2008 group returned to talk about what they have been doing recently. These included Bill Brower who is based in Washington with GlobalGiving (an on-line market place designed to connect donors with community projects), Tom Berman who has set up his own consulting company, Consep Ltd, designed to help companies improve their environmental and sustainability performance, Galvin Clancey now based in Portland, Oregon described his work with Vestas who are the world's leading supplier of wind power solutions. Colleen Duncan (2008) has spent the year working for Engineers Without Borders (Canada) in Malawi, whilst Brendan Baker described his experiences with the Practica Foundation in Ethiopia. Scott Kelly has embarked on a PhD in Cambridge and is currently involved in modelling the decarbonisation of the UK residential sector and Uma Sreenavasamurthy has spent the year working with EcoFys on renewable energy and energy efficiency projects.

Other students talked informally about their work with Arup, UK planning authorities, the civil service in Whitehall, Mott MacDonald and other organisations. The event highlighted the diversity of opportunity available to graduates from the MPhil programme and provided a stimulating discussion and networking across the years. It is intended this event will become a regular fixture in the Department following the successful annual MPhil Dissertation Conference in which current students present the work of their individual research projects.

The Centre for Sustainable Development website: www-g.eng.cam.ac.uk/sustdev/

Creating 3D models with a simple webcam

In the last decade researchers in the Department of Engineering have pioneered the recovery of accurate 3D models from arbitrary and uncalibrated photographs.



Left to right (a) Object rotated by hand in front of camera. (b) Point cloud obtained from on-line structure from motion estimation followed by bundle adjustment. (c) Delaunay Tetrahedralisation of point cloud, partitioning the convex hull into tetrahedra. (d) Carved mesh obtained from recursive probabilisitic tetrahedron carving. (e) Texture-mapped surface mesh.

Professor Cipolla and his team are now able to produce very accurate 3D copies of arbitrary objects, including deforming objects, from a single camera and with standard equipment. The 'Digital Pygmalion' project (article at: www.eng.cam.ac.uk/news/stories/2005/digital_pygmalion/) showed how this method produced breathtaking results, which guided the sculptor Antony Gormley in scaling up one of his sculptures from life-size to be over 25 metres high.

More recently a group of researchers here at the Department; Qi Pan, Dr Gerhard Reitmayr and Dr Tom Drummond have aimed to produce simpler, approximate shapes but in realtime. They have created a program able to build 3D models of textured objects in real-time, using only a standard computer and webcam. This allows 3D modelling to become accessible to everybody.

Qi, Gerhard and Tom presented the system at the 20th British Machine Vision Conference (BMVC'09), in London.

During the last few years, many methods have been developed to build a realistic 3D model of a real object. Various equipment has been used: 2D/3D laser, (in visible spectrum or other wave lengths), scanner, projector, camera, etc. These pieces of equipment are usually expensive, complicated to use or inconvenient and the model is not built in real-time. The data (for example laser information or photos) must first be acquired, before going through the lengthy reconstruction process to form the model. If the 3D reconstruction is unsatisfactory, then the data must be acquired again.

The method proposed by Qi and his colleagues needs only a simple webcam. The object is moved about in front of the webcam and the software can reconstruct the object "on-line" while collecting live video. The system uses points detected on the object to estimate object structure from the motion of the camera or the object, and then computes the Delaunay tetrahedralisation of the points (the extension of the 2D Delaunay triangulation to 3D). The points are recorded in a mesh of tetrahedra, within which is embedded the surface mesh of the object.

The software can then tidy up the final reconstruction by taking out the invalid tetrahedra to obtain the surface mesh based on a probabilistic carving algorithm, and the object texture is applied to the 3D mesh in order to obtain a realistic model. Thanks to this simple and cheap system, 3D reconstruction can become accessible to everybody.

The project won 'Best Demo Prize' at a conference called ISMAR 2009 (International Symposium of Mixed and Augmented Reality). Demonstration video: www.youtube.com/watch?v=vEOmzjImsVc

Summer 2009 Industrial Work Experience Feedback

Emily Lester worked at Eurocopter UK Limited for her summer industrial placement. Darren Underwood Manager of Aerial Operations summarises her time there.

Emily was working within the maintenance department assisting me on a major project to identify the timescales required to perform all of the maintenance tasks that we undertake. She was tasked with looking at each and every task we performed and analyse the historical data from our time booking system to identify an average time taken. The data she accrued was then entered into our computer system against those tasks so that our engineers knew exactly how long they had to complete the task every time it was performed.

It was a huge project that involved data spanning approx 10,000 line items on a spreadsheet. Emily completed the task extremely quickly and professionally.

The data has been used to great effect in the maintenance department since she has left and we have identified other areas where the data can be used for example: maintenance forecasting, maintenance planning and contract development.

Emily was a very enthusiastic and capable member of our team for the short time she was here.

4th year Hugo Scott Whittle receives a Sir William Siemens medal

Hugo Scott Whittle, a 4th year undergraduate in the Information Engineering division of the Department, was awarded a Sir William Siemens Medal at a prize-giving ceremony held in the Museum of Science and Industry, Manchester.

Hugo Scott Whittle (left) & Andreas Goss

Hugo was accompanied and introduced at the event by Dr Peter Long of the Mechanics and Materials Division.

Sir William Siemens was a businessman and engineer, and the younger brother of Werner von Siemens, founder of Telegraphen-Bauanstalt von Siemens & Halske, the forerunner of Siemens AG. Sir William managed the company's London office and is best-known for the installation of the first electric street lighting at Godalming in Surrey, the laying of an impressive Indo-European telegraph cable and the successful completion of an ambitious project to install the first direct telegraph link to the US.

The Siemens medal was established by Imperial College London in 1883 and originally presented to the College's top final year electrical engineering student. It is now awarded annually by Siemens plc to one student from each of eighteen leading UK universities, but the bronze medal is still struck specially by the Royal Mint, using one of the original dies. The medal is accompanied by a generous financial reward. At this year's ceremony, the medals were presented by Andreas Goss, Chief Executive of Siemens plc. Each university was asked to nominate one recipient using its own selection criteria. Hugo was awarded the medal based on his outstanding performance in his two third-year projects, Image Processing and Software, for which he received the highest marks.

Image Processing

The storage of 'raw' digital images (where each of the three colours in every picture element, or pixel, is represented as one of 256 levels) requires large amounts of space in computer memories and hard disks. However, it is possible to take advantage of redundancy in an image to reduce this requirement considerably. For example, in an image containing a large area of blue sky, it is not necessary to store every pixel individually, since they are all very similar; it is more efficient to record just the differences between adjacent pixels. Techniques of this sort form the basis of 'lossless' compression. It is also possible to take advantage of the characteristics of the human visual system to remove information from an image without changing its appearance: this is the aim of 'lossy' compression.

This project, for which students worked in pairs, investigated both compression methods. It made use of the Laplacian Pyramid, Discrete Cosine Transform and Discrete Wavelet Transform for energy compaction. These three techniques decompose an image into its constituent frequencies, or frequency bands, to some of which the eye is much more sensitive than others. Very high frequency image content, such as the texture of a finely woven fabric, can be 'quantized' coarsely, so only a very rough approximation to the image information needs to be stored. So-called entropy coding was also employed. Like Morse code, this aims to encode commonly-occurring pieces of information (such as the 'no change' message in the blue sky example) using short codewords to reduce the total amount of data.

The Image Processing project took the form of a competition to compress three pictures to less than a thirteenth of their original size, and to uncompress them, with the students' compression systems judged on the quality of the resulting images. The systems developed used many of the techniques present in the popular JPEG and JPEG2000 image formats. Hugo was awarded a BP Design Project prize for this work.

Software

When designing modern large-scale digital circuits, it is usually too expensive and time-consuming to test every prototype using real hardware; instead, a software package is used to simulate the behaviour of the circuit on a computer. This project, carried out in teams of three, developed just such an application, called Logsim.

Logsim accepts a text file specifying how the user's chosen circuit should be constructed from simple components (logic gates, bistables and clock sources): the first task of the project was therefore to write a specification, using the EBNF language, to define precisely the format of the circuit description file and how it should be interpreted by the simulator. The bulk of the programming work was then split between the three team members, before the final integration and testing.

Logsim allows the user to define both combinational circuits (where the outputs depend only on the current inputs) and more complex sequential circuits (circuits with memory); it displays the electrical signals at particular points in the circuit over a chosen time period on a virtual 'logic analyzer' display. Switches can be incorporated into the user's design and opened and closed while the simulation is running to examine the effect on the signals being monitored, and the whole circuit can even be re-wired from the powerful graphical user interface.

The software provides an intuitive, colour-coded display of the signals of interest, which can be zoomed and dragged around to better examine a particular section of a waveform and to aid understanding of the circuit's operation.

Logsim was developed using the C++ programming language, the wxWidgets user interface library and the OpenGL graphics engine, and versions were produced for both the Windows and Linux operating systems. Hugo received an i2 Computer-Based Project prize for his contribution to Logsim.

For more information on the Sir William Siemens Medal Programme visit: www.siemens.co.uk/

CamBridge Bridge Design Competition

The Department's Outreach Officer Dr Joy Warde ran two competitions to design bridges for the River Cam to mark the University's 800th anniversary celebrations. CamBridge Junior Competition (ages 5-11) and the CamBridge Senior Competition (ages 11-99).

The Junior Challenge (ages 5–11)

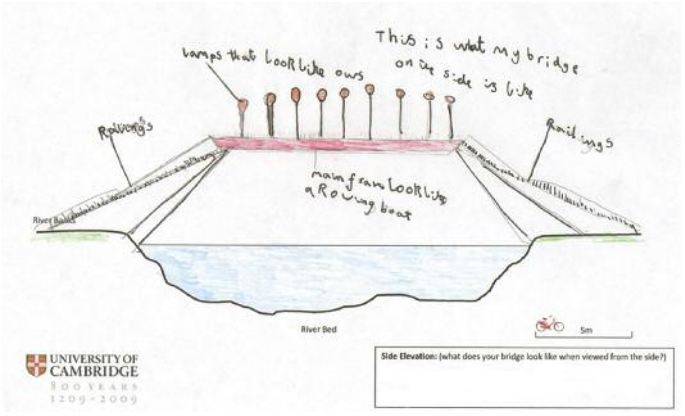
The junior challenge was to consider what the bridges of the future will look like and to design a foot and cycle bridge for the River Cam for 2109. There must be a clearance of 4m at the mid point of the bridge to allow boats to pass underneath.

Entries were judged according to their aesthetics, quality of drawing and technical plausibility.

The two winning designs will be included in the "Letters to the Future" which will be stored at the University Library until 2109. These letters will be opened during the 900th anniversary celebrations.

Winner 5–7 age range

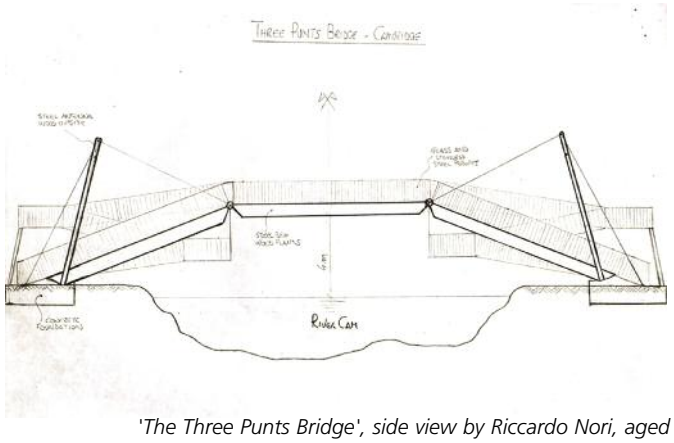
The 'Rowing Boat' by James Pachebat, aged 7 from Stuntney, Ely.



The 'Rowing Boat' bridge, side view by James Pachebat, aged 7.

Winner 8–11 age range

'The Three Punts Bridge' by Riccardo Nori, aged 8 from Bourn.



'The Three Punts Bridge', side view by Riccardo Nori, aged 8

The Senior Challenge (ages 11–99)

For the senior challenge, local families and schools designed, made and tested a model bridge.

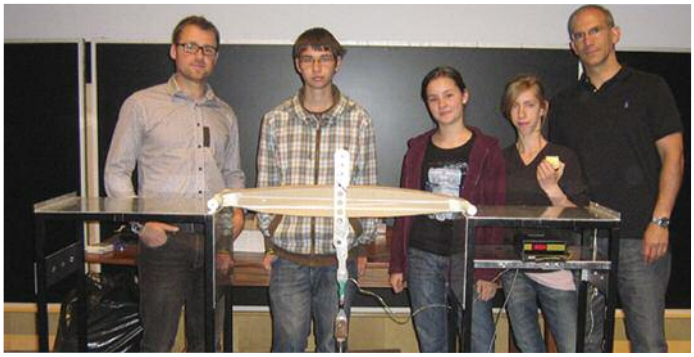
Teams were 4–6 people. A list of acceptable building materials and competition rules were sent to all participants in advance of the competition.

All teams were encouraged to plan their bridge design in advance of the competition as the construction time was very short. Teams could build and test their bridge at the Department or build their bridge at home and bring it to the Department for testing.

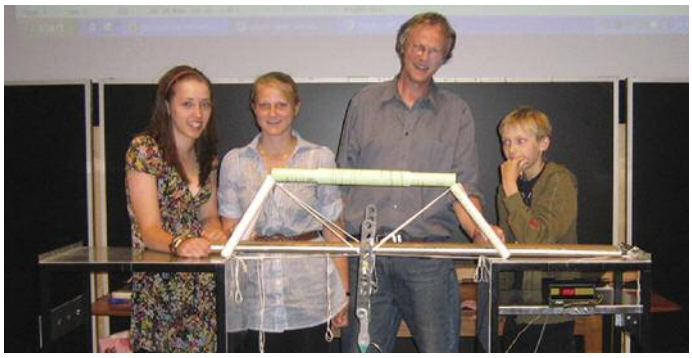
The bridges were judged on the basis of:

- The maximum load it can support at mid span
- The maximum load divided by the weight of the bridge (a measure of efficient use of materials)
- Aesthetic appeal

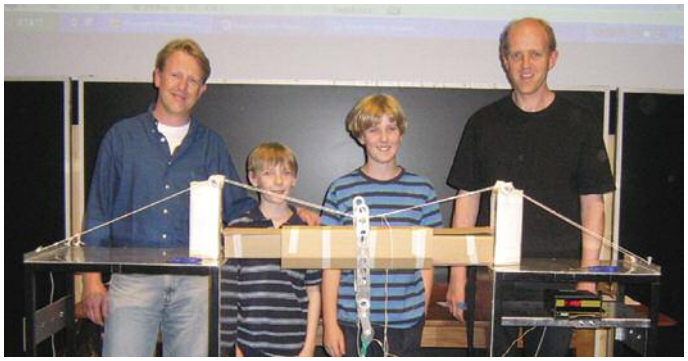
The winning teams



Most aesthetic design



The maximum load carried by a paper/cardboard bridge was 75kg



The most 'efficient' bridge was able to carry 77 times its own weight

The results of all the teams in the Senior Bridge Building competition, with photos can be seen on the Outreach webpages: www.eng.cam.ac.uk/outreach/

Royal opening for IfM's Alan Reece Building

The Chancellor of the University of Cambridge, HRH Prince Philip, Duke of Edinburgh, officially opened the Institute for Manufacturing's (IfM) new home, The Alan Reece Building, in November 2009.

The Chancellor was greeted by the head of the IfM, Professor Mike Gregory, who introduced him to the institute's main benefactor, Dr Alan Reece. Vice-Chancellor Professor Alison Richard also attended the special ceremony.

Opening the building the Chancellor, the Senior Fellow of the Royal Academy of Engineering, said he had a special relationship with the University engineering department.

"I opened the Department of Engineering [in1952] and seem to have been opening things ever since," he joked.

Around 400 people packed into the common room to watch the Chancellor unveil a plaque to commemorate the event.

The Vice-Chancellor paid tribute to Professor Gregory and his team of "entrepreneurial academics" for delivering such a prestigious building.

She said: "This building is extending the breadth of what we do at Cambridge University. There is no more vivid a model of linking academia with the needs of society than the Institute for Manufacturing."

"Since I became Vice-Chancellor six and a half years ago I have been on an incredible journey with the IfM, which has seen it accomplish so much."

She also paid tribute to the amazing generosity of Dr Reece, founder of Pearson Engineering, whose philanthropy, along with donations from the Gatsby Foundation and local industry, made the building possible.

Professor Gregory, head of the IfM, said the opening was timely just as manufacturing was becoming popular again and was being placed firmly at the heart of policy. Before the ceremony, Professor Gregory took the Chancellor on a tour of the IfM. Prince Philip was introduced to Manufacturing Engineering students at work in the IfM's Design studio and the Automation Lab before seeing the facilities in Photonics.

The Chancellor was introduced to the heads of the IfM research centres and members of the IfM's education and consultancy team. He also took time to chat with the heads of the institute's teaching staff.

The IfM moved from its cramped former home in Mill Lane to its new £15m home in June this year. The IfM, a division of the Department of Engineering, brings together expertise in management, economics and technology to address the full spectrum of industrial issues.

Its activities integrate research and education with practical application in companies, providing a unique environment for the creation of new ideas and approaches to modern industrial practice. The IfM works closely with industry at a regional, national and international level, providing strategic, technical and operational expertise to help companies to grow and to become more competitive.

From left to right: Professor Mike Gregory, Vice Chancellor Professor Alison Richard, Benefactor Dr Alan Reece with Head of the Department of Engineering Professor Dame Ann Dowling

The Chancellor meets the students

The new building is a major addition to the University's West Cambridge campus for science and technology. It joins an existing concentration of related research centres, as well as the Hauser Forum, a focal point for entrepreneurship and technology transfer.

The IfM's website
www.ifm.eng.cam.ac.uk/

The End of the Road

After an epic journey in a solar-powered car race from Darwin to Adelaide, Cambridge University Eco Racing (CUER) finished in 14th place.

Cambridge University Eco Racing team

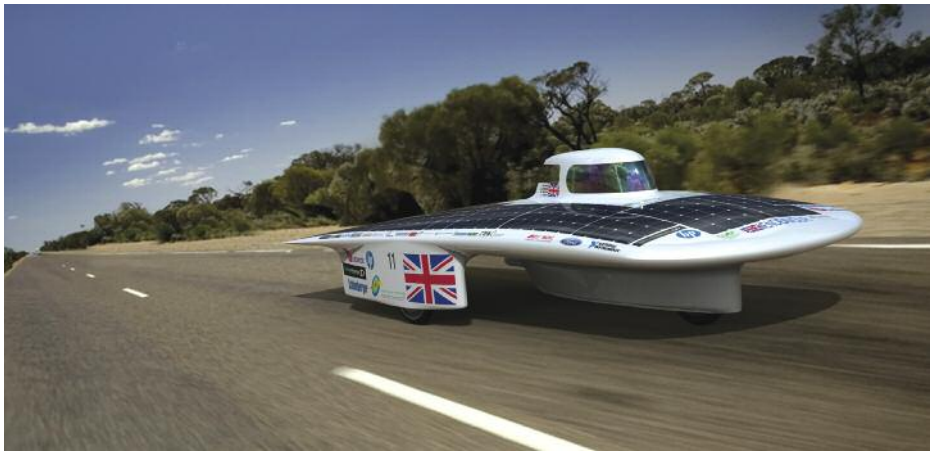
The team sent this report the day after they finished the race: "Well, we never really thought that yesterday would arrive. We arrived in Adelaide with Endeavour on the trailer but we crossed the finish line in Victoria Square on solar power. We crossed the line at 1:20pm SA (Southern Australia) time, Saturday 31st October having set off from State Square, Darwin at 8:00am NT (Northern Territories) time, Sunday 25th October. It took almost six full days, much heartache, and hard work to cover the 3000km from Darwin to Adelaide but we did it and 1616 of those kilometres were under solely solar power.

"The feeling of crossing the finish line after such an epic and extraordinary journey was incredible. So many supporters and team family members and other teams were there to welcome us, clapping and cheering as Endeavour came to a final stop over the line. We could not be more pleased and overawed by the achievement of crossing an entire continent and the moment was such that the only way to do it justice was to pick up both of our team managers and throw them bodily into the fountain! A spray of champagne may have made contact with the solar cells but it seemed a fitting end to such an 'Endeavour'.

"The Global Green Challenge Award Ceremony was held last night and congratulations are due to all the teams who competed but especially to the Japanese Challenge class winners from Tokai University who completed the race in 29.49 hours at a remarkable average speed of 100.54kph. It is rumoured that their top race speed was an incredible 140kph! Second place went to the team from Delft, Nuon in Nuna V. Their exciting last day saw solar car tag up the Stuart Highway with the team from University of Michigan in Infinium, with Nuon finally crossing the line only 30 minutes ahead. We awoke this morning to find that the final results had been posted and that CUER had succeeded in coming in 14th. This is great result considering all the problems that we encountered and although we did not quite achieve our aim of top 10, we believe that for a first try, with faulty hardware, we have done pretty well!

"Adelaide saw its bars overrun by solar car teams from 13 different countries at the (unofficial) after party. The feeling was one of relief that the event was over, sadness that, in some cases, two years of work had come to an end, and excitement as plans were made between new-found friends from different countries to stay in touch. The Global Green Challenge has been an incredible experience, one full of highs and lows; frustration and disappointment yes, but more importantly, excitement, awe, a sense of achievement and international camaraderie. Cambridge University Eco Racing, the only team from the UK, is honoured to have been a part of such an event and will return in 2011 with renewed vigour and, hopefully, a car that can take us across the line in first place."

The CUER website www.cuer.co.uk/



Sustainability Innovation Student Challenge Award 2009

Judith Sykes has received the Dow Award for Sustainability Innovation Student Challenge, a prize run by the Cambridge Programme for Sustainability Leadership, for her research into Polices for Delivering Energy Efficient Urban Environments in Developing Countries.

Judith Sykes

Judith was specially commended amongst the three winners and has been invited to attend a further awards ceremony at Dow in the US.

Her research is a component of the MPhil in Engineering in Sustainable Development she is currently undertaking. She specifically chose the MPhil course at the Centre for Sustainable Development because it has allowed her flexibility to pursue interests in energy use, generation technologies and energy policy, as well as studies into the broader issues around sustainable development.

It is the context of global issues of rapid urbanisation, economic growth and increasing energy consumption, and given that over 50% of energy consumed in developed nations is in the heating and lighting of buildings that led Judith to the question at the core of her thesis. How do rapidly urbanising cities pursue paths that are delinked from use of fossil fuels in the provision of the built environment as well as meeting other social development goals such as improved human welfare?

This is clearly a vast topic and with only a short period in which to complete her research, she will be focussing on South Africa as an example of an emerging economy, principally looking at urban development in the cities of Johannesburg and Cape Town.

The core element of research will be looking at barriers to implementation of energy efficient buildings, what indicators can be used to measure the success of policies and what international support can be provided to overcome such barriers, such as capacity building, technology transfer and finance mechanisms including the Clean Development Mechanism (CDM) and Emissions Trading Schemes (ETS) revenues.

Judith is using the prize money to fund a research trip to South Africa to spend time in both Johannesburg and Cape Town. Through links with the Universities of both these cities she has arranged interviews and meetings with a number of developers, municipal planners and representatives from Non-Governmental Organisations, she has also been invited to visit exemplar energy efficient projects in Witsand and Ivory Park in Johannesburg and similar projects in Cape Town.

Judith is clearly very excited about her research project and has also received an enthusiastic response from those already working in the sector in South Africa. The outcome of her research will not only assist those furthering South Africa's energy policy, but will also feed into the work here at the Centre for Sustainable Development, the Cambridge Centre for Energy Studies and particularly the Electricity Policy Research Group where her supervisor, Karsten Neuhoff, is based.

Summer 2009 Industrial Work Experience Feedback

My summer industrial placement was at TTP LabTech. The project I was assigned to, Proteus, was a large automated chemistry lab which was halfway through assembly when I arrived. My primary role was to help set up the machine and complete tests in preparation for the FAT and installation in Sweden. This entailed a wide range of tasks and I was involved in all aspects of the project including providing client support and both project and company meetings.

I learnt a lot from my placement, primarily that something that may be correct in theory may not always work as planned in practice, especially if there are several components involved or large amounts of code. I learnt how to approach problems, in some cases persistent and occasionally seemingly impossible, and calmly think of and try different methods of pinpointing the problem and finding the solution. My work was challenging at times but ultimately very rewarding. Was it worth it? Would I do it again? Without a doubt, yes.

Gemma Raven

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