

Welcome to the Annual Review 2016

by Professor Gary Lock Head of Department

The greatest strength of our Department is the quality of our undergraduates, and recruitment continues to be buoyant. In 2014/15 approximately 2300 students applied for 225 places. These places were almost completely filled with students who achieved A*AA or better at A level, making this intake the most highly-qualified cohort of any department in the University. In 2015/16 UK and overseas applications rose by 12% and 10.5% respectively, with the target intake increasing to 240 in total. An increase in the A-level standard offer might be necessary to control numbers in the coming year – a nice problem for our admissions team!

The National Student Survey went well for the Department with 94% and 96% satisfaction rates for graduates on the Mechanical Engineering and Aerospace degrees. This placed the Department 7th and 2nd respectively in the national NSS league table, a great result that has since been reflected in numerous league tables.

A new degree in Integrated Design Engineering was approved by the University in October 2015 and recruitment has begun for the 2016/17 academic

year. This degree involves a series of design/prototyping, interdisciplinary projects in the third and fourth year and will appeal to creative engineers who favour a practical approach to engineering product development.

Design is at the heart of all teaching activities in the Department, which is to be celebrated at the Design Exhibition and Keynote Address on 25th May. This coming year is the 50th Anniversary of the University. The first Design Keynote Address was given by Dr T Emmerson of GKN in 1972 entitled, *Some Thoughts on Design and Designers*. He concluded his address with the statement: *"There is much to be done – and I hope I have done something to encourage you to come into industry and do it."* This year the Keynote Address will be given by Dr Jenny Cane, a graduate from our Department in Aerospace Engineering and currently at the Culham Centre for Fusion Energy.

Our teaching and research is underpinned by our superbly-skilled technical staff (pictured below) and I welcome alternative suggestions for a collective noun for our kit of technicians.



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Medical Engineering in Istanbul: Theory and Practice by Dr Kate Fraser



The Pekkan Group at Koç University have some impressive facilities for studying their branch of medical engineering: paediatric cardiovascular fluid mechanics. They have a left heart simulator and high speed cameras for measuring mock vascular flows; 3D printing for prototyping new medical devices, and optical coherence tomography which they use to investigate the development of embryonic chick hearts. However, seated in the waiting room of a nearby hospital, I was grateful for some less advanced medical engineering: the x-ray.

Situated 30 km north of Istanbul city centre, Koç University is surrounded by forest, has stunning views of the Bosphorus and Black Sea and is one of our Strategic International Research Partners.

I was there to visit Kerem Pekkan and his group for a week in early April to start our collaborative project on cannulae. We were awarded a grant by the University as part of the International Research Initiator Scheme, as well as a similar grant from Koç University, to get things going.

The project has two aims: to create a numerical model for blood clotting in cannulae, and then to use the model to design cannulae without clotting risk for paediatric left ventricular assist device patients.

I may have left the hospital with a diagnosis of pneumonia, but I also left Koç University well on the way to completing the numerical model, with some cannula designs, and having met several other researchers with a view to expanding the collaborative project towards haematology and multiphase flows. To that end, I look forward to welcoming members of the Pekkan group to Bath later in the year.

Student finalists in CISCO Switch-Up Challenge Reducing Food Waste within the Home



A team of students from the University of Bath has come third in the final of the Cisco Switch-Up Challenge with their idea for reducing food waste within the home. Team Gorgon includes Mechanical Engineering students Leanne Yip Heung Win, Rosie Ezekwesili, Andrew Taylor; Integrated Mechanical & Electrical Engineering student, Alex Stokoe; and Maths student, Alexandria Nash.

The team's project aimed to replace traditional barcodes with RFID tags that are able to store more substantial amounts of information, including expiration dates for food products. The

team designed an app that would populate a virtual 'fridge' at checkout and then give notifications and recipe suggestions when these products are about to expire.

Leanne Yip Heung Win, Project Manager for the team, said: "The Cisco Switch-up Challenge is a great opportunity to create a new idea that will be financially viable and have a positive social or environmental impact. The final was held at Cisco's UK headquarters, where we presented our idea to senior managers and UK & Ireland CEO Phil Smith."

"It was an amazing experience, as we were given the chance to gather their valuable feedback. We were able to discuss key business strategies and ideas that we could improve on in the future. In addition, through the process we talked with Cisco's graduates and hiring managers to get tips for summer internships and graduate jobs. We hope more Bath students will make use of this incredible opportunity, as it shows that you have a passion for innovation, technology and product design."

Phil Smith, Chief Executive of Cisco Systems UK & Ireland, commented: "I was blown away by the young talent we have across the UK Universities. All the ideas and breadth of knowledge presented on the day were excellent. It was a really well organised unique event and I am looking forward to the next one."

Fabulous Beasts - Innovative Family Game

by Dr Elies Dekoninck



A research collaboration between Mechanical Engineering and a game studio has resulted in a brand new family game which combines digital and physical technologies. The new game “Fabulous Beasts” is a stacking game, somewhat akin to Jenga but with an extra dimension - an immersive digital world that is affected by each new layer stacked.

It has been developed by the company Sensible Object, in partnership with Dr Elies Dekoninck from the Department of Mechanical Engineering through the Arts & Humanities Research

Council’s REACT project. The REACT “Play Sandbox”, brought together collaborations to support and develop new products or services that would benefit children.

Dr Elies Dekoninck, Industrial Designer and Programme Leader at Bath for the MEng in Advanced Design & Innovation explained “Our role in the game’s early development involved taking a systematic design approach to developing the technology whilst working extensively with children on the dynamics of the game play. The resulting product is right at the forefront of a new genre of games which combine digital and physical elements. In my opinion, Fabulous Beasts can re-engage the whole family in game play”.

An online Kickstarter campaign successfully raised more than £150K to bring the game to market. Another £150K Venture capital has been raised and a patent has been applied for. All the design’s components are currently being prepared for mass production in China and the first buyers will receive their copy of the game in November 2016.

Alex Fleetwood, Director of Sensible Object, the makers of the game added “Play Sandbox and the support of Elies and her team accelerated our development process and provided invaluable resources for reflection and creativity.”

TT Electric Racing Motorcycle Design Winner

by Jeff Barrie



Louis Flanagan, a final year MEng Mechanical engineering student, has won last year’s Siemens PLM student design contest. The contest is a competition run by Siemens PLM academic programme where

students submit an image of their best CAD designs produced from SolidEdge and NX. The winning image is of an electric TT racing bike produced in NX. This bike design is part of the brand new Bath Zero Emissions Motorcycle (BOEM) team, who aim to design and build a 215hp electric racing bike for the Isle of Man TT race in May. NX is the preferred CAD software for Team Bath Racing and BURST.

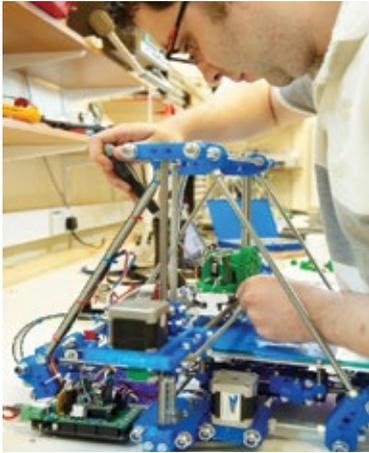
Louis says “This machine is designed from scratch by five Engineering students. We will race the machine at this year’s TT Zero race. The bike features a custom chassis, 18wh Battery powering a 160Kw motor and our target is a 100 mph average lap. This image depicts the initial design of the “core” of the motorcycle.

The initial idea came from the pure excitement of the Isle of Man TT, it is the oldest and most prestigious motorcycle race in the world and is a spectacle to watch let alone compete in. Whilst on placement I looked into racing at the TT and found the TT Zero class, a relatively new class purely for electric motorcycles. The high paced development and constantly evolving technology also provides much scope for innovation and allows for some interesting concepts.”



Plans for Student-Centric Project Activity Initiative

by Dr Dirk Schaefer and Jeff Barrie



The “democratization of innovation, design, and manufacture in the globalized interconnected world” is one of the most powerful paradigm shift the product development community has seen in decades. Some even say “makers” are enabling a new industrial revolution...

Today, each and every one can become an inventor of a breakthrough product or service, or enjoy hunting for the proverbial next big

thing. As we know, many of the world’s most influential products originated in a garage of sorts.

Embracing and fostering a culture of creativity, innovativeness, and entrepreneurship across campus, the Department of Mechanical Engineering is planning an initiative to create a state-of-the-art project activity space. A makerspace can be defined as *“a network of creative spaces providing resources and equipment for you to develop ideas and make them reality”* (MAKLAB, Glasgow).

The aim for the departmental proposal is to provide open workspace.

“ .. where engineering students can come together outside the classroom to think, experiment, design, build and exchange ideas – or work on your own project” (Dyson Centre for Engineering Design, University of Cambridge)

As part of this planned initiative, rapid prototyping and digital fabrication accessibility will be enhanced and some of our facilities will be transformed into a shared, friendly and inviting space that empowers students to design, experiment, and prototype – and, of course, to socialize with their peers, collaborate in competition teams, work on both academic and personal projects, whilst engaging with the wider student community.

The makerspace is anticipated to be student-centric/student-run and free from teaching timetabling and class bookings; students will have more control over when and how the space is used. All of this entails training of student head technicians, student-led development of training and safety procedures, peer support, informal competitions and challenges and the creation of a SU Maker society. The objectives of this student-led space will be to enhance creativity, freedom and introduce more practical work in the early years of engineering and design. The Makerspace initiative is the first step in democratizing prototyping equipment and technology, and enhancing student-led learning and innovation.

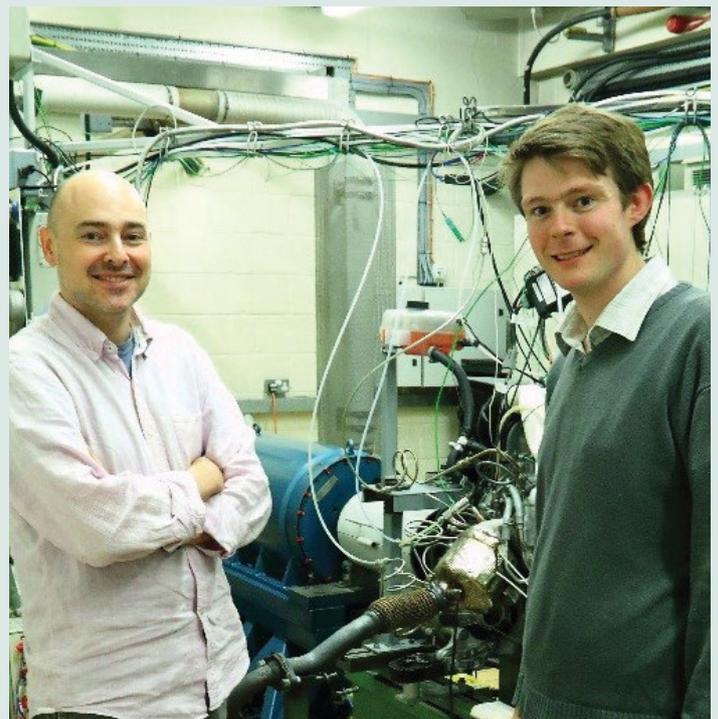
RAE Distinguished Visiting Fellow Scheme

by Dr Richard Burke

Prof Jose Serrano visited the Department from Valencia in August 2015 under the Royal Academy of Engineering Distinguished Visiting Fellow Scheme. He was invited following Dr Richard Burke’s previous secondment to Valencia to boost collaborative research into turbocharged engines. Prof Serrano is a leading researcher in the field of turbochargers and turbocharging based within the Combustion engines research institute (CMT Motores Termicos) at Universitat Politècnica de València.

The aim of the visit was to transfer specialist knowledge on turbochargers from Valencia into a full engine system environment at the University of Bath in both simulation and experimental configurations. During his stay, Professor Serrano worked with over 15 researchers within the Powertrain and Vehicle Research centre providing advice on their work. During his visit, Prof Serrano and Dr Burke also visited the Universities of Huddersfield, Loughborough and Queen’s in Belfast as key turbocharger research institutes and Cummins Turbochargers, and the Ford Technical Centre in Essex.

After his visit, Prof Serrano said *“The major and short term potential for growing generated links in teaching activities are the exchange of Ph.D. students (in both directions) between UPV and these institutions and the possible collaboration in teaching with the Gas Turbine group from Bath University.”* This summer the Department will host Luis-Miguel Garcia, a Lecturer from Valencia working under Prof Serrano as a continuation of this exciting collaboration.



Outreach: STEMQuest Teaching Coding at Rochester Grammar School

by Dr Dirk Schaefer



Conducting research for her final year project on "Understanding Crowdfunding" (supervisor: Dr. D. Schaefer), Mechanical Engineering student Hannah Forbes explored a number of avenues and small-scale crowdfunding campaigns to put some of her research into practice.

One of these initiatives was aimed at introducing secondary school students to coding and app development in a new and creative way. Hannah was introduced to coding in the first year of her degree course but found, as a consequence of the traditional teaching methods, the concepts difficult to grasp. It was only when she returned to coding using e-learning tools that she fully appreciated the importance and value of being able to code. Hannah felt the websites she had used such as "Code Academy" or "Code with Chris" fostered deep learning by encouraging students to immediately apply what they have learned to a personal project they care about.

Intrigued by this idea, Hannah devised a plan to mimic this process with secondary students by transferring these principles from the virtual environment into the real world of face-to-face teaching. Being a woman of her word, she devised a lesson plan to combine the creative side of app development with the technical requirements of coding to produce a well-rounded series of learning activities. The first activity was aimed at conveying the basics of HTML coding for students to immediately apply their learning by developing their own mini-websites.

Following on from this, Hannah exposed the students to a more creative product development activity. The task was to develop a concept for a really cool iPhone app, to then apply the just-learned coding skills to actually implement the app. The STEMQuest activity at Rochester Grammar School in Kent turned out to be a huge success. Caitlin, a Year 10 student at the school said "Everyone at my school loved it" and another student stated that she had been considering studying Computer Science at University and that now she was certain. She stated "the combination of creative and technical activities made the lesson really enjoyable and it felt like we were learning something that would genuinely be useful in the future".

Student ambassadors like Hannah make a huge impact on the success of our department and university by showcasing the spirit, creativity and technical excellence of our student body across the country through informal outreach activities like STEMQuest.

Hannah's blog can be found here:

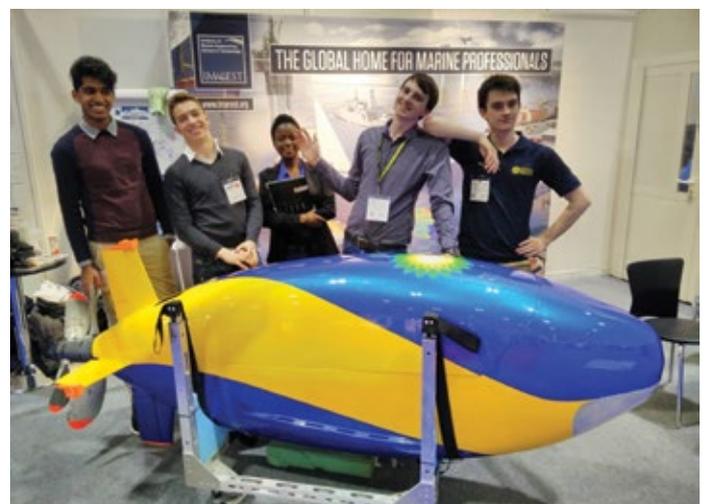
<http://hannahforbes.co.uk/2016/03/27/stemquest-teaching-coding-at-rgs/>

Bath University Racing Submarine Team (BURST)

by Harry Turner, Mech Eng student

The Bath University Racing Submarine Team (BURST) have had a busy year, building upon and improving their submarine, Salacia, readying her for the international competition in July. We've seen a huge increase in membership, up from ten to forty, with most being students in their first and second years looking to get some hands on experience outside of their degrees. The projects in which they involve themselves range from electrical control systems, to propeller design, to gearbox design. We're also making a bigger name for ourselves amongst our sponsors and fellow competitors by attending exhibitions and design shows for the first time. Not only does this attract sponsors and build our profile, but it's a great experience for the students as well, as representatives of the University.

The submarine is on track for completion well before the races, and multiple testing and training days are planned for the team, to ensure we have the best possible outcome at the competition. Last year, we achieved best British team, a title which we aim to keep. This year we're aiming higher.



Sustainable Development - The Egyptian Way

by Philipp Trotter, PhD student



Egyptian academics from the University of Lincoln in the UK and scholars from Cairo University jointly organised the 1st annual workshop “Rebuilding Communities for Resilient and Sustainable development: Eco- Cities” in Aswan, Egypt. The workshop took place from the 13th – 16th December, 2015. It brought together 20 scholars from the UK with 20 scholars from Egypt. The academics, ranging from early career research students to seasoned University professors, discussed how and to what extent Egypt can implement different sustainability and resilience practices in its cities.

The workshop was set up as a mixture of several expert presentations, group work exercises and numerous field trip excursions. The city of Aswan, famous for a variety of ancient Egyptian sights, functioned as a case study for the workshop.

The sustainability challenges Aswan faces include an economic recession, low energy efficiency of its infrastructure and buildings and high reliance on fossil fuels for household energy needs with high running costs.

These challenges have been complicated by the political turmoil Egypt has witnessed since the mass-protests of early 2011. The ensuing political uncertainty took a massive toll on tourism earnings crucial for Aswan. As a consequence, people have started to move away from Aswan in search of better opportunities, resulting in a noticeably high percentage of vacant properties.

In addressing these issues, the workshop greatly benefited from the presence of several regional politicians and government consultants. Among them were a senior national government advisor on sustainability and green growth, Dr Hussein Abaza, the mayor of Aswan and the head of urban planning for Upper Egypt. Together with the academics, a number of first ideas were worked out how Aswan could tackle the challenges:

Notably, especially the Egyptian workshop participants pushed for sustainability despite limited available funding – rebuilding environmentally friendly homes and increasing domestic renewable energy usage for instance were seen as ways of making urban life in Aswan more attractive to stop the migration. Aswan may want to diversify its economy away from tourism – there has been little recovery in the sector since El-Sisi’s presidency, and efforts of local retailers to move from producing souvenir artefacts into the wood and textile industry could be better supported.

In the case of Aswan, resilience and sustainability were found to have a surprising high level of congruence – both principles could help urban planners to address current challenges in-depth with a long-term rather than a short-term focus.

Funding for the workshop was provided by the British Council and the Newton Musharafa Fund.

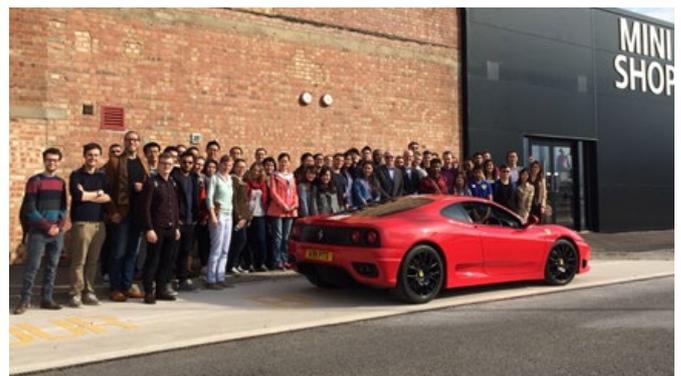
Visit by MSc Students to BMW Oxford Mini Plant

by Baktagul Imasheva, MSc Student

On 14th April 2016, MSc students from the Department of Mechanical Engineering had a visit to the BMW Oxford MINI Plant. This plant has a rich history; in 2014, the plant clocked up 100 years. After the BMW acquisition of the Rover Group, they invested in a high-technology automated body building facility, a new assembly area and car preparation centre, a new logistic centre as well as a state-of-the-art paint shop. The BMW vision is to manufacture in line with individual customer requirements. In order to achieve this vision, the operation and production line of the plant operates ‘just-in-time’.

The visit started with an introduction of BMW MINI’s technology and marketing strategy and a brief history of BMW MINI’s Oxford Plant. After the short lecture, they gave us insights about production line through a tour of the plant. We had a chance to see the body shop. This plant builds three models of car and the different models can be produced in any order. It is the result of “just-in-sequence” performance of the whole plant from the body shop to the assembly line. The whole process in the body shop is operated by robots while in the assembly line humans dominate. The assembly line is the final stage of the MINI’s journey. Features such as seats, steering wheel, panel or wheels are specified individually for each car. In order to identify the customer

specification every car is equipped with a barcode which allows the plant to operate ‘just-in-time’ and ‘just-in-sequence’. Before leaving the plant, the assembled cars pass the camera visioning system for quality checking. Our guide assured us that none of the cars would leave the plant before passing the required quality checking test. Before driving from the assembly line the car is fuelled ‘just enough’ according to the delivering distance. Overall, it was fascinating to see the technologies behind the MINI vehicles and the whole production line.



Not every car is a Mini: MSc students at the BMW Mini Plant

Autonomous Underwater Crime Scene Investigation for the Metropolitan Police - by Dr Alan Hunter

The Metropolitan Police have a nationally deployable team of specialised divers capable of carrying out a variety of underwater missions. These range from search and recovery of missing persons to the collection of evidence. Typically, the divers are required to operate in confined shallow-water environments with low visibility (canals, lakes, water reservoirs, etc.) and they must deploy and complete their tasks within very short time frames. Due to their unique training for these difficult conditions and their limited numbers (84 in England and Wales and 34 in Scotland), they are a valuable resource that is in extremely heavy demand.

Researchers at the University of Bath are assisting the Metropolitan Police by developing autonomous robotic systems to aid and complement the capabilities of their divers. The aim is to develop an ultra-portable and fully autonomous robot equipped with sensors that can inspect the underwater environment for objects of interest (e.g., bodies, weapons, and improvised explosive devices) as well as potential hazards to the divers. This enhanced situational awareness will contribute to greater effectiveness, efficiency, and safety of the team.

The Police Robot for Inspection and Mapping of underwater Evidence (PRIME) is a proof-of-concept system that is being developed under a collaborative effort between the Department of Mechanical Engineering (led by Dr Alan Hunter) and the Department of Electrical Engineering (led by Prof Peter Wilson). A series of unmanned surface vehicles (USVs) have been created via a “rapid prototyping” approach using a combination of laser-cutting, 3-D printing, and off-the-shelf components. Electrical Engineering researcher Dr Ben Metcalfe has been developing the power and control systems and mechanical engineering postgraduate student Mr Ben Thomas has been developing the sonar sensing payloads.

The latest PRIME USV is a trimaran design propelled by two thrusters. It can be operated by remote-control or by autonomous GPS way-point following. The primary underwater sensors use sonar – emitting ultrasonic waves and recording the reflected echoes from objects and the environment. A side-scan imaging sonar provides wide-area surveillance up to tens of metres either side of the vehicle and a multi-beam sonar provides a high-resolution 3-D map directly beneath.

The prototype is being delivered to the Metropolitan Police presently. The next phase of work will focus on the specific application of body detection in water and aims to transition from a proof-of-concept towards a commercial product. To this end, further developments are required to deal with automated data interpretation and object recognition, intelligent path planning and obstacle avoidance, and human interfacing. It will also be crucial to test, demonstrate, and evaluate the performance of the system with relevant experimental trials.

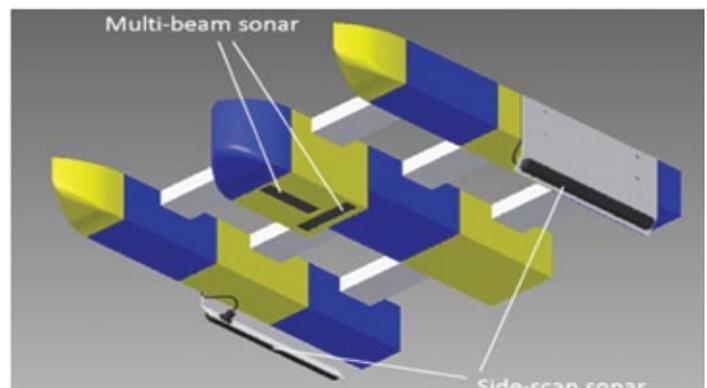
This work is funded by the Metropolitan Police Service: Technology, Research, and Innovation. The side-scan imaging sonar was purchased under a grant from the Bath Alumni Fund and the multi-beam 3-D sonar has been contributed by UK SME Picotech Ltd.



The second PRIME USV prototype performing a sonar survey in the Kennet and Avon Canal



Testing an acoustic camera for the detection of small weapons on the canal floor



Underside of the third PRIME USV prototype illustrating the various sonar transducers.

Powertrain and Vehicle Research Centre (PVRC)

by Dr Sam Akehurst

Researchers from the PVRC (Dr Andrew Lewis, Mr Karl Giles, Dr Sam Akehurst and Prof. Jamie Turner) along with other partners from the Ultraboost project from Shell and Jaguar Land Rover (JLR) have recently won the ARCH T. COLWELL MERIT AWARD and the HARRY L. HORNING MEMORIAL AWARD for a joint paper: SAE paper 2014-01-2718, "Octane Appetite: The Relevance of a Lower Limit to the MON Specification in a Downsized, Highly Boosted DISI Engine." The two awards were presented at the SAE World Congress in Detroit. The Horning Award recognizes the author of the best paper relating to the mutual adaptation of fuels and internal combustion engines presented at an SAE event in a calendar year.

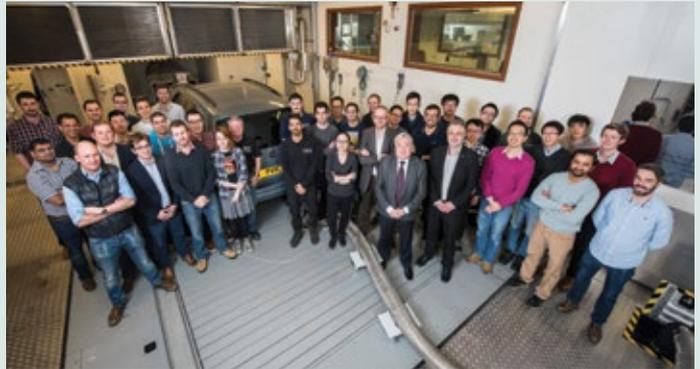
The paper highlights new insight into the performance requirement of future fuels to improve the performance and fuel economy of highly downsized engines. The Ultraboost engine developed in the project was 2.0L displacement and demonstrated a 23% fuel economy benefit over the original 5.0L V8 engine, but with near identical performance. The prototype engine delivered over 550Nm of torque and 142kW/L specific power. The original Ultraboost project was funded by Innovate UK, the UK's innovation agency. The Ultraboost project is still continuing beyond the original project timeframe, now directly funded by JLR with fuels support from Shell.

Two further PVRC papers were published at SAE World Congress. "A study on dynamic torque cancellation in a range extender unit" and "Development of a Low Cost Production Automotive Engine for Range Extender Application for Electric Vehicles". Both papers were a result of another innovate UK project, LowCAP, "Development of a low cost auxillary power unit" in collaboration with Tata Motors European Technical Centre (TMETC) and Ashwoods Automotive. The project has delivered a unique low cost range extender engine for electric vehicles to reduce "range anxiety" of potential EV owners and thus improve the uptake of

EVs. The system is based on a compact 600cc Tata Nano engine coupled to an Ashwoods Electric motor.

Furthermore PVRC research on the application of Selective Laser Melting additive manufacturing of metals applied to automotive components, has recently been reproduced by the SAE, Automotive Engineering magazine, <http://www.nxtbook.com/nxtbooks/sae/16AUTD04/index.php#/32>, the research was undertaken in collaboration with Hieta Technologies and GE-Precision engineering. This work was also funded by Innovate UK. Finally the PVRC have achieved more success in the latest round of innovate UK, low carbon vehicle funding, being awarded £304k to support Meteor Power and Westfield sports cars in a project entitled, "High Performance Low Emission Hybrid Power Train For Motorcycles And Lightweight Sports Cars". The total project, value in excess of £3M, will develop a novel extremely high power density IC Engine coupled to electric machines to develop to deliver a hybrid electric superbike. The PVRC team, Profs. Brace and Turner and Dr Akehurst, will support modelling of the engine systems.

Team Photo:



BathWrist Joint Simulator

by Alex Joseph, IMEE Final year Student and Professor Tony Miles



Wrist joint mobility is important for many of our daily living activities including writing, eating, sport and many more. However, despite modern developments in prostheses for joints such as the hip and knee, wrist joint replacement has been somewhat less successful. One of the key aims of joint replacement surgery apart from pain relief, is to restore function of the joint to enable the joint to carry out typical daily living activities.

Alex Joseph a final year IMEE student has undertaken an innovative project in the Centre for Orthopaedic to develop a control system for the Bath Wrist Joint Simulator. The project aims were to physically simulate everyday wrist motions in the simulator to evaluate wrist replacement prosthesis designs. Originally designed in 2002, the wrist simulator uses four cables in place of tendons which are linked to stepper motors and used to control wrist movement. Alex's project using a Leap Motion Controller, a non-contact infrared sensor, allows the position of the hand and wrist to be tracked in three dimensional space and this motion is fed into the control system of the wrist joint simulator. This allows a user to control the position of the wrist simulator using motions from their own wrist.

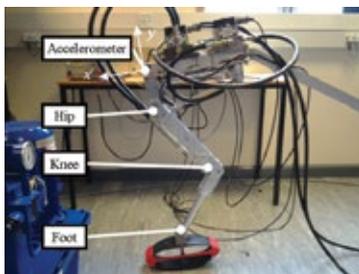
Alex's project has involved developing a control system which allows the wrist simulator to accurately replicate wrist movement by tracking actual wrist joint motions. This will enable the wrist joint simulator to be used to assess the capability of different designs of wrist prostheses in terms of the ability to perform typical daily living activities.



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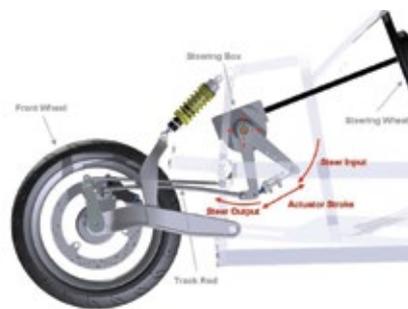
Centre for Power Transmission and Motion Control (PTMC) by Professor Andrew Plummer

The Centre for Power Transmission and Motion Control (PTMC) has a world-leading reputation as a centre of excellence in many aspects of fluid power, actuation, and dynamics and control of electro-mechanical systems. Current research is being applied to aircraft flight controls and fuel system control, powered prostheses (bionics), smart rotating machines, noise and vibration control, wave energy converters, robotics and many other areas. As well as research, we run 4-day short courses in hydraulic systems, electrical drives and control, with about 100 delegates every year. The Centre is staffed by a Director, 9 academics, 3 support staff, and 25 researchers.



A hopping robot leg used for research into the potential for agile robots to run over rough terrain.

Since 1988 the Centre has run an annual Fluid Power and Motion Control symposium, which has become the world leading research conference in its field. Since a partnership with the American Society of Mechanical Engineers was established in 2008, the symposium has been held four times in the USA. After a very successful FPMC2015 in Chicago, we are looking forward to FPMC2016 back in Bath in September.
<http://www.bath.ac.uk/ptmc>



Steer-by-wire for a 3-wheel commuter vehicle

EPSRC Funding for MAST to ADAPT Composites

by Professor Richard Butler and Dr Andy Rhead



Materials and Structures Centre members Richard Butler and Andy Rhead have been awarded £1.1m of EPSRC funding for their collaborative project "ADAPT: Analysis and Design for Accelerated Production of Tailored composites". ADAPT will create unique continuum models for manufacturing processes and new analysis-driven design principles for aerospace composites. The project is joint with Tim Dodwell at Exeter, and project partners GKN, Airbus, the National Composites Centre and Chomarac. It will commence in September of this year and is due to finish in 2020.

Composite manufacturers need to adapt new technologies if they are to reduce cost and time in production of large parts. The killer in time and cost is the current need to robotically deposit 12 mm wide tows very carefully over moulds with complex curvature in order to avoid the formation of defects (wrinkles, gaps or overlaps). The idea behind ADAPT is that quick deposition of material in flat wide strips could make huge time savings. The tricky bit - which is why it isn't done now - is the careful control of fibre deformation required during forming of flat laminates into complex shapes. The new Cosserat Finite Element will be developed to model viscoelastic laminate forming, and design methods will be established which produce formable laminates without compromising performance, e.g. in terms of buckling and damage tolerance requirements.

Colin Sirret (Head of R&T, Airbus) says that "there is a concerted effort to reduce cost and increase rate for production of composite wing structures and ADAPT addresses these issues in a timely and innovative way" and Enrique Garcia (CTO, NCC) adds that "ADAPT will play an important role in developing high rate manufacturing routes for composites for application in aerospace, automotive and other sectors." Richard Butler underlines the importance of engagement with industry for getting research funded, and rooted in impact, via programmes like the Royal Academy of Engineering Industrial Secondment Scheme. Richard undertook an ISS with GKN in 2011 and now holds a RAEng Research Chair with the company.

Team Bath Drones

by Dr Jon du Bois

In the summer of 2015, Team Bath Drones ventured to Bruntingthorpe Aerodrome for the IMechE's inaugural Unmanned Aerial Systems Challenge. The competition pitted student teams against each other in the design, build and test of aircraft to be deployed in a hypothetical humanitarian aid delivery operation. The aircraft were tasked to navigate a series of waypoints, identify an alphanumeric character from a ground marker, and deliver two 1kg payloads, all without human intervention.

The Bath team fielded an aircraft that was widely thought to be the best at the competition, and outperformed all competitors on the first day of the event. The trailblazing performance was ultimately their undoing, though, as nervous safety officers asked them to resume manual control while travelling at 65mph at the far perimeter of the airfield – the transition was a difficult one and the aircraft sustained damage which left the team unable to complete the event. They narrowly missed 1st place to finish 2nd in the manufacturing category, and the team can be proud of their accomplishments.

Building on this promising start, the team is now gearing up to the 2016 event to be held in July at Throckmorton Airfield. The facilities and support at the University continue to improve to support the activity, which is burgeoning with the enthusiasm of the students. The activity spans the group design and business project and the final year research project, and includes students from the Aerospace, Mechanical and Integrated Mechanical and Electrical Engineering degree programmes. It offers a fantastic opportunity to practice hands-on aerospace engineering and engage with the growing area of autonomous vehicle research. This year's students have been proactive in building on the foundations put in place by their predecessors, establishing new sponsorship deals and external links as well as improving on the build and test schedules. Following the precedent set last year the team have eschewed conservative designs in favour of an ambitious flying wing configuration: an innovative design optimised for efficiency and range with a modular construction for improved robustness. The team's efforts have left them well-prepared and we are all excited to watch Bath's second foray in this competition.



2015 team, clockwise from top left: Alex Hickson, Woolsey Williams, Enrique Gutierrez LLaser, Hayden Sansum, Tom Magowan, Josh Taylor, Wojciech Wasinski and Sam Short.



2015 competition flight for the Stingray aircraft.



Rendering of the 2016 aircraft: the Skyseeker. The aircraft build is under way as this article goes to press.

Team Bath Racing - The Last 10 Years

by Marko Mann



2005 Formula Student Car

Back in 2005, a team of 15 students from the University of Bath took on the challenge of designing and building the best formula student car in the UK - a bold claim. The team had a major task on their hands, as funding was limited and the facilities were bare. The work was done in a corner of the department's model shop without the luxury of CAD or Finite Element Analysis, so the monocoque was put together by fastening large sheets of carbon fibre and aluminium honeycomb sandwiched together with aluminium sheet. What resulted was a car affectionately known as "the coffin car" (see above). With its supercharged Yamaha R6 engine, it was the first formula student car in the world to run 75m under 4 seconds, the first of a long list of achievements for the University of Bath at formula student events.

10 years later, Bath University Racing Team (BURT) has become Team Bath Racing (TBR), and TBR15 is the UK's best formula student car by miles, joining the fight up front between the best European teams from Delft, Zurich, Stuttgart and Graz. TBR is now run on the model of a business, with an extensive list of sponsors including BP, Santander and Cosworth supporting the team. With its aerospace grade hybrid carbon monocoque and

steel space frame, full aerodynamics package and turbocharged KTM single-cylinder engine, it lived up to expectations and won the endurance event at the famous Silverstone circuit in 2015. (picture below)

There are many factors which have contributed to TBR's rise in success over the last decade. From the modest work space of the beginnings, the team has upgraded to a buildroom which includes a full engine dyno facility, brand new rolling road, simulation supercomputer and access to the department's composite autoclave. In addition to the facilities, the level of support from the University and team sponsors has also increased and allowed the team to exploit cutting edge technologies such as Additive Manufacturing, Carbon Fibre Composites and Rapid Prototyping. With a trip planned to two European Formula Student events in Hungary and Czech Republic in July and August this year, Team Bath Racing has much to look forward to in addition to their home event at Silverstone, which they will attend with the intention to win it outright for the first time in the team's history. It has taken time and dedication to bring TBR to where it is today, but with the support from staff, sponsors and of course all of the students involved in this thrilling undergraduate project, it is fair to say it has been quite a journey. Bring on 2016.



2015 Formula Student Car

Visiting Professor - Prof Vitaly Topolov

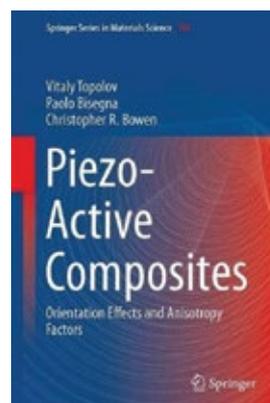
by Professor Chris Bowen

Professor Vitaly Topolov visited the Department of Mechanical Engineering in January-February 2016. This was one of his regular visits to the Department for collaborations with Professor Chris Bowen on piezoelectric materials and composites for transducer applications, such as sensors and energy harvesting.

Professor Topolov is from the Department of Physics at the Southern Federal University in Rostov-on-Don in Russia. He has published over 300 academic papers and was recently awarded the Wilhelm Leibniz Medal for Achievements in Technical and Physico-Mathematical Sciences (2014) and a Gold Medal "European Quality" (2014). He has also been a visiting scientist at the Moscow State University, University of Saarland, RWTH Aachen, Karlsruhe Research Center and University of Rome.

His own university was awarded 5th place in the Annual Independent National University Rankings and famous alumni include Aleksandr Solzhenitsyn; writer and Nobel prize winner. The writing tradition continues since Professor Topolov has

co-authored three books with Professor Bowen on piezoelectric composites (Springer Verlag). His latest visit to Bath was to make plans for a joint fourth book and he will be sure to visit Bath and his friends in the department again soon!



Industrial Placements by Alison Ukleja, Placements Manager

Star student Sophie maximises placement experience



Sophie Orleans is currently working on placement with Tesla Motors in California. Sophie is the second student to take this opportunity following in the footsteps of George Kalligeros who paved the

way in 2015. Both students successfully persuaded Tesla, world renown specialists in electric vehicles, to employ them for their 6 month Semester 2 External Integrated Project (EIP).

Sophie is blazing a trail through her Mechanical Engineering degree by maximising every experience open to our undergraduates. She secured a Ford scholarship in her first year

and went on to have a successful one year placement with Jaguar Land Rover after her second year. This was followed by a summer placement with McLaren. Now in her fourth year she has relocated to California from February to August. For her EIP project Sophie is designing an air suspension compressor bracket for the Model 3; Tesla's newest car targeting the mass market.

"Things are good but also very very crazy! It's such a fast paced company and they chuck you in right at the deep end which is really scary at first but it feels like I'm starting to get the hang of it. I also seem to have ended up in the ideal department as I can borrow a Tesla almost whenever I want to which is cool!"

Sophie is a dynamic student maximising the possibilities of her degree experience by taking advantage of all the opportunities open to students and making it happen. A successful career in the automotive industry lies ahead.

Students visit China with Huawei Seeds for the Future programme

Congratulations to Victoria Corrigan and James Parry (both 1st year Mech), Stuart Boyd (3rd Year Mech), and Oliver Matthews (4th Year IMEE) who have all won a place on the Huawei 'Seeds for the Future' programme along with 2nd year Physics student Tomos Davies. Competing with 167 STEM students from selected Universities across the UK candidates were short-listed and interviewed after submitting essays demonstrating their knowledge and interest in the Chinese economy and culture. The four week programme includes learning Mandarin in Beijing then discovering Huawei's international business culture, products and solutions in Shenzhen, Guangdong Province. Technical training will be given by Huawei professionals whilst visiting their R&D labs and state-of-the-art factories. Visits to The Forbidden City, Tiananmen

Square, the Olympic Park and the Great Wall of China are on the itinerary too. This will be a wonderful opportunity to learn about a dynamic global business strengthening the students' employment prospects for the future and preparing first year's Victoria and James for their placement recruitment next year.

Bath students have been offered the opportunity to apply to the Huawei programme for the first time which starts a new and exciting relationship with the company.



Golden tickets for Jaguar Land Rover placement students

Second-year mechanical engineering students Joe Willey and Matthias Christian have won a 12 month industrial placement at Jaguar Land Rover through our new golden ticket competition.

Students were tasked with demonstrating their engineering knowledge by outlining an upcoming or innovative technology (real or fictional), which will impact the automotive industry in the coming years. Nine students were invited to present their ideas to a panel of engineering alumni. Joe and Matthias were chosen based on their innovative solutions for car security and the MYT Engine. Imaginative solutions were presented by all students who took part with topics on hydrogen fuel cells, incident prediction, autonomous vehicles and bio-composite materials for body panels. Some of the fictional innovations included self-compressing cars and origami-inspired folding roofs.

"This competition is testament to the hard work my team puts into working with our contacts and alumni to find new and inventive ways for our students to secure placements." Alison Ukleja, Placements Manager



Engineering Placement Fair

The second Engineering Placement Fair will be held on **Friday 18th November 2016**

70 engineering companies will be able to promote their business and recruitment opportunities to our students

12 month placements
Summer placements
Graduate roles

Contact the placement Team for more details
fac-eng-placements-team@bath.ac.uk