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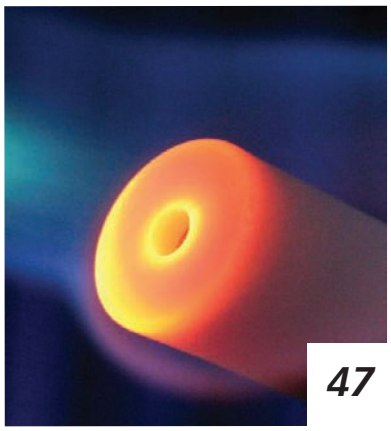

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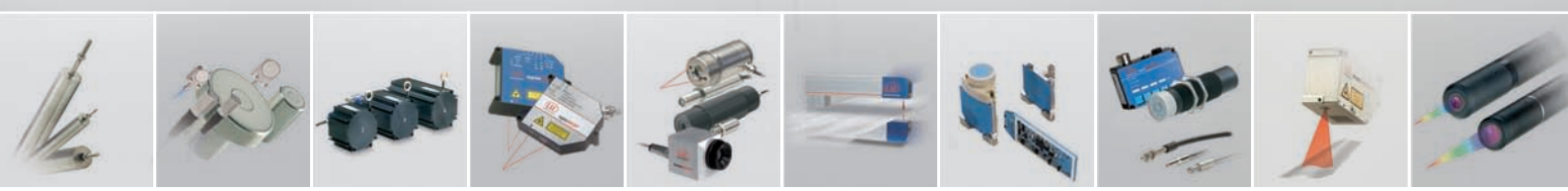

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Call to speak to a sensor expert +44 (0) 151 355 6070 or visit **www.micro-epsilon.co.uk**

Editor
Paul Fanning
pfanning@findlay.co.uk

Deputy Editor
Justin Cunningham
jcunningham@findlay.co.uk

Web Editor
Laura Hopperton
lhopperton@findlay.co.uk

Group Editor
Graham Pitcher
gpitcher@findlay.co.uk

Art Editor
Martin Cherry

Technical Illustrator
Phil Holmes

Advertising sales
01322 221144

Sales Manager
Luke Webster
lwebster@findlay.co.uk

Deputy Sales Manager
Simon Bonell
sbonell@findlay.co.uk

Sales Executive
James Slade
jslade@findlay.co.uk

Production Manager
Heather Upton
hupton@findlay.co.uk

Circulation Manager
Chris Jones
cjones@findlay.co.uk

Publisher
Ed Tranter
etranter@findlay.co.uk

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Hitting the right notes

Paul Fanning, Editor (pfanning@findlay.co.uk)

October saw two events that have served to bring together and celebrate the very best of design engineering. And I am proud to say that both were organised by *Eureka*'s parent company, Findlay Media.

The first was the inaugural Engineering Design Show, which took place on 10th-11th October and attracted more than 1,600 design engineers to the Ricoh Arena, Coventry, to see the products and services offered at the only exhibition in the country tailored specifically to them.

The second was the British Engineering Excellence Awards Ceremony held in London on the 25th October. This was the fourth such event and, by celebrating the very best of design engineering, the BEEAs have come to establish themselves as prestigious and highly-valued benchmarks of quality in product design and development.

Of course, investment in these events serves to demonstrate *Eureka*'s and Findlay Media's ongoing commitment to supporting design engineering in the UK. However, what is more important is that their success demonstrates that you, our readers, are enthused by and supportive of our ideas and products. After all, without your attendance at the Engineering Design Show or your readiness to enter and support the BEEAs, neither event could exist – let alone be held to be a success. For that, we would like to offer our sincere and heartfelt thanks.

Of course, from my perspective, it was a particular pleasure to have seen and spoken to so many readers at these events. To see first hand how loyal to and engaged with *Eureka* many of you are is both gratifying and inspiring. And, of course, it makes us even more determined to maintain our commitment to offering you products that continue to capture your imagination and offer real value to the modern design engineer.

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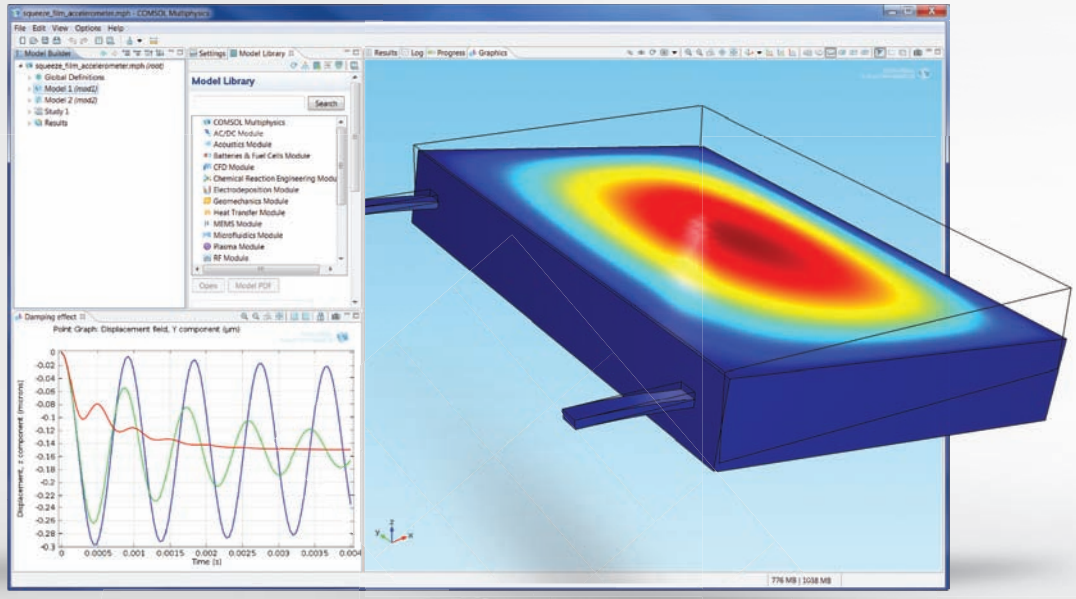

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TSB launches £7m 3D printing competition

The Government's Technology Strategy Board (TSB) has launched its £7m additive manufacturing (3D Printing) competition at the Enabled by Design-athon event in London.

TSB expects to make grants of between £50,000 and £750,000 for projects that help overcome some of the factors that have prevented a rapid expansion of this game-changing technology. They cite these barriers as: high cost, inconsistent material properties, lack of applicable industry standards, unexpected pre- and post-processing requirements and the failure to exploit the new design freedoms offered.

Robin Wilson, lead technologist with the Technology Strategy Board

Announcing the competition, Robin Wilson, lead technologist of the Technology Strategy Board, said: "We're particularly keen to attract new entrants from the design and 'maker' communities who wouldn't normally look at manufacturing competitions and we know many of these people will be attending the Enabled by Design-athon.

"Enabling these individuals and small companies to partner up or subcontract with some of the more established design, manufacturing and 3D printing companies is one of the challenges we are hoping to overcome."

Denise Stephens, Founder of Enabled by Design, says: "We're extremely proud and excited that the Technology Strategy Board has chosen the Enabled by Design-athon to launch its competition briefing document. I know there are a lot of people who are eagerly awaiting to hear about these details and people coming to our event will be the first to have the opportunity to gain further insights into the competition.

"We're passionate about Design for All and feel that 3D printing technology will take accessible design to the next level through customisation of new and existing products, better supporting individuals' needs. So a competition supporting the uptake of additive manufacturing in new areas is something we're keen to see."

Details of the £7m Technology Strategy Board CR&D (Collaborative Research and Development) competition "Inspiring New Design Freedoms in Additive Manufacturing / 3D printing" are now up on the Technology Strategy Board competition website. It opens for registration on 3rd December and the briefing / consortium building event is on 11th December 2012 in London.

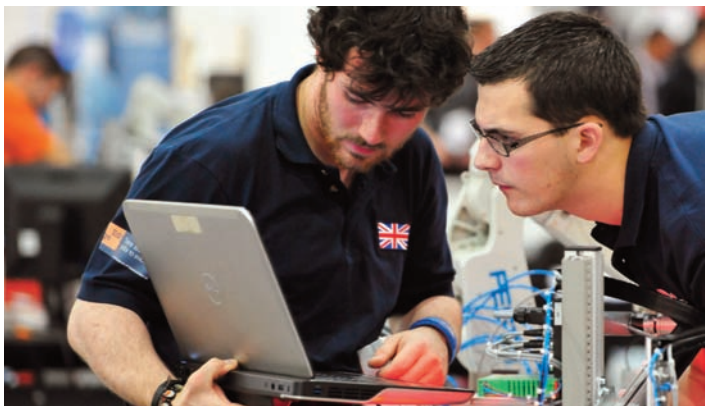
This competition aims to overcome some of the barriers to adoption that exist around 3D printing – including what Wilson referred to as the "dirty secrets" of additive manufacturing. By investing in these target areas, the aim is to accelerate the creation of exciting new design, production and supply chain competences for UK businesses.

All proposals must be collaborative and business-led, involving at least one other non-academic partner. We expect to invest between £50k and £750k in each project, although projects outside this range will be considered. The TSB is primarily looking to fund innovation projects in the category of industrial research, attracting 50% public funding (60% for SMEs).

This is a two-stage competition. It opens on 3 December 2012 and the deadline for applicants to register is noon on 23 January 2013. A briefing and consortium building event will be held in London on 11 December 2012.

www.innovateuk.org

New vocational courses announced



New vocational courses in engineering are to be introduced in UK schools in 2014, Chancellor George Osborne has announced.

Speaking at the opening of a new state of the art Rolls-Royce apprenticeships academy in Derby, the Chancellor said the move would encourage more schools to offer engineering courses and help Britain 'thrive' in the global economy.

In January, the government controversially downgraded the value of the engineering diploma for 14-16 year olds from five GCSEs to one, a move that angered the likes of the Institution of Mechanical Engineers and the Royal Academy of Engineering.

The latter organisation has now been tasked with working with employers to re-design the Principal Learning element of the engineering diploma into four 'rigorous' qualifications, each equivalent to one GCSE.

"If Britain is to compete and thrive in the global economy then we must lead the way in science and technology," said Chancellor George Osborne. "These new engineering qualifications will give young people the skills that they want, and that businesses need, to be at the forefront of this race."

3D printing used to verify parts on wounded knee

OPS has supplied an Objet Eden 3D printer to surgeons in the UK to help them plan the reconstruction of the knee of a British soldier, which was smashed by a bullet while he was serving in Iraq.

Professor Justin Cobb, from London's Imperial College Healthcare NHS Trust, based at Charing Cross Hospital, will be using the 3D printer to produce micron-layer precise knee joint models and patterns for titanium plates that will be used in the pioneering reconstructive surgery.

This is expected to help the surgeon's more accurately plan the surgery, reconfigure the bones more quickly and avoid the need to replace the entire knee joint.

The pre-surgery procedure will use the effectiveness of low radiation dose CT scanning of the anatomy of the patient's limb to capture multiple slice images of the joint and ligaments to create a personalised knee scan.

This will then be built up into a SolidWorks 3D imaging model to provide an accurate visual address to the extent of the damage to the limb, which will then be transported into the Objet 3D printer using the MED 610 bio-compatible material, allowing prolonged contact to be made with the skin.

This solid model not only gives pre-operative visual and tactile information, but also the intra-operative guidance to assist the planning and undertaking of the surgery.

As well as the MED 610 material, the Objet Eden 3D 250 printer has the capability to work with up to 10 different materials, including ABS, polypropylene and transparent materials, with a variety of colours and physical characteristics.

The process is based on using 16 micron print layers to create models accurate to between 0.1 to 0.3mm, while being realistic and useable for form, fit and function, prototyping and testing.

www.ops-uk.com

Charlie Jessey
Technical Support Engineer

"The new SolidWorks UK Student Facebook page is awesome. The tips and tricks that I've learnt from this page have helped me with my final year project, thanks."

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Bomb disposal robot gets lift with linear actuator

A high-performance linear actuator from HT Servo has been deployed in a new generation of robots for the disposal of explosive ordnance.

The Cutlass vehicles, developed by Coventry-based firm Remotec UK, will be used by the MoD for anti-terrorism operations worldwide.

According to its developers, they are capable of accommodating a wide range of payloads, sensors and tools, and offer mobility on all types of hard and soft terrain and in all weather conditions, including floods.

All motion axes, including the six drive wheels on the Cutlass, are electrically driven, powered by an on-board Lithium ion rechargeable battery. The manipulator arm is equipped with a state-of-the-art gripper and has nine degrees of freedom for greater movement and agility inside limited spaces, such as the interior of a car.

The actuator is used to lift the whole robotic arm to provide extra power to the internal base axis rotator gear, maximising its performance and helping counteract the turning moment created when a load is experienced with the arm in an extended position.

"This sort of project usually requires a bespoke solution," noted David Baillie of HT Servo. "We worked closely with the Remotec design team to identify maximum loads, speed requirements and other operating parameters. Fortunately the Thomson Electrak LA14 fitted the bill nicely, although we paired it with an extra powerful motor and made a few other modifications commensurate with the likely operating conditions of the Cutlass."

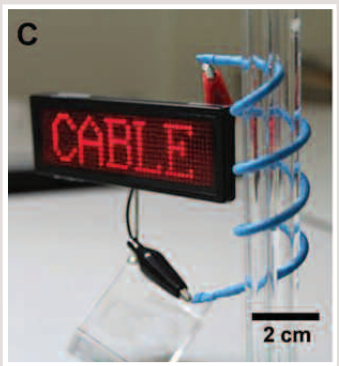
www.htservo.com

Solution to last month's Coffee Time Challenge

The solution to last month's Coffee Time Challenge of how to make a flexible battery comes from Korean-based LG Chem. Its researchers are trying a completely new approach to develop a battery that is highly scalable, can be manufactured with a wide range of capacities, and is also extremely flexible.

The team coated copper wires with nickel-tin, coiled them around a rod and stretched them, obtaining a hollow spiral, spring-like flexible anode. Finally, the anode was coupled with a lithium-ion cell. The elegance of this design is that the electrolyte can be easily injected in the battery and is easily spread throughout the electrodes. Also, more importantly, battery capacity can be simply designed by controlling the number of copper wires and the thickness of the cathode composite that wraps around them. Preliminary tests showed the cable battery to be stable in discharge performance regardless of their degree of bending, with almost no change compared to a non-bending state.

The batteries can be woven in series or in parallel to assume nearly any shape (including sheets) with finely controlled energy density. As such, they are versatile like no other battery. LG seems to be betting on this technology, and said that if it can resolve outstanding issues, the batteries could soon hit the market and have an enormous impact on portable, wearable, and flexible electronics in the near future.



www.lgchem.com

Raising thermal efficiency

LiquidPiston has announced the X2, a 40hp rotary engine that requires no valves, cooling systems, radiators, mufflers or other components.

The innovative design operates on the company's patent pending High Efficiency Hybrid Cycle (HEHC), which is optimised to increase average efficiency over conventional diesel engines from less than 20% to more than 50% under typical operating modes.

According to LiquidPiston, the cycle reduces fuel consumption by as much as threefold over conventional diesel engines, and when working in combination with the rotary engine architecture, enables an engine that is up to ten times lighter, significantly quieter and two to three times more efficient at part-load than conventional engines.

www.liquidpiston.com

MICRO-EPSILON HAS ONLINE TOOL FOR SENSOR SELECTION

Precision sensor manufacturer Micro-Epsilon has launched a new online tool for assisting customers in selecting the most appropriate infrared temperature sensor for their application.

Product Selector is an easy to use product configurator that utilises just four parameters in order to identify a suitable sensor.

First, the user specifies the material of the object to be measured from a pre-defined list of options that includes more than 40 materials such as glass, ceramics, steel, aluminium, plastics and rubber.

Next, the user specifies the spot size diameter between 0 and 400mm, followed by the distance between the sensor and the target object (0 to 6,750mm). The user is then asked to select the temperature measuring range – anywhere between -50 to 1,800°C. If a product with laser aiming/marking is required for accurate alignment, or if space restrictions call for a more compact sensor with integrated controller, the user can refine the search accordingly.

Based on the four parameters above, the user is then presented with a list of on-screen product options.

www.micro-epsilon.co.uk

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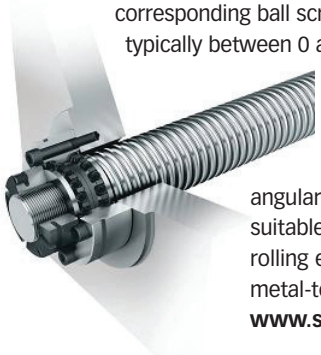
Hybrid bearings prevent premature failures

A new angular contact ball bearing has been developed that prevents the premature failure of ball screws in short stroke applications, particularly those that occur due to false brinelling.

Short stroke operation of screw drives can result in the premature failure of bearing supports due to false brinelling. This occurs when the separating lubricant film between the rolling elements and raceways is no longer present, for example, due to a lack of relative motion between the rolling partners or where the pivot angle is very small. This leads to localised fretting corrosion where the unprotected steel-to-steel contact point starts to corrode. Vibrations cause the corroded parts to detach and become embedded in the lubricating grease. Over time, the rolling elements fuse to the raceway, leading to bearing failure.

With bearings for screw drives, false brinelling repeatedly occurs if the corresponding axes are at a standstill for extended periods of time or if they perform small strokes. Depending on the pitch of the corresponding ball screw spindle, these strokes distances are typically between 0 and 2mm. Due to the small workpiece sizes involved, false brinelling is a particular problem in mould production and medical equipment.



Schaeffler's new ZKLF -HC hybrid angular contact thrust ball bearings provide a suitable solution. The bearings use ceramic rolling elements, so there is no possibility of metal-to-metal contact.

www.schaeffler.co.uk

New general purpose polyester tape from 3M

Diversified technology company 3M has added a high-performance yet cost-effective general purpose polyester tape to its industrial tapes range. Ideal for powder-coat masking or splicing, the new General Purpose Polyester Tape 8995 from 3M can also be used as a flash breaker for adhesive overspill or for bagging in the composite bonding process.

Available in 25mm or 50mm widths and coloured blue for recognition, General Purpose Polyester Tape 8995 is a 60 micron tape with a polyester carrier and pressure-sensitive silicone adhesive which gives a tight bond for sharp edge lines. It is flexible and conformable, even round curved edges, with good tensile strength for tearing through cured paint or adhesive coatings. It offers clean removal up to temperatures of 200°C.

Kirsty Horsfall of the 3M Industrial Adhesives and Tapes Division explained: "There are times in any industry when you need a quality product at a competitive price and General Purpose Polyester Tape 8995 offers a cost-effective alternative to some of the more specialised tapes. It is ideally suited for high-temperature applications such as flash-breaking in composite bonding, powder coat masking and splicing silicone and non-silicone coated papers."

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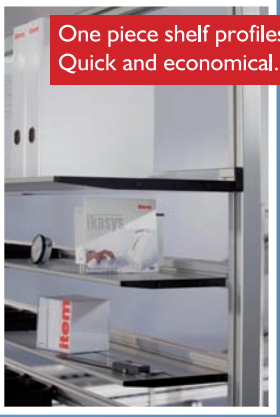

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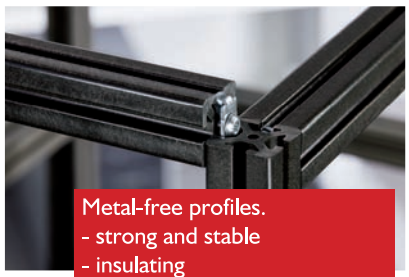

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Best in class

Young Engineers and Green Products led the field at this year's British Engineering Excellence Awards. Graham Pitcher reports.

The winners of the 2012 British Engineering Excellence Awards were announced on 25 September at a gala luncheon at 8 Northumberland Avenue, one of London's most prestigious venues.

Congratulations to all the winners and to Grand Prix winner Parker Hannifin Racor. And thanks to all the companies that entered. The BEEAs will be back again in 2013, so watch out for the call for entries next year.

1. Grand Prix 2012
Sponsor: Findlay Media
Winner: Parker Hannifin Racor Super Impactor CCV

The winner of the British Engineering Excellence Grand Prix was selected by the Judges from the winners in the other categories; a challenging task, given the standard of entries to this year's Awards.

Some 30 million diesel engines are manufactured each year and it's no surprise that designers of these engines have focused on reducing the exhaust emissions. But there remains another problem: 'blow by'. This happens when combustion gases under high pressure are 'blown by' the piston rings in the crankcase. These gases have to be allowed to leave the engine to avoid pressure build-up, but without increased emissions, so crankcase ventilators (CCVs) are employed to clean the gases and return them to the engine's air intake system.

Alongside solving the blow-by problem, the Superimpactor doesn't include a replaceable filter, nor does it feature rotating parts or electrical components.

2. Consultancy of the Year
Sponsor: Eureka
Winner: Team Consulting

Team is a 25 year old company which focuses on the design and development of medical products, systems and devices. Amongst projects which have been completed recently are drug delivery systems,

critical care and surgical tools.

According to Team, two things have helped to grow its business: a focus on the medical sector; and the desire to save lives and make people better.

The Judges were particularly impressed by Team's development of a system which helps to keep a human liver alive for 24 hours, avoiding the need for racing against time to get the organ to its recipient. Clinical trials for the product have started and Team's customer expects to launch the product in 2013.

3. Small Company of the Year
Sponsor: D Young & Co LLP
Winner: Outram Research

This year's winning company, Outram Research, applies specialist skills in analogue and digital signal processing and embedded microprocessor design to develop power quality analysers for

utilities, network operators and other users. The products are used to troubleshoot power network problems around the world.

First established by John Outram in 1980, the company developed the Ranger data logger and licensed the design to a number of organisations. However, he decided in 2003 that the data loggers were not achieving their potential and negotiated the return of the IP, a move which allowed Outram to design, manufacture and sell the products. This move has funded the development of products such as the Outram FLM.

4. Start Up of the Year
Winner: Amantys
Sponsor: Cambridge Consultants

Set up in 2010 by former executives from ARM and an academic from the University of Cambridge, Amantys is targeting high power conversion across markets where power requirements can reach the MegaWatt level, with voltages as high as 6.5kV. Through a combination of embedded

intelligence and analogue control techniques, Amantys is addressing a market which it says is worth $4.6billion and which is set to grow by 12% a year.

Its approach is to allow designers to optimise the efficiency of power converters and to improve system reliability. The company has raised more than £7m in funding and now has 14 staff, as well as its own high energy test and qualification facility.

5. Design Team of the Year
Sponsor: Anglia
Winner: Qioptiq SAKER

The SAKER design team faced a number of challenges; the weapon sight needed to be compact, lightweight and to have low power consumption. Innovations needed to be made in the package, the two objective lenses and the image combining optics.

Design commenced in October 2011, with a target date for the first prototype of 1 June 2012. This date was brought forward to 21 May 2012. putting the programme was two weeks behind schedule. Through a team effort, however three days before the event, significant amounts of work remained, but two prototypes were delivered in time for the launch.

Highly Commended: Congratulations to ByteSnap's EV charging post design team, whose entry was highly commended.

6. Green Product of the Year
Sponsor: National Instruments
Winner: Racor Super Impactor CCV

In order to meet the Euro 5 emissions targets, engine manufacturers are using closed crankcase ventilation (CCV) systems to return cleaned blow by gas to the engine's air intake. The Racor Super Impactor CCV reduces engine emissions to the level required by Euro 6/tier 4 legislation. But customers have been more rigorous. One potential user required more than 98% of blow by oil to be recovered and for the device to be useful on new and worn engines.

Made from recyclable nylon PA66, the SuperImpactor CCV works without using a replaceable filter, reducing the amount of hazardous waste generated.

7. Materials Innovation of the Year
Sponsor: Engineering Materials Magazine
Winner: Tata Steel Europe HPrail

Work on HPrail – a special grade of steel developed specifically for railway applications – was prompted by the Hatfield rail disaster in 2000, which was said to have happened as a result of rolling contact fatigue (RCF), whereby cracks develop due to a mismatch in the rail's microstructure between ferrite and cementite. Tata Steel's solution is to strengthen the soft ferrite by alloying additions of silicon and vanadium. Meanwhile, nitrogen levels are controlled to ensure the desired particles precipitate during manufacturing.

8. Electronic Product of the Year
Sponsor: Digi-Key
Winner: Nujira NCT-L1100

Mobile phone power consumption is a topic on which many have a view. One of the 'guilty' components is the power amplifier (PA). In a conventional configuration, the PA operates from a fixed supply voltage and often operates at less than maximum efficiency. Nujira believes it has solved this problem using envelope tracking, where the supply voltage is constantly adjusted to make sure the PA is running at peak efficiency for the given power requirement.

The NCT-L1100 is the first device in Nujira's Coolteq.L range of envelope tracking power supply modulators. According to Nujira, the part can reduce the amount of wasted power by more than 50%, not only extending battery life, but also reducing heat generation.

9. Mechanical Product of the Year
Sponsor: igus (UK)
Winner: Johnston Sweepers C201

While the C201 compact road sweeper is based around technology developed some 50 years ago, it features a range of new design concepts, including what is described as a revolutionary four wheel steering system. While the previous model – the C200 – was a success in the UK, overseas sales suffered because the machine didn't offer four wheel steer.

There are more than 30 design improvements on the C201, ranging from a new chassis and engine mounting to a host of safety and comfort features. Designing a new chassis allowed four-wheel steer to be added as a modular option.

10. Young Design Engineer of the Year
Sponsor: RS Components
Winner: Michael Aldridge and Simon Pykett

In one of the most keenly contested Awards, the Judges were unable to separate this year's joint winners.

Michael Aldridge graduated from Strathclyde University with a Master's Degree in Product Design Engineering in 2008. Now a design engineer with 4c Design, he has been involved with a range of projects, including: developing a 'fresh outlook' on liferaft design; the complete design of an electric bike – which involves a patent application; and a machine which can bottle vaccine solutions under sterile conditions.

Meanwhile, since starting work with Penny Hydraulics, Simon Pykett has 'transformed the company's nuclear business', winning a £160,000 contract within six months.

Originally tasked with developing a way to lift and handle spent nuclear fuel, Pykett took ownership of the project, developing an internal capability by winning and delivering a contract, rather than by seeking contracts after the capability had been developed. His work also resulted in Penny Hydraulics becoming a quality assured supplier to Sellafield a year earlier than anticipated. He has since secured business at other nuclear sites, including a £240,000 contract with Magnox.

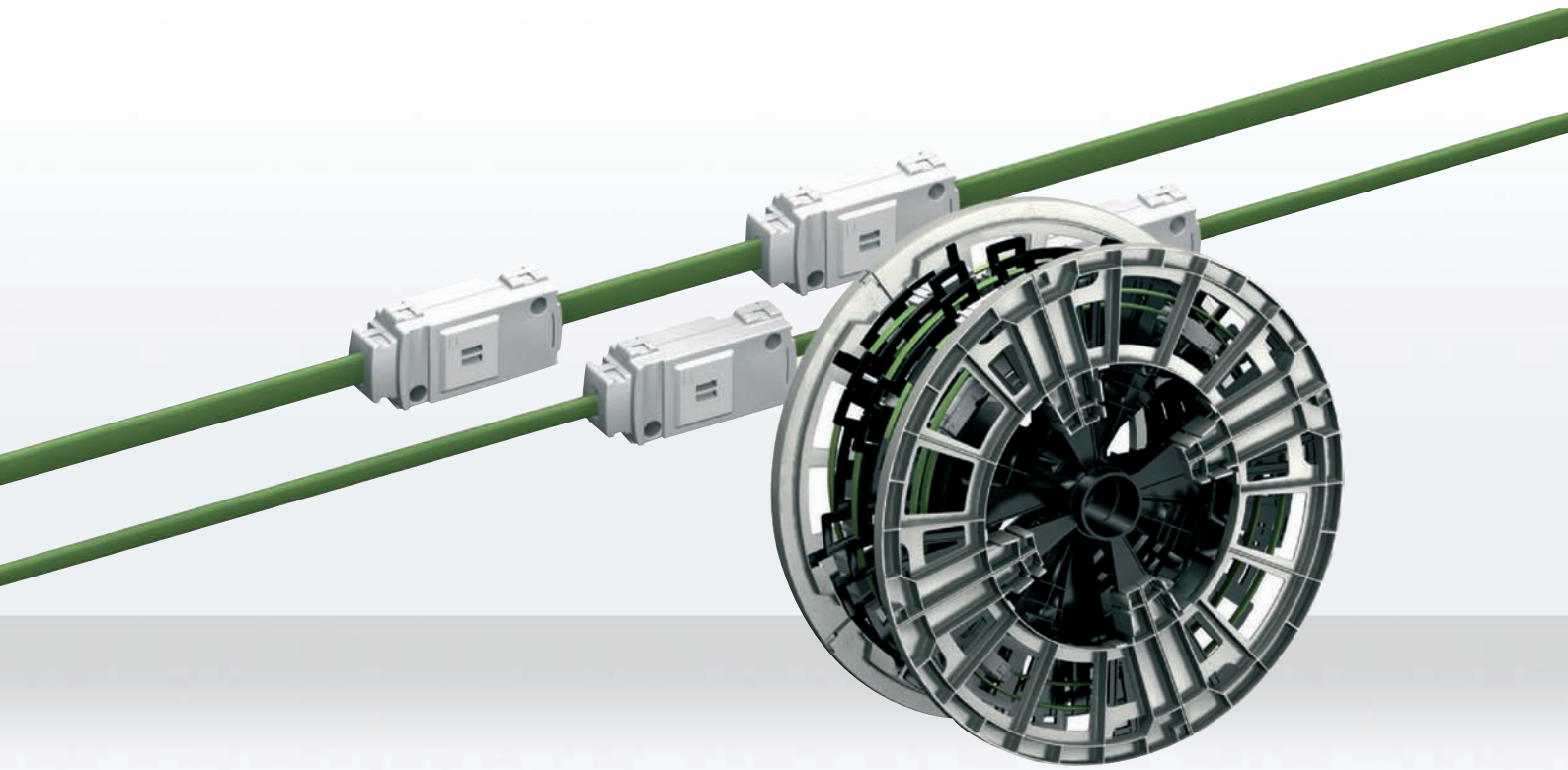
11. Design Engineer of the Year
Sponsor: Mouser Electronics
Winner: James White

In a recent two year project, James White lead the development of three loader arm assemblies. This has, for the first time, given Caterpillar a family of loader arms with a common design for its backhoes. The project also reduced the number of loader designs from five to three and increased manufacturability and assembly efficiency.

White is named as the designer of an innovative clamp protected by design rights and has a patent pending for an element of the next generation loader arm design.

Canalis KDP

Lighting and power socket distribution



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Due to its flexible design, Canalis KDP busbar trunking simplifies routing, thus reducing design and installation times.

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A specific connector for lighting control

This reduces cabling errors and saves 1 hour assembly time per control point as well as making the installation easily upgradeable.

Access points available where required:
The rearrangment of premises is not a problem; feeders can be rearranged or added whenever required.

Remarkably flexible and compact:
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Schneider Electric™

Bloodhound – firing the

A wet and and blustery day in Cornwall seems an incongruous setting for a display of cutting edge engineering, but it was here, at RAF St Mawgan in Newquay, that the latest step in the saga of the Bloodhound Supersonic Car was taken.

This is because it was here that the rocket that, it is hoped, will propel the car at 1,050mph or Mach 1.4 across the Hakskeen Plain in South Africa was test fired. Developed by Falcon Project, this rocket was to be the biggest fired in the UK for over 20 years. Indeed, it was hard to move for all the statistics being thrown at one on the day. At 4m long and 45.7 cm in diameter and 450kg in weight, Bloodhound's rocket is the largest of its kind ever designed in Europe. Equally, one was assured, the sound made would be the largest man-made sound in the world that day – equivalent to 30 Jumbo jets taking off.

For all these claims, however, one thing was repeatedly made clear: this was to be an experiment rather than a demonstration. No-one was sure what was going to happen when the rocket was fired. This was made clear by the Bloodhound's eventual pilot Squadron Leader Andy Green, who said: "This is the first big test of the technology…we've got to push the tech hard to find if there's a weak point. If the rocket blows up after five seconds, then at least we still have five seconds of hard data."

The possibility of very public failure was a very real one, but as Green pointed out, this was very much inherent to the nature of the project as a public enterprise. "Not since the Apollo mission has anyone undertaken this level of experimental engineering in public. Normally, people do these things behind closed doors and then invite the press and public in," he said.

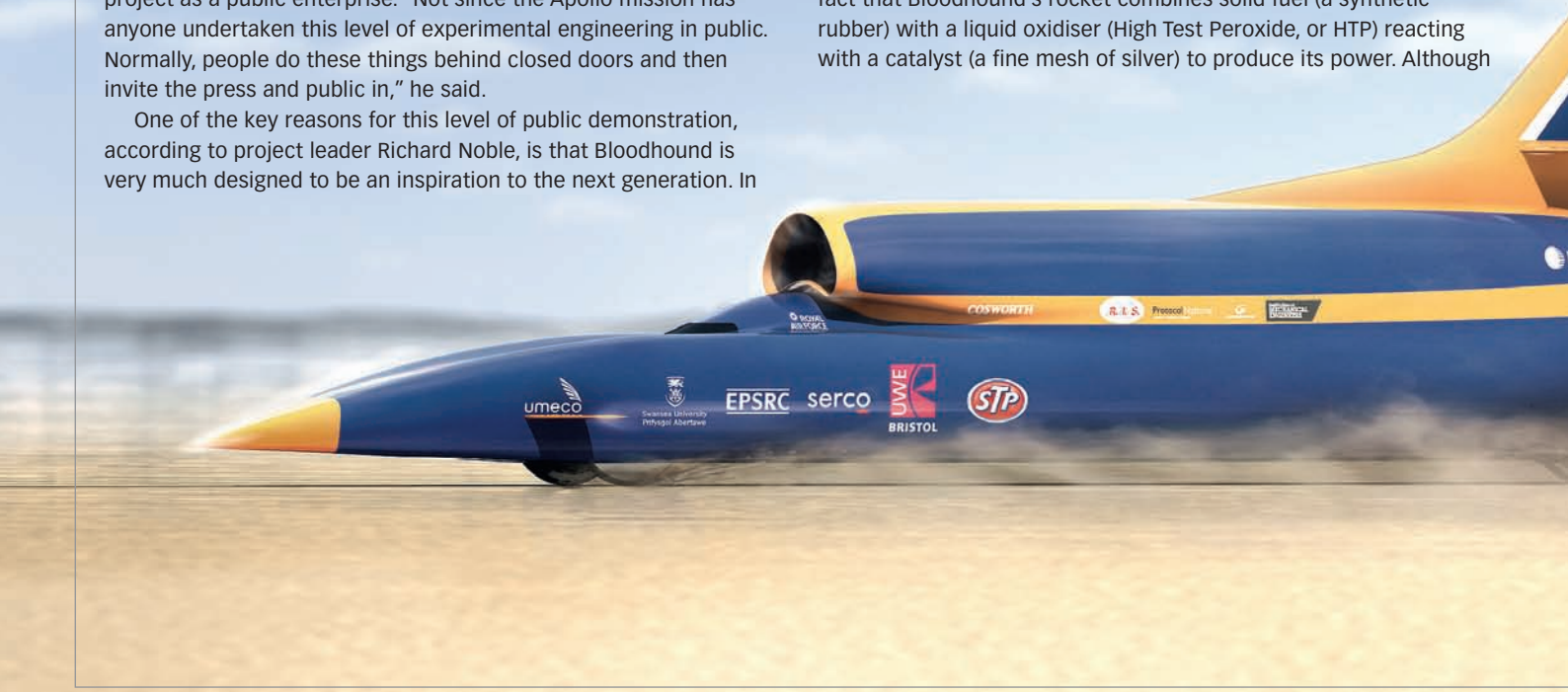
One of the key reasons for this level of public demonstration, according to project leader Richard Noble, is that Bloodhound is very much designed to be an inspiration to the next generation. In fact, this is at the forefront of the mission as far as the team is concerned. All data relating to the car is being shared with 5,300 schools across the UK, as well as universities and other educational establishments.

In fact, the value of Bloodhound as a means of attracting young people into engineering has recently been acknowledged by the MoD in the form of a 'concordat' between the two signed by Defence Minister Philip Dunne and Bloodhound Director Richard Noble, which outlines their commitment to work together to achieve common goals.

Naturally, these goals include promoting Science, Technology, Engineering and Mathematics in the UK and raising the profile of Science and Technology in Defence, with Dunne saying: "Bloodhound is an inspirational project that will have a lasting legacy for the UK by inspiring future generations into careers in Science, Technology, Engineering and Maths. These are essential skills to British industry, particularly within the Defence sector, and it is vital that we nurture them."

However, any benefits bestowed by Bloodhound in this regard will ultimately be reliant on the success of the technology. And in this regard, the test proved a (literally) roaring success. During the test, which was streamed live to the web, the rocket burned for 10 seconds, generating 14,000lb of thrust – the equivalent of 30-40,000 hp. Sound levels at the rocket nozzle reached 185dB.

The term 'hybrid' used to describe this rocket stems from the fact that Bloodhound's rocket combines solid fuel (a synthetic rubber) with a liquid oxidiser (High Test Peroxide, or HTP) reacting with a catalyst (a fine mesh of silver) to produce its power. Although



imagination

The successful test firing of Bloodhound's rocket was headline news. However, as Paul Fanning reports, this is just one area of progress for this high-profile engineering project.

technically demanding, the Bloodhound team believes the approach to be the safest and most controllable option, allowing driver Andy Green to shut off the flow of oxidiser and extinguish the rocket, if required.

During the test, the Cosworth F1 engine revved to 16,600 rpm in order to fire HTP into the rocket at a pressure of 820 psi – equivalent to holding a large family car on the palm of your hand and with enough flow to fill a bath in five seconds.

Initial results show that the peak thrust of 14,000lbs was achieved with the Cosworth F1 engine at a lower throttle position, delivering 20psi more than the engineers were expecting, giving them even more confidence in the system.

The rocket's steady, smooth combustion is the result of a ground breaking Computational Fluid Dynamics (CFD) study that mathematically mapped the burning fuel grain within the rocket chamber. This resulted in a unique, star-shaped rubber fuel grain that produced perfect 'Mach diamonds' in the rocket's plume (Mach diamonds are a formation of standing wave patterns that appear in the supersonic exhaust plume of an aerospace propulsion system).

Bloodhound's engineers were able to evaluate the performance of the complete rocket system for the first time, comprising of the Cosworth CA2010 F1 engine, High Test Peroxide oxidiser tank, custom designed gearbox and software and Falcon Hybrid Rocket, designed by 28 year-old self-trained rocketeer Daniel Jubb.

The rocket burned for 10 seconds, generating 14,000lbs of thrust

But there is more to Bloodhound than just the rocket, of course. The whole project is one where the engineering is operating at the limits of knowledge and performance. Some idea of just the levels of strain under which even the most fundamental components will operate can be seen from the car's wheels, which, by virtue of the fact that they will need to travel faster than any other wheels in history, have to be unique.

The 90kg, 900mm diameter solid aluminium wheels will spin up to 177 times per second at top speed, withstanding a load of 50,000 radial G at the rim – in other words, a 1kg weight on the rim will be equivalent to 50 tonnes when the car reaches top speed. Manufactured by Glasgow-based Castle Engineering, they are the product of a three year design study by Bloodhound engineers, Innoval Technology and Lockheed Martin UK.

The challenges the team had to overcome included creating a design that would not fly apart when turning 10,200 times per minute and that could be manufactured to incredibly tight tolerances with zero distortion. According to Andy Green: "They illustrate the extraordinary nature of Bloodhound: at the speeds we're aiming for, nothing is straightforward. Even the simplest aspect is challenging. So this is a case of people reinventing the wheel...we had to!"

Of course, the wheels also have to be able to provide grip, something that will be in short supply at certain points of the run, as Green explains. "At high speeds, [Bloodhound] will be dominated

The view Andy Green will have from the cockpit of Bloodhound SSC

by aerodynamic forces, while at very low speeds there will be enough grip from the wheels. The problem is at intermediate speeds of around 300-400mph, where the wheels will be sliding all over the place. The wheel grip is at its lowest and the aerodynamic grip is very low, so that's where we'll fire the rocket – maximum acceleration, maximum dynamic changes on the vehicle. That's the bit where understanding which end of the vehicle is sliding and how to correct that – either with steering or power – becomes vital."

The aerodynamics, of course, are an area where the supersonic nature of the flow and in particular the presence of shock waves and their interaction with the ground create a unique set of circumstances. Bloodhound will, after all, be the only land-based vehicle in history to travel for a sustained period of time well above the speed of sound.

Shock waves form because of the nature of the propagation of sound waves through the air. Under normal subsonic conditions, the object transmits pressure disturbances ahead of it in the form of sound waves. These waves carry the 'information' to air molecules ahead of it that the body is coming and that they need to start moving out of the way. However, when the body itself is travelling at the same speed (sonic) or faster (supersonic) than the speed of these sound waves, it can no longer transmit this information forward and the waves 'bunch up' right in front of the vehicle forming a shockwave and audible 'sonic boom'.

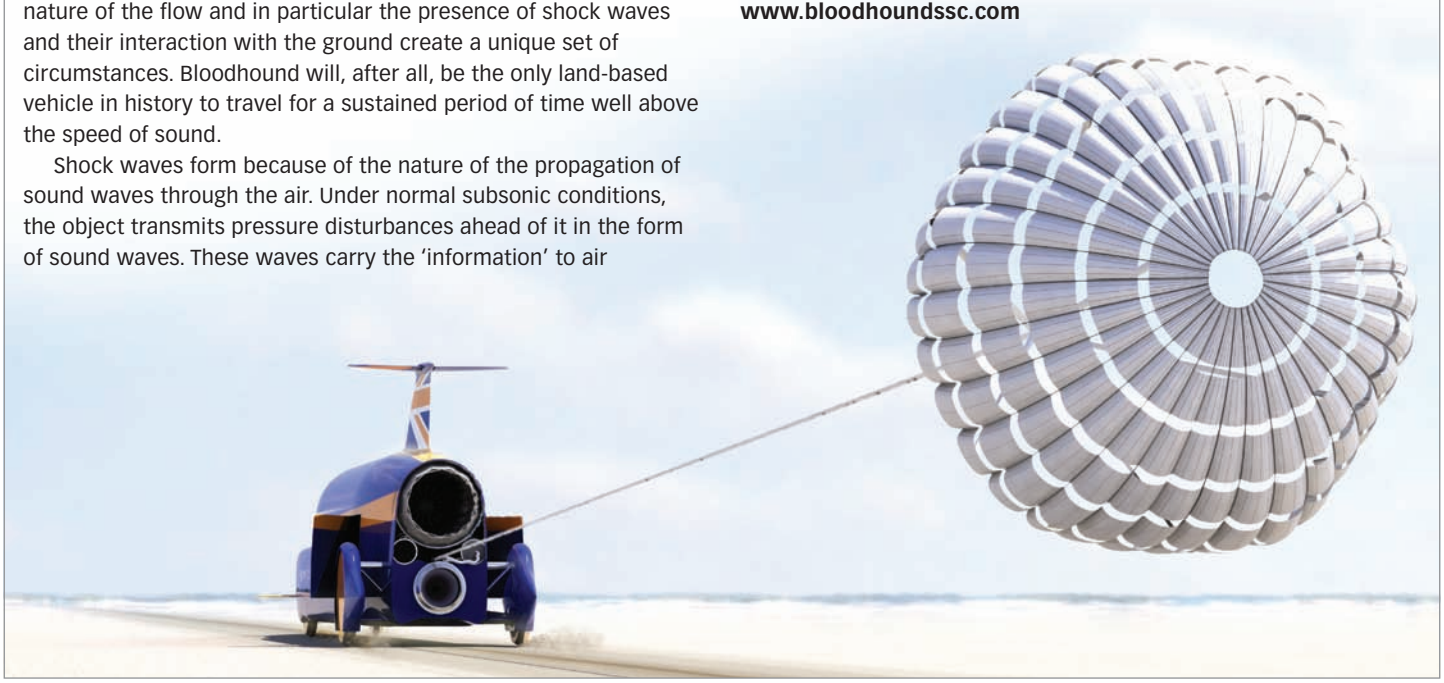
The flow properties around the vehicle no longer vary smoothly but change rapidly under these shock waves. An understanding of how these shock waves interact with the vehicle and with the desert surface has been a crucial part of the aerodynamic research for the Bloodhound programme.

The aerodynamic behaviour of individual components of Bloodhound SSC has been studied in conjunction with studies of the vehicle as a whole. For instance, a modelling of the flow around the base of the wheels under various configurations has been very important in understanding how they will interact with the desert surface. The overall dimensions of the wheel had been fixed, at the outset, by structural integrity specifications. Aerodynamic considerations were then applied to design of the finer detail of the wheel profile.

Analysing stand-alone components, such as intake, duct, or winglets is of value. However, it is not until all of these components fit together, and the full vehicle aerodynamic behaviour analysed, that the team will truly understand how these components interact with each other aerodynamically.

The fact that such fundamental design imponderables still exist at this stage of such a massive undertaking only serves to bear out the experimental nature of this engineering project. As Green puts it: "This is experimental science. No-one has ever done this before. Which Apollo unit was going to land on the moon? They decided that during the Apollo programme because they were developing the technology as they went. We're in the same boat."

www.bloodhoundssc.com



Getting real about nano

For too long, nanotechnology has been a victim of its own hype, something the director of the NanoKTN would like to remedy. Paul Fanning reports.

The word 'nanotechnology' for many is associated with futuristic visions, while others understand it as a technology that, while it may be significant in the future, for the moment remains out of reach in terms of design.

As director of the NanoKTN (Nanotechnology Knowledge Transfer Network), Dr Alec Reader is keen to dispel these perceptions, both of which he blames on an excess of hype that greeted this apparently revolutionary technology when it first appeared.

"I think we all suffered from that," he says. "10 or 15 years ago there was an enormous amount of hype and it really went out of control. I think about 15 or so years ago, the hype went up to a peak and then five years ago, it went into a trough because nothing seemed to be happening. Things have picked up again recently, but expectations are much more realistic. It's not science fiction hype anymore, it's real, practical and commercial solutions to everyday problems. The application areas are more realistic now. This is normally how technology advances."

And advance it has. According to Dr Reader. the NanoKTN has three areas of focus in the UK where it believes the country has a strong nanotechnology base that it can exploit. These are: medical technology; ICT hardware and engineering applications such as automotive, aerospace and defence.

Dr Reader points particularly to developments in medical applications as areas where nanotechnology is offering practical, real world solutions. "Things like sensors and other devices can be already be applied directly to patients in their own home to monitor various things such as glucose or insulin levels or even more simple things such as monitoring older people in their own homes rather than have them in costly hospitals or care homes. Putting devices on elderly people to ensure that they're still moving or to monitor heart rate or blood pressure remotely over a mobile phone connection is perfectly possible."

Reader also points to companies starting to sell very specialised kits that can be set up in a GP's office that can take a drop of blood into a microfluidic device and analyse it there and then – again saving money for the NHS.

In the engineering sphere, Dr Reader points out that nanomaterials have been used for many years, saying: "There are a lot of applications in aerospace such as coatings on fuselages. These are essentially just very sophisticated paints, really, but they reduce drag and resist heat. Equally, within turbines, you can put various nano coatings in there as well. That's not new and has been going on a while, but most people simply aren't aware of it."

Of course, with increased use comes an increased subjection to regulation and, in this regard, nanotechnology is no exception. As Dr Reader points out, any substance over one tonne is subject to REACH (Registration, Evaluation, Authorisation & restriction of CHemicals) and nanomaterials are having to jump through all these hoops along with everything else.

This can be a difficulty in such a relatively new field, of course, but even this is providing opportunities. Says Dr Reader: "One of our member companies [NanoSight] is growing at 200% a year because they've developed a piece of equipment that measures the size and shape of free nanoparticles. And they're doing brilliantly out of that. They've got the instrument and application-specific software to do it worldwide and are contributing to the UK's balance of payments."

For all these advances, however, Dr Reader is insistent that people's feet should remain firmly on the ground with regard to nanotechnology. He doesn't see nanotechnology becoming an off-the-shelf solution for industry any time soon, saying: "I think it will generally remain limited to bespoke or niche solutions for the most part… Individual issues will arise and nanotechnology will deal with them… We should dispel any public perception that nanotechnology's going to be everywhere and be doing everything. That's great for science fiction, but it's not the real world."

https://connect.innovateuk.org/web/nanoktn

Nano man

Dr Reader has over 30 years' experience in the micro and nano-electronics industries, working most recently at Innos and Polymer Vision. He is accredited with establishing Innos at the forefront of industrial R&D.

His tenure at Innos (Polymer Vision) was a continuation of a successful career that includes prominent positions as International Marketing Manager and Head of Department at ST-Microelectronics and Business-Line Manager at Philips Analytical (Semiconductors).

Neil Prescott

Managing Director, Heidenhain GB

"We were delighted to be associated with this inaugural Engineering Design Show and were pleasantly surprised at how busy it was right from the start. The venue worked very well for both exhibitors and visitors and we found that the visitors we talked to at our stand were from exactly the target audience we had hoped to reach."

"Resounding success" for Engineering Design Show

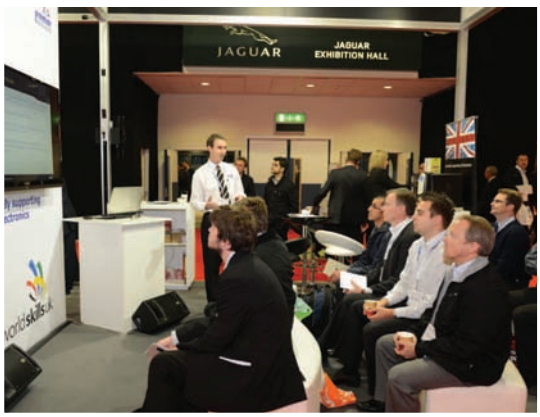
The inaugural Engineering Design Show took place on the 10th and 11th October with visitor numbers exceeding expectations and pleasing visitors and exhibitors.

Having been first officially announced in October 2011, on the 10th of October 2012, the Engineering Design Show finally opened its doors. And, over the two days it ran, the show welcomed some 1,600 design engineers, who came to access more than 80 market leading companies and learn about the latest technologies, techniques and strategies employed by experts at the forefront of their field.

Given that the original target of the Show was to attract 1,000 design decision makers, it is no exaggeration to describe this attendance as a great success. Exhibitors on the first day reported being too busy even to take lunch as visitors thronged the Jaguar Exhibition Hall at the Ricoh Arena, Coventry.

Alongside the exhibition itself, the Conference and Workshop programme also attracted great crowds. This was perhaps hardly surprising, since the Conference programme included high-profile representatives of companies including BAE Systems, AgustaWestland, McLaren and Jaguar Land Rover. Meanwhile, the two workshop theatres saw impressive levels of attendance, with some of the sessions being restricted to standing room only.

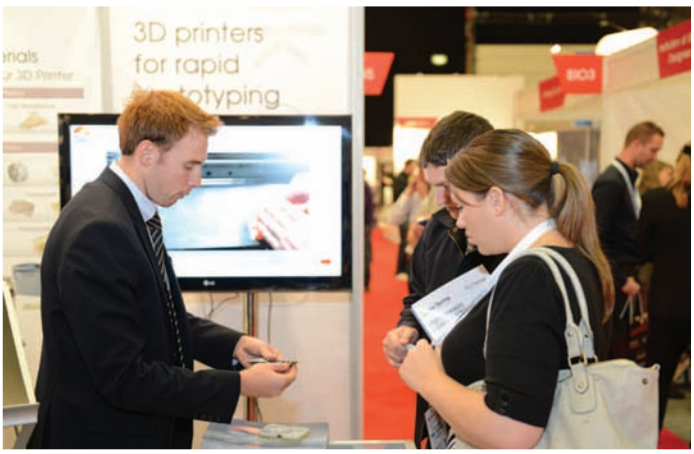
Particular highlights of the workshop programme included Man and Machine's presentation entitled 'Next-generation digital prototyping and simulation', which looked at Autodesk 360 and the benefits of simulation. Also packed to the rafters was the Workshop session hosted by Ian



Phil Mayo

Managing Director, Premier EDA Solutions

"Many thanks to everyone at Findlay who made the Engineering Design Show such a great success. Your hard work and dedication was superb and very much appreciated. We're looking forward to next year."



Harris, partner, chartered and European Patent Attorney with D Young & Co LLP. Here, the crowd was drawn by a practical explanation of the issues surrounding the sometimes daunting issue of intellectual property.

The thorny issue of intellectual property also arose in the Conference, where it was the subject of a panel discussion between Nigel Robinson of D Young & Co LLP, Jon Calvert or ClearView IP and James Baker, managing director of BAE Systems Advanced Technology Centre, chaired by Eureka's editor Paul Fanning. Subjects ranged from the issues of costs of IP protection, to the levels of understanding of the subject and, of course, the question of protecting IP in emerging markets such as China.

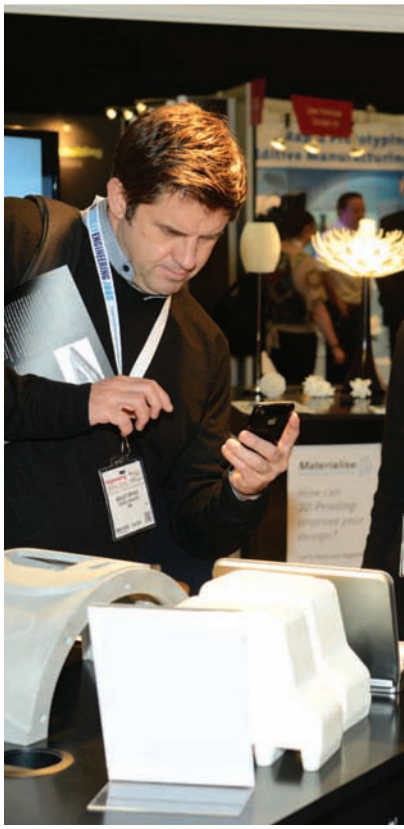
Other highpoints of the Conference programme included an insight into the motorsport industry's importance to UK engineering by the Motorsport Industry Association's chief executive Chris Aylett. Motorsport also featured heavily in Tim Strafford of McLaren's presentation on designing a Formula One control system.

Ed Tranter, Findlay Media's Executive Director said: "When we asked readers of Eureka and New Electronics magazines whether they would attend a design show targeted specifically at their requirements, we got an overwhelming 'yes'. That enthusiastic response was matched by suppliers to the engineering design market and I'm delighted to announce the resounding success of the 2012 Engineering Design Show – which exceeded all our expectations. The success of this year has been immense and we believe next year can be even better."

Shaun Addy

Chief Development Engineer, Cubewano and Design Engineer of the Year 2011

"Although I have been using RP technologies for 6 or 7 years now, I was surprised and excited by the advances demonstrated by some of the exhibitors at the show and have subsequently identified some new opportunities for reducing my development times."



Engineering design show

Engineering Design Show 2013

The enthusiasm with which this inaugural event has been received by exhibitors and potential visitors has convinced organiser Findlay Media that an event designed for design engineers is not only an idea whose time has come, but one that merits further expansion.

With this in mind, next year's event will triple in size. Occupying two halls here at the Ricoh Arena – a floorspace of 6,000m^2 – and expected to attract around 250 exhibitors, will take place on the 2nd and 3rd October 2013.

The show will of course remain true to the founding principle of catering specifically for design engineers, but will include a number of new elements. The most significant of these will be the launch of the Electronics Design Show, which will co-locate with the Engineering Design Show, occupying the whole of Hall 2 next year.

Created by Findlay Media using its market-leading brand New Electronics, the Electronics Design Show will provide exhibitors and visitors alike with a unique opportunity to take part in an event aimed exclusively at electronic design engineers and will attract key decision makers from all areas of electronics design over the two days.

electronics design show

As with the Engineering Design Show, the Electronics Design Show will offer best practice learning and practical design ideas for visitors through conference and workshop sessions. The conference will provide 16 sessions over the two days, while the workshop programme will offer 20 practical and technical sessions.

Prior to launching the Electronics Design Show, New Electronics conducted extensive interviews with design engineers, using key job functions across electronic design to discuss their requirements for an exhibition, what it would need to include and their current level of event attendance. This revealed that, of the New Electronics audience, 68% welcomed the launch of the Electronics Design Show.

As if to further emphasise this resonance within the industry, the Electronics Design Show has already received strong institutional and industry support, making it a must-attend event for anyone trying to reach electronics design engineers.

Engineering Materials Live!

Further leveraging the strength in depth of Findlay Media's editorial offering, the Engineering Design Show 2013 will also see a new section

Karen Preston

Marketing Services Manager, Schaeffler UK

"As an exhibitor at a brand new show, it was always going to be difficult to assess just how many we were going to see at the show, but I was very impressed with both the quantity and quality of visitor to our stand over both days... We are looking forward to continuing the initial engineering discussions from the show".

specifically devoted to the engineering materials sector.

The decision to incorporate this element of the show is intended to capitalise on this year's successful launch of Engineering Materials, the latest member of Findlay Media's stable of design engineering titles. Launched to meet the increasing demand for information on the latest materials and their applications, Engineering Materials has been extremely well received throughout the industry. Reflecting this warm reception, incorporating Engineering Materials Live! into the Engineering Design Show is the natural and logical next step.

Ultimately, co-location with the Electronics Design Show and the incorporation of Engineering Materials Live! represent not a departure from, but a continuation of the Engineering Design Show's most fundamental aim – to offer design engineers a comprehensive event focusing on their needs and their needs alone. These new elements can only complement this year's winning formula.

This year was great. We believe next year can be even better. We look forward to seeing you there.

To find out more about the Engineering Design Show 2013 or to book your place for next year, call Luke Webster on 01322 221144 or visit www.engineeringdesignshow.co.uk

The best Tweets from the @EngDesignShow 2012

M.Buttkereit Ltd
(@mbuttkereit) Awaiting the stampede, all ready stand A10 @engdesignshow

Haughton Design
(@Haughton_Design) Here at the @EngDesignShow! Only an hour left till @DavidMills_HD presentation #countdown #EngDesignShow

Rachel Park
(@RPES12) Lovely to catch up with @stevecrownshaw @EngDesignShow! Great to hear things are moving forward with #SLM - #3dprinting in metal for mnfg

Steve Crownshaw
(@stevecrownshaw) Good start to @Engdesignshow, at Ricoh arena, lots of interest.

Rutland Plastics
(@RutlandPlastics) Great morning @EngDesignShow. Very encouraging. Hopefully this will continue!

Richard H
(@RichRap3D) WoW! Enjoying the #arm 32bit micros talk, amazing business!

Sarah Kelly
(@sarahkelly_bsi) A really good day at the first #EngDesignShow. And it will be even bigger next year!

Graham Lock
(@cogentevents) @engdesignshow today – super example of publisher successfully turning readers into visitors.

maxon motor uk ltd
(@maxonmotoruk) Fabulous day yesterday at @EngDesignShow let's see what today brings!

David Maffin
(@David_Maffin) Great day at Engineering Design Show. Excellent to meet @thealloygus of @_BDI_ and Paul & Luke of @EurekaMagazine

OgleM+P
(@Ogle_Models) We've had a great couple of days at the #Ricoh arena for the @EngDesignShow. Lots of new faces and plenty of new projects to develop. #Great

Mark Gradwell
(@mjg73) @engdesignshow was very encouraging, busy & positive, w/ full workshops & healthy conference sessions. Well done to the team!

Getting connected

How will the ever-growing need for communication between different devices be met? Cambridge Consultants has some ideas.

Whether you use the latest buzz phrase 'Internet of Things' or the more traditional machine to machine (M2M), there is a growing need for communication between different devices. Sometimes it's a local need – creating a small data collection network, for example – but other applications have a wider range and need to rely on larger scale technologies.

An indication of the scale of demand for the internet of things was provided recently by Ericsson, which predicted there would be 50bn connected devices by the end of this decade.

Tim Ensor, a business developer in Cambridge Consultants' wireless team, says: "We're in the middle of an upsurge in interest in this technology. Companies are looking to add connectivity to all manner of devices." He believes Ericsson's estimate of 50bn connected devices may be on the high side. "But if you look at all the different ways there are to connect devices, the figure is not too unreasonable."

Ensor says there's a lot of work being undertaken to add wireless technology to products and systems. "It's a new wave," he begins. "The focus is now on what new services can be provided and what new value can users get from the data that the connected devices make available? By combining data from sensors, analysis of the data and the ability to control other devices, designers are making step-changes in the capability of their products."

So why is there an upsurge in interest and why might engineers want to build connectivity into their products? "Fundamentally, they are building in connectivity in order to both make their products easier to use and to enable new services," says Ensor. "The classic example is obviously the mobile phone – originally it was just about taking away the wire to make it easier to use. Today of course, it's all about what new services can be provided to users. Many other devices are going through the same cycle today where adding connectivity is just the beginning of whole new classes of product. Designers are really able to bring their products to life through adding connectivity."

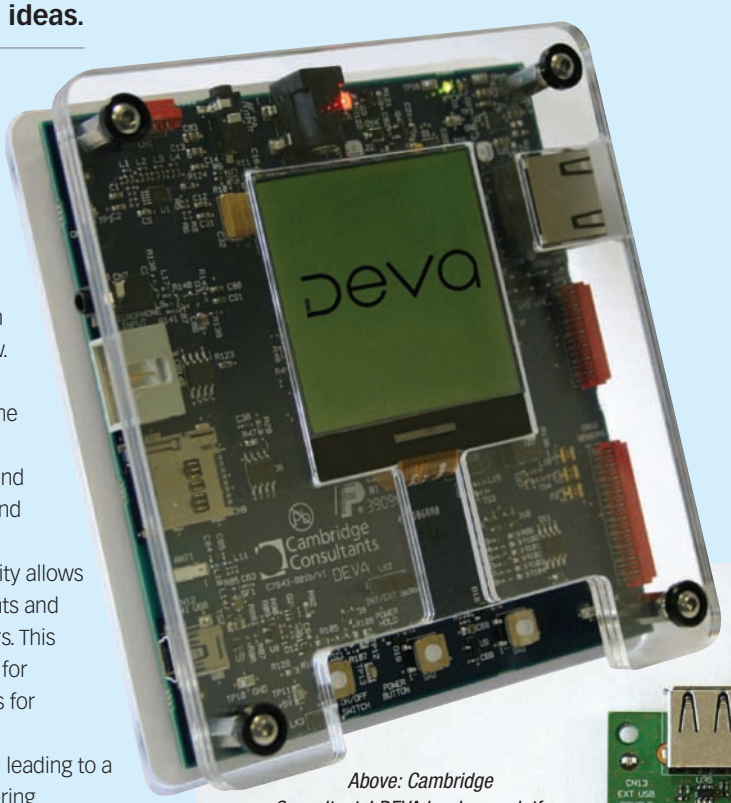
Ensor points out that, by connecting devices, users have the ability to analyse data which has not been available until now. "There is a wide range of applications being developed," he notes, "from smart meters or container tracking for logistics and distribution, through to health and medical devices. In healthcare applications, wireless connectivity allows data to be collected from patients and fed back to health care providers. This should lead to better outcomes for patients and lower service costs for providers."

These new opportunities are leading to a lot of activity within the engineering community. "It's a huge development area," Ensor says. "More and more companies are looking to take advantage of the benefits offered by connectivity to develop new products, new services or even new business models."

But he is keen to point out that it's not just about designing wireless connectivity into new products. "It is also appropriate to retrofit the technology to existing devices."

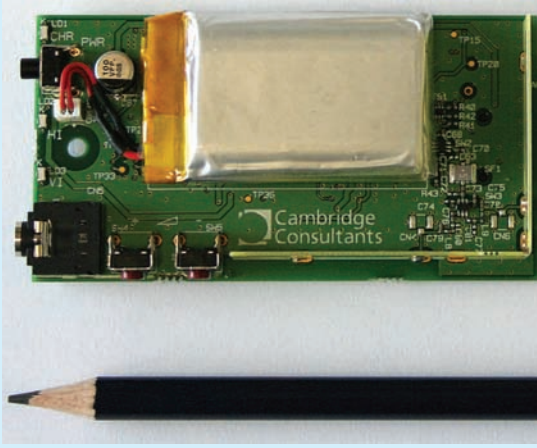
So if you're interested in adding wireless connectivity to the products you are designing, what technologies are available and what are their benefits?

Ensor says there is a wide range of technologies available. "At one end of the scale, there are cellular technologies, including 2G, 3G and now LTE/4G systems. Other well known methods include Wi-Fi and Bluetooth – which are short range and operate in license-free spectrum. At the other end of the scale are emerging technologies that enable devices such as



Above: Cambridge Consultants' DEVA hardware platform enables developers to quickly design and test differentiated Bluetooth products

Below: Cambridge Consultants has licensed its Salix wireless audio distribution system to digital cinema systems manufacturer Doremi Cinema



implantable medical electronics or that monitor what's happening down oil wells. But designers have to remember that each approach has different benefits and drawbacks."

Some development projects might consider using mobile phone technology; for example, if the device needs to connect to the internet. "But the business case may not work for these technologies because of the high cost of the components," he points out, "in which case, you have to look to less obvious solutions."

Where does a design engineer start? "It all depends upon what you want to achieve," Ensor says. "Assessing wireless technologies starts from the same point as all design decisions; understanding what your requirements are and the constraints within which you have to work. At Cambridge Consultants, we start from first principles to understand our client's objective and to answer questions such as what end-to-end outputs are needed, what range the device needs, how much data will be transmitted and received, how important response time is and how much power is available. After that, we move on to consider the operating environment such as temperature, exposure or expected interference sources along with commercial requirements, such as interoperability with other devices and how the new or upgraded product would provide a return on investment."

Sidewinder is one of the smallest commercially available 2G and 3G small cell platforms. The device has been developed by Cambridge Consultants to offer a low cost of entry for companies wishing to exploit a range of mobile communications standards

In Cambridge Consultants' experience, there are always some parameters which have been fixed by the use case. "Many use cases may require long transmission range, but will also want low power consumption which can introduce a potential conflict into the requirements, so you have to optimise," says Ensor.

And that can lead to earnest discussions between technical and marketing teams. "In some cases, the technical team will have to educate the commercial team in what's possible. Marketing might want a small, responsive product with the greatest range, but the technical team will have to help them understand what trade offs need to be made."

Ensor says that going through this process can appear somewhat mechanistic. "But it always provides interesting options, and we often don't recommend the answer that our clients were expecting. Technologies such as Wi-Fi or Bluetooth Low-Energy might seem to be the obvious answer, but sometimes the answer doesn't fall out of the bottom of a matrix and it requires more creativity to identify the right technology."

In some cases, the appropriate technology doesn't exist. "In those cases, there's often the opportunity to 'repurpose' an existing technology for a new application," Ensor points out. "For example, you could take DECT technology – used in cordless phones – and 'tweak' it for another application."

He says the benefit of this approach is that it reuses high functionality devices available 'off the shelf' and at low cost. "This approach can allow designers to meet requirements for a new product which you'd struggle to achieve otherwise at the target cost-point."

One communications technology gaining popularity in a variety of short range applications is ZigBee. Defined by the IEEE802.15.4 standard, ZigBee has functionality similar to that of Bluetooth, but offers the ability to create short range mesh networks and consume less power.

"One of the attractions of ZigBee mesh networks is that they can be self-configuring and self-healing," Ensor notes. "This is useful in applications where there is limited control of where you can place the technology. Large industrial environments are a good example; pumps and motors are difficult to move to get a better radio signal."

With a mesh network, there are a number of devices in the same area and any one device is capable of forwarding the messages of another device. This solves the problem of a particular point to point link being difficult to establish.

While many communications technologies have been around for some time, there is one 'new kid on the block'. Whitespace communication is being enabled by the end of analogue TV transmissions. Using old TV frequencies between 470 and 700MHz, Whitespace communications have long range and could provide an alternative to the use of mobile technologies and networks. "It depends to some extent on OFCOM to open up this band," he concludes, "but it's looking likely that they will make it available. It has the potential to bring new communication options to the UK's engineering design community and could enable a whole raft of new connected devices. With all the options available to designers, they really have to consider what reason they have not to add connectivity to their products."

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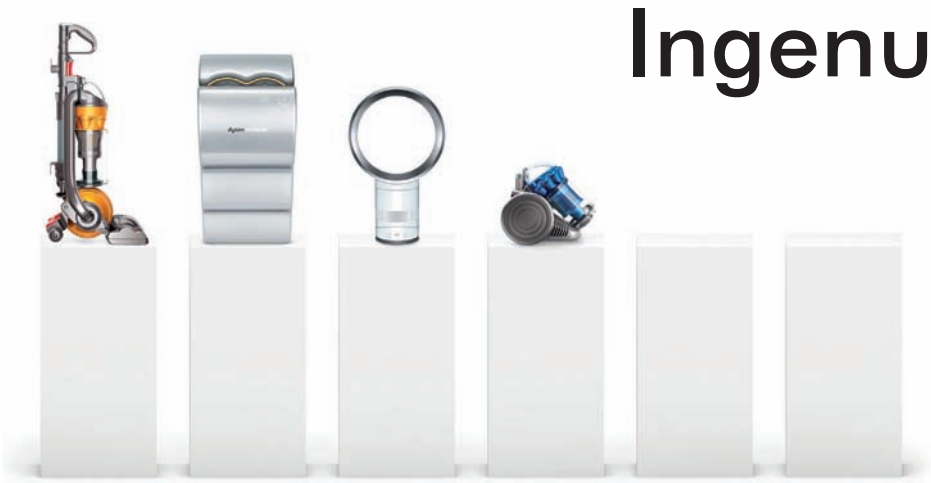

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Understanding 3D printing

As it becomes ever more hyped, Justin Cunningham asks just what additive manufacturing really means and the true benefits it offers to engineers.

The exotic geometries of this heat exchanger are difficult to produce using any other process

Developments in the technology driving additive manufacturing continue to move at pace. Yet, despite the improvements, it is often still misunderstood by many designers and engineers who question, what are the benefits? Those who do 'get it' generally love it, but many are still asking if this is a superfluous exercise that is more about marketing gimmickry than true engineering advantage.

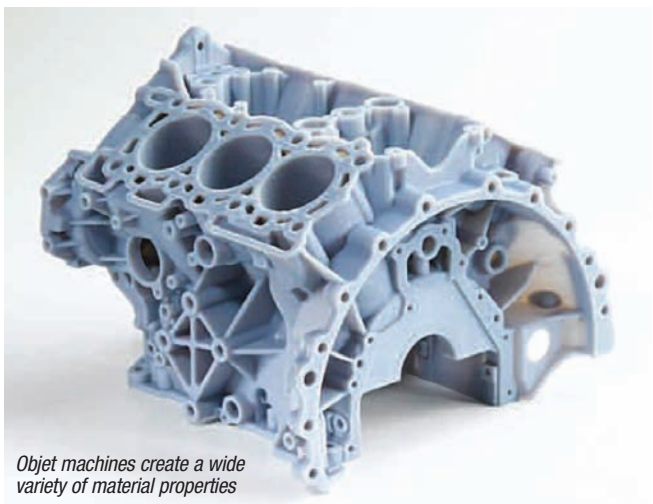
However, a general ignorance of both the technology and where it can be used must take part of the blame for these attitudes. This has not been helped by the many names the technology is known by, which are often used fairly interchangeably by all but the experts. Rapid prototyping, stereo lithography, SLS, FDM, 3D printing, rapid manufacturing, metal sintering... the list goes on.

"It does cause a lot of confusion," says Steven Wilcox, sales engineer at Objet Printer Solutions. "People ask what the differences are and though 3D printing certainly sits very well with people, additive manufacturing is the overall term and best describes the process; adding material as opposed to removing it."

The technology has moved along since the days of the fragile models that were not to be touched. Many desktop machines now offer materials that can mimic numerous physical properties. These can be printed in a single go with many parts that can show form and fit, are able to move and can be used to check functionality.

"People want to get more from additive manufacturing," says Wilcox. "Before, engineers might print a part, see it, pass it around, use it for marketing and then chuck it in the bin. But now they ask what analytical data can be found out? Do the parts from a CAD model fit together the way that's expected? Is it a snug fit? Is it a press fit? We want people to be able to test that functionality."

Objet recently announced that its Connex range of 3D printers can create over 100 different materials ranging from rigid to rubber-like substances in terms of texture, standard to ABS-grade engineering plastic in terms of toughness, as well as from transparent to opaque.

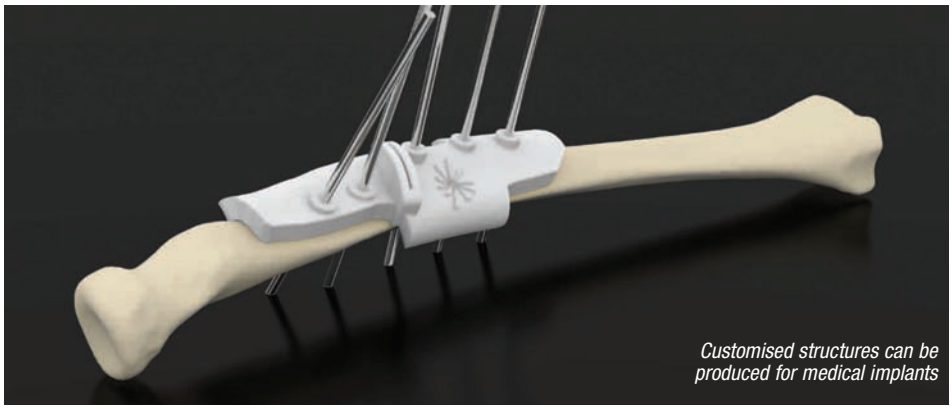


Objet machines create a wide variety of material properties

Many of these materials are derived by the mixing of more than 30 primary materials to enable designers and engineers to simulate precise properties that will closely resemble the intended end product with a high degree of realism. This ability to match proposed properties with those available from additive manufacturing has left some seeing opportunity and asking whether traditional production methods are needed at all?

Ian Halliday, chief executive of 3TRPD, which offers plastic and metal additive manufacturing services throughout the UK and Europe, says: "As it has become more competent, it has progressed from being purely visual to being production capable, especially on the metal sintering side. However, for production, it is still too expensive for most people and sectors.

"You can't compare it to injection moulding on price unless it is a very short run like in aerospace and motorsport. We are making parts for the inside of test jet engines, non-critical plastic parts for aircraft, and even some



Customised structures can be produced for medical implants

components that have gone in to space. Now it is a question of working down from those top end applications."

Additive manufacturing allows exotic geometries to be made that might leave conventional plastic moulders or CNC machinists scratching their heads. This offers a unique proposition: a move away from design-for-manufacture towards design-for-function.

In conjunction with Within Technologies, 3TRPD produced a heat exchanger to provoke thought and show just what the capabilities of the technology are. The device was produced using direct metal laser sintering (DMLS) and was made up of a number of teardrop-shaped tubes.

Inside was a series of struts (Turbulators) created to increase internal surface area and disrupt the flow of the cooled fluid and maximising heat transfer. The outside form was designed to increase the cooling surface area and maximise the work done by the air passing through the device.

"There is definitely scope for creating structures that you can't produce in any other way," says Halliday. "There are constraints, though, particularly with the metals, but also with plastics. The geometrical constraints might be minimal but you can end up with a poor surface finish or integrity.

"Customers need a realistic sense of excitement so they don't go rushing off thinking it will solve all their problems, because it won't. Designers need to understand the constraints and then design around them. It is working from a different viewpoint, so you need an open mind, but the opportunities are plentiful."

Additive manufacturing also allows flexibility in production and making 1 or 1000 makes little difference to unit price. Tweaks to geometries such as hearing aids or implants, can easily be made without affecting the downstream process. This is something on which Sheffield-based Materialise has tried to capitalise.

"It gives you design flexibility," says Johnathan Andrews, UK account manager for additive manufacturing solutions at Materialise UK. "You can change the design without much investment. You can build 20 parts one night, decide you want to change the design and it won't cost you anything other than a couple of hours of CAD work. It therefore facilitates customisation and gives the potential for additional revenue streams.

"It has allowed us to move in to the medical industry making bone structures. We are able to take CT scan data and create replacement parts for a patient whether it be a jawbone or, hip or knee replacement."

The team was also able to facilitate the rapid design and production of Belgium's Group T University's Formula Student entry. The chassis of the Areion electric kart was made using Materialise's mammoth stereolithography machine which prints parts up to 2100 x 680 x 800mm, and the process allowed a number of unique design features to be incorporated.

First was the textured surface that was printed directly onto the nose. The shark teeth-like ridges aim to improve aerodynamic performance. Additionally, the left side pod used complex channels that put nozzles behind the radiator to optimise cooling by directing the airflow directly through the radiator. In the right hand pod, the complex channels created a cyclone effect that removed water and dust from the air before it entered the engine compartment. The chassis was produced in just two weeks and the structure stood up to the all the knocks on track and heat from the engine.

"This is an example of how additive manufacturing has made a design viable," says Andrews. "The key driver was to be able to manufacture it quickly and have the ability to easily change the design. It was also more cost effective than any traditional manufacturing route they would have gone down."

In most cases, however, additive manufacturing is not about replacing existing methods, but rather complementing other technologies within a business. It is not just individuals, but also companies that need to take a look at their products and recognise the opportunities for additive manufacturing. "We believe designers and engineers can create better products if they have additive manufacturing in their toolbox," says Andrews.

www.ops-uk.com
www.3trpd.co.uk
www.materialise.com

The ability to quickly produce parts that can be easily changed and remade is attractive to low-volume end users

Materials offer fastener opportunities

Fastener manufacturers are looking to materials to offer innovation and benefits to their customers. Justin Cunningham reports.

There has been a trend in recent years of using unconventional materials on conventional parts and components. Whether it is to remove weight, offer superior performance, allow performance in extremes, manufacturers and suppliers are offering more product variants as a result of material developments.

This can be seen in the automotive sector which is increasingly using lightweight plastics to remove weight from structures. Equally, the aviation industry is using composites to do the same. But material developments are not lost on fastener companies, which are also riding the trend to offer product differentiation in a market where that can be hard to come by.

To cope with very hot applications, Goodfellow has developed a ceramic fastener that is capable of being used at 1650-1700°C. Ceramics offer many advantageous properties, particularly when it comes to managing heat. Not only do ceramic components block heat, they also have a low thermal expansion, are practically immune to corrosion, and most acids or fluids have no effect on them.

The fasteners are generally sold in low volumes to fairly specific sectors, which include space and research applications. But it is demand from these industries that drove Goodfellow to develop them. The fasteners are made in both alumina and high strength zirconia, and have the distinct advantage of not only being able to operate at extremely high temperatures, but are produced much more cost effectively than ceramic fasteners previously on the market.

James Taylor, sales supervisor of the ceramic and glass division at Goodfellow says: "The difference with the ones we are supplying is they are actually injection moulded. Previously they were manufactured using high pressure moulding. The injection moulding process reduces the cost as it is just a case of using a simple mould and repeating that."

The production of the ceramic fasteners is being driven by applications and is a response from customers needing fasteners that will cope with extremely high temperatures. However, ceramics have always been problematic as an engineering material because of brittleness, and these fasteners are no exception. Over-tightening a bolt will crack it, and probably break the head off completely.

"If they get a slight crack on them, if they drop or if too much pressure is put on them, they shatter," says Taylor. "There is no deformation. But, you wouldn't really use these for tightening, that is not there typical application."

The bolts have a four-point bend strength of 352MPa and a maximum service temperature of 2,200°C, and come in a variety of metric and imperial sizes. The company claims a standard M2 bolt is actually stronger than an equivalent Nylon bolt but with other inherent material advantages.

Using material developments to find a niche in low-volume specialised markets has been a success for Goodfellow. However, TR Fasteners has found success in using materials to exploit higher-volume applications. It has been a supplier of plastic fasteners for sometime but has recently been identifying applications that can use plastic fasteners in place of metal alternatives.

"We are moving in to an area with a tremendous market in the plastic side of things,"

The Ariel Atom uses plastic fasteners to help take weight out of the structure

says Kevin Rogers, plastics product sales manager at TR Fastenings. "TR has been a traditional metal based fastener company. Though selling a lot of plastic fastener parts, they have always been considered a category added on to the other business. But it is now a core product."

It has found successful application, and replacement fastener applications, on the Ariel Atom sports car using plastic fasteners to help take weight out of the structure. This makes for a good example of where a standard plastic fastener did the job adequately.

But it is not just for weight removal that TR has found applications. Plastic fasteners can lend themselves to assemblies. Though the actual part might be more expensive, by speeding up production, the overall cost to the customer is often reduced.

"We might see three metal fasteners in an assembly," says Rogers. "But, why use a nut, bolt and a washer, when you could use a two-piece plastic rivet that takes half a second to apply? That is where the innovation is."

TR has evolved from being a traditional fastener company that also sells plastic fasteners to making plastic fasteners a core range. However, to really exploit this evolution, it is increasingly approaching its clients and asking to see their processes to see if they can improve them.

"We are constantly being asked to cost down," says Rogers, "but we cannot take any more cost out of the parts. However, we can suggest using a plastic part if there might be some production benefit."

Plastic fasteners are not for every application of course, and like everything in engineering there are tradeoffs and limitations. There are structural limits to plastic fasteners where they might need to support certain loads, or tightened to specific torque ratings. Inevitably in these situations, a metal fastener will be used to give the necessary strength.

However, many applications do not require these specifics, with the electronics industry being a case in point. Where it traditionally uses small metal fasteners, TR is encouraging the uptake of plastic rivets. However, the buying power of larger electronic companies means the screws are already extremely cheap.

"We could have the instance where the plastic products are actually more expensive," says Rogers. "However, we might be able to reduce the assembly time by some 75% so that there could still be substantial savings to be made. We just need to change that mindset."

The metal fastener industry is very regimented, with many international standards in place. "With many plastic fasteners you do not have that," says Rogers. "So it is not as well regulated and there is an awful lot that requires you to use common sense when you are using them.

"Plastic fasteners are rarely used for heavy duty industrial applications. They tend to be more internal and for smaller diameters. A chassis bolt might be a big M16 size, but you are not really ever going to have something that big in plastic. Applications are suggested on a logical fit for purpose basis."

Another design advantage of plastic materials is the ability for their properties to be manipulated. From the possibilities of having various colours to being made flame retardant, it allows for many potential applications than many engineers might first think.

TR believes that plastic fasteners will open up more design opportunities – particularly in the automotive industry - and as a result has got PPAP level 1,2,3 to give customers confidence in the supply chain and ensure they produce a product that consistently meets set out requirements.

www.goodfellow-ceramics.com
www.trfastenings.com

New washers double security

Paul Fanning reports on a new generation of industrial washer.

Described by the company as "A new evolution in bolt security", Nord-Lock's X-Series washers promise to provide an all-round solution to the twin problems of loosening due to vibration and 'settlement' into softer materials.

Traditionally, application design has involved trying to figure out which particular stressn factor will have the biggest effect on the joint and choosing a solution to handle that one problem. It is a difficult compromise to make, especially when both could cause application failure.

In addition, new technologies and demands are creating unique design challenges. Designers need to take into account factors such as thick surface coatings to fight corrosion, new sandwich composite technologies and many more.

Joints increasingly need to be able to withstand stresses from multiple fronts, including: spontaneous bolt loosening due to vibration and dynamic loads, and slackening due to settlement and relaxation.

X-series combines Nord-Lock's established wedge-locking protection against spontaneous bolt loosening due to vibration and dynamic loads with an exclusive spring effect to protect against slackening due to settlement and relaxation. This combination, the company believes, makes X-series the first, true multifunctional solution — offering the highest security for critical joints, without compromise.

As with Nord-Lock's original washers, each washer pair has cams on one side and radial teeth on the opposite side to secure the bolted joint with tension instead of friction. The Nord-Lock X-series washers' conical shape also creates an elastic reserve in the bolted joint to compensate for the loss of preload and prevent slackening.

Nord-Lock believes that the X-series will eventually supersede its existing washers, although not for between three and five years.
www.nord-lock.com

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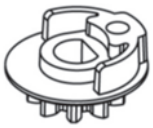

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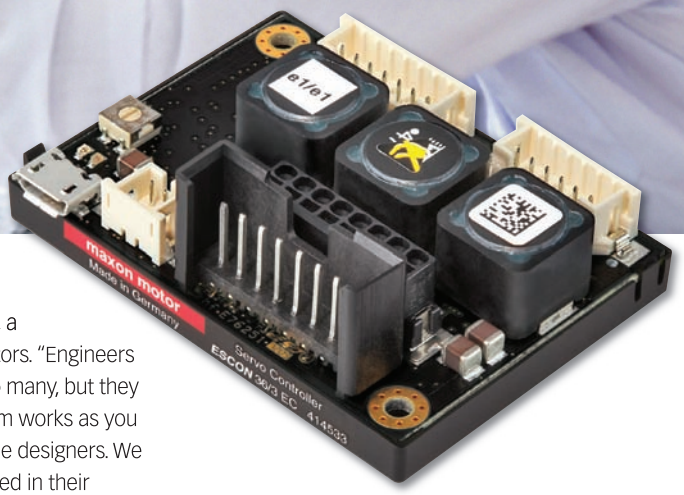
Help is at hand

Justin Cunningham goes back to the classroom to learn about selecting controllers for motorised applications.



Increasingly, some rudimentary knowledge of electronics is not just an advantage, but a necessity for mechanical engineers. As someone with a background in mechanical engineering, I'm fairly sure I'm not alone when I admit I'm not entirely comfortable with one area of this, namely motor controllers.

I understand the principles of the technology and their purpose, but selecting the best one for a given application, setting it up and optimising it for a specific purpose is not something with which I feel completely au fait about.

Fortunately, help is at hand to go through the basics, and beyond. Maxon Motor UK, based just north of Farnborough, runs training courses twice a month that are free to all, and go through the often misunderstood technology. I decided to sit in on one and report back what I learnt.

Maxon offers significant resource in terms of online information and free training courses to help engineers select the correct motors and controllers for applications. The courses are designed to stop the trend of skipping advice from experts and buying direct from online suppliers to try and save on cost, only to run in to problems later down the line in a project.

"Whenever you consider buying a controller there are questions that need to be asked," says Mark Gibbons, a technical engineer at Maxon Motors. "Engineers can get vexed as there can be so many, but they need to be addressed so a system works as you want it to. We are not the machine designers. We give designers the tools to succeed in their control applications."

The half-day course was on the ESCON controller; a speed and torque controller (with no positioning). It precedes the EPOS session that includes positioning and assumes some knowledge of motor selection. The online help available to analyse duty cycle and advice on choosing motors is open access and excellent for both the novice and expert, so it's worth a look to check you know what you think you know.

The basic principles of DC motors – as you should definitely know – is that voltage is proportional to speed at a fixed load and current is proportional to torque at a constant voltage. When you analyse a duty cycle and work out the mechanical requirements of a motor, it can have a significant impact on the controller. You need to be sure that the controller can handle the peaks and the RMS currents.

"These first principles are important when choosing a controller," says Gibbons. "You need to look at what your motor is doing in your application, how fast it is turning and what current it is pulling (power = speed x torque or voltage x current). It comes down to the voltage you are applying and what current is available as to whether the controller is fit for application; what type of load is it? Is it continuous or cyclic, for example, and are you going to be dynamically braking or regenerating?"

Motors are generators

Something that is often overlooked and causes controllers to fail is that motors are generators. Think back to the days of sitting physics exams looking up and seeing everyone pointing their fingers and thumbs to recreate Fleming's left and right hand rules: the electromagnetic principles of field, current, and thrust motion.

When a motor is driven by the load (the load

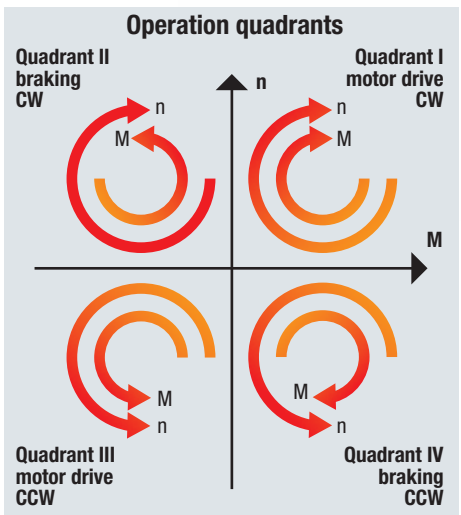
is pushing the motor in the direction it is travelling), its inertial load will generate through the motor converting the kinetic energy into electrical energy, creating a backward flow of voltage, back EMF (electromagnetic force). If the power supply is bi-directional, then this energy can be recovered, but many circuits are not and so the energy must be dissipated as heat.

"At a particular voltage a capacitive resistive circuit called a shunt is activated which essentially burns off the power," says Gibbons. "If you have a dynamic process where you are slowing down inertia load you have to use a shunt."

The practicality of this is that if you are controlling the decent of a load - for example a cam or lever with a load rotating unsymmetrically around an axis – electricity will be generated by the falling load. This needs to be managed.

One of the big considerations is a 1-quadrant vs. a 4-quadrant controller. A 1-quandrant controller cannot apply opposing voltage, so it won't brake or slow a motor. A 4-quadrant on the other hand enables the flow of power forwards and backwards and this allows the motor to brake and decelerate using an opposing voltage that can overcome the back EMF.

"If you have a motor and a cam arrangement, while lifting a load it is not a problem," says Gibbons. "But, as soon as you go past top dead centre, the load starts pulling down. That generates electricity and if you are trying to maintain speed then you need to decelerate the motor in that downward section. Unless you have a four-quadrant drive, you can't do that."



The controller is easily linked to a PC via a USB and the training course talks you through the configuration which uses drop down menus in a windows format. This also features an auto tune function so PID (proportional–integral–derivative) values are automatically calculated.

Applications

The ESCON can be put to use in a number of practical applications where there is a requirement for things to be moved from one place to another with no need for position. They can be used in a hand tool for example, on a compressor circuit where the motor winds up and fires a nail, or in a normal drill. These can also be used on a conveyor belt, having a stop circuit somewhere along a ball screw. The ESCON has also been used for the traction control of robots, having one on each track. Both are set to a constant speed so the torque will be varied as it goes uphill, downhill and over bumps.

"A favourite thing to do is use the ESCON as a dumb servo," says Gibbons. "The encoder is connected to a PLC which calculates the position and sends speed and current inputs the ESCON. That is essentially a low-cost positioning system."

If, like me, you feel a little ignorant about the selection of motors and controllers and want to improve your own systems and designs, or just get more up to date with the technology, then perhaps it is time to take a glimpse into the world of controllers.

www.maxonmotor.co.uk

Controlling position

If positioning is necessary then you will no doubt benefit from the second session. It will go through control of the EPOS controller that has been specifically developed for commanding and controlling in a CANopen network, USB, RS232 and on some models EtherCAT are available as further communication interfaces.

The EPOS has a variety of operating modes, such as position, velocity and current mode, which means it can be used in automation technology, tool building and in mechatronic drive systems. There are also functions such as step and direction modes for incrementally controlling the movement of the motor shaft mimicking stepper drives as well as the Master Encoder Mode for synchronising axis that can be electronically geared so different motors and encoders can be synchronised easily together. Commanding through an analogue set value voltage PWM input may also replace conventional servo amplifier applications.

Its motion control functionalities offer a dual loop position and speed controller with the use of a second encoder (EPOS2 36/2, EPOS2 50/5, EPOS2 70/10 & EPOS3 70/10). With Interpolated Position Mode the position controller is able to synchronously follow a path set by support points with great speed and precision knowing only position velocity and time (PVT).

Commanding can take place using CAN Master, (EPOS2 P, SPS, Soft SPS, PLC or using PC via USB or RS232) and 128 drives can be networked and coordinated through the standardised CANopen interface. Beckhoff, Siemens S7 / Helmholz and VIPA PLC libraries are available to ease integration. Windows DLL files and Linux shared object dictionary are available to integrate to industrial PC (IXXAT and Vector also) or embedded chip. Further to this Labview VI libraries are available for seamless integration into your National Instruments compact RIO project.

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Sensing in the extreme

Justin Cunningham looks at some sensor developments that are allowing measurement in very harsh environments.

Sensing in harsh and hostile environments doesn't come much more intense than measuring the combustion process inside a jet engine. Yet Oxford based Oxsensis has managed to produce sensors that can be relied upon to withstand the heat.

The sensors are actually tiny microphones and measure the noise produced by the combustion process. They are in fact so small that they can be encompassed within the combustion chamber itself, termed a combustor on a gas turbine.

Sensors are currently used to measure instabilities that occur during the combustion process. However, due to extreme nature of the combustor, sensors cannot normally be placed there, having to be placed further back within the engine structure. However, this has meant that high frequencies are highly attenuated, making accurate measurements and instabilities more difficult to detect. However, early detection of combustion instabilities is essential to preventing damage. Additionally, accurate measurement of the combustor could allow aircraft engine manufacturers to reduce emissions.

"The best way to do that is by having a very lean fuel-to-air mix," says Alex Winterburn, business development engineer at Oxsensis. "You are running it like a candle that is about to run out of wax, the flame kind of splutters. If that splutter gets too big, though, it starts to rattle the whole structure, which can cause damage to the engine and even the engine blades.

"By monitoring the behaviour of the flame inside the combustor it has promoted a new level of understanding and management of what exactly is going on inside."

This splutter is extremely loud – some 140dB plus – and so the best way to measure it is acoustically. The team has developed what essentially can be described as a very high-temperature microphone. The microphone needs a lot of noise – and consequently a lot of pressure – to actually register an output. In fact the microphone will not register anything under 138dB.

Single-crystal sapphire is used to provide the super heat resistance needed and this essentially acts as a diaphragm. With a melting point of over 2000°C it is combined with innovative fibre optic interrogation techniques to give the sensitivity and immunity from electro-magnetic interference (EMI) effects which are common in turbomachinery such as gas turbines.

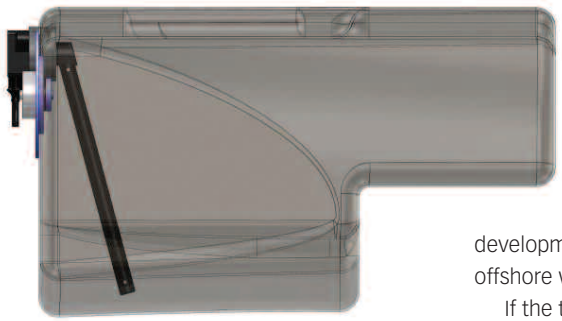
The Oxsensis sensors are capable of measuring the combustion process inside a jet engine

"The idea came from a lecture that a Rolls-Royce engineer gave at the IMechE [Institute of Mechanical Engineers) in London," says Winterburn. "They were saying they could not get a sensor to work in the heart of the gas turbine." The founder of the company had a background in telecomms and knew of materials that could be used to cope with such extreme temperatures. After coming up with a few ideas, he got some initial funding from the TSB and started working on a small Rolls-Royce Viper engine.

The sensor uses a light that shines on the sapphire membrane and bounces back inside. The pressure waves inside the combustor push against it, changing the size of the vacuum cavity. Additionally, the piece of sapphire thermally expands. So, by measuring the change in these two thicknesses, both pressure and temperature can be calculated.

The company has also developed the sensor for a small helicopter engine, and has since installed and trialled the sensor in a giant

The Penguin B aircraft from UAV Factory uses Gill Sensors' innovative fuel sensor



Gill Sensors has developed an innovative fuel level sensor to enable accurate and reliable monitoring of fuel levels in the 7.5 litre tank of a UAV

200MW gas turbine, which has been running at Didcot power station since 2009.

"We started off in the R&D world, but once manufacturers get more comfortable with the technology, then hopefully we will branch out to supplying sensors that will actually go into engines in the field," adds Winterburn.

The company has won further funding from the TSB to develop an aircraft fuel quantity indication system with Parker Hannifin and the Science and Technology Facilities Council (STFC). The project known as the Silicon-based Optical High Accuracy Pressure Sensor (SOHAPS) will deliver high-accuracy, multi-parameter optical sensors for the measurement of pressure and temperature within the next generation of aircraft fuel systems. Oxsensis will design the sensor and draw on the expertise of the STFC to model and fabricate novel sensor head elements.

There is a trend in the aviation industry towards the use of composite materials, particularly in wing construction and therefore the EMI immunity of optical sensors is a major advantage. This improves the intrinsic safety of the fuel system. The sensor technology developed in SOHAPS, has potential to be applied to engine driven lubrication pumps, hydraulic systems, main engine bearings, landing gear and other major systems.

Another fuel sensor innovation comes from UK based Gill Sensors. It recently helped play an important part helping a UAV Factory team smash a world record for the longest recorded flight for a small unmanned aircraft. In July 2012, the Penguin B aircraft stayed in the air for 54.5 hours, breaking the previous record by over 16 hours.

Gill Sensors developed an innovative fuel level sensor to enable accurate and reliable monitoring of remaining fuel in the 7.5 litre tank. The main challenge was that space was extremely limited. The irregular shape of the fuel tank meant there was no space to mount the sensor through the top of the tank, as would normally be the case.

Engineers at Gill Sensors therefore designed and produced a micro-liquid level sensor that could be mounted through the side wall of the tank that used a specially angled probe to allow accurate monitoring of the depth of fuel.

Mike Rees, head of marketing at Gill Sensors says: "We are able to utilise the proven microelectronic level sensor technology that is currently supplied by Gill into other specialist applications."

Optical sensing has also recently found application in the offshore renewable industry. RWE Innogy and the Carbon Trust's Offshore Wind Accelerator programme have set about testing innovative wind measuring buoys.

Two Light Detection and Ranging units (LIDAR) are being mounted on buoys ten miles off the North Wales coast. Both units will collect wind data which can then be compared with information from the met mast. This will be used to build confidence for future wind farm developments.

Chief operational officer at RWE Innogy, Paul Coffey, says: "The need for research in the field of offshore wind power continues to be immense. The construction of measuring stations is an important step towards recording and analysing local wind conditions. The data is of fundamental significance for the development, construction and operation of offshore wind power plants."

If the trials are successful, LIDAR devices are expected to be simpler, quicker, more effective and cheaper alternatives to met masts during offshore wind project development. The two models being trialled, one manufactured by the Belgian company FLiDAR, the other by the British producer Babcock International Group, differ particularly in terms of design.

The prototype developed by FLiDAR floats on the waves and is undergoing a trial for wave motion compensation. The prototype has already been successfully used in the Belgian North Sea for accurate wind data collection. The measuring buoy from Babcock is currently under construction and is characterised by its low motion buoy design.

Both prototypes will be towed by ship to the chosen measuring sites where they will be anchored to the seabed. Electricity will be supplied by photovoltaic panels and micro wind turbines installed on the buoy. Like a conventional met mast, the buoys will supply weather data on wind velocities and wind direction. These trial laser-based measuring systems will be used to record wind velocity and wind direction both horizontally and vertically up to a height of 200m and data could be critical to the development of future offshore wind projects.

www.oxsensis.com
www.gillsensors.co.uk
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Two Light Detection and Ranging units (LIDAR) are mounted on buoys ten miles off the North Wales coast

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What's the difference between an exclusive licence and an assignment?

Eureka has partnered with leading intellectual property law firm D Young & Co LLP to offer guidance on how to protect IP. Here, D Young senior associate Carina Badger looks at exclusive licences and assignments.

The investment in securing registered intellectual property rights is all well and good, but the reward for the monopoly (or quasi-monopoly, depending on the right concerned) comes from the exploitation of that right. Many rights holders will exploit IP directly by using the patent or affixing the trade mark to their own goods, for example. Others seek rewards from letting third parties use their IP, which is where the question of licensing vs assignment arises.

The different types of licensing arrangements are:

- Exclusive licence: this means that the owner of the patent agrees not to grant any other licences of the technology concerned, and agrees not to use the technology himself.
- Sole licence: the owner of the patent agrees not to grant any other licences of the technology, but is allowed to use the technology himself.
- Non-Exclusive licence: patent owner reserves the right to grant licences of the technology concerned to third parties and use it himself.

A patent assignment entails transferring ownership of the patent to a third party, so the assignor no longer has any involvement or claim on those rights (unless the parties contractually agree otherwise). If the owner of the patent exclusively licenses use of that right to another party (so cannot use the right himself), what isthe difference is between an exclusive licence and assigning the patent to the third party?

Five key questions for the rights holder

- How do you want to be paid?
- Are you able to determine the potential value of the technology?
- Do you want to get the rights back in certain circumstances (e.g. if the third party becomes insolvent or is bought out)?
- Do you want the third party to have full use of the technology for all fields of use?
- Will you keep researching and designing in this field?

A licence is not always a desirable means of dealing with commercialisation of an IP right. For example, under English law, intellectual property created during the course of one's employment is usually first owned by the employer (not the employee); however, some rights created by consultants for a company, such as copyright in software or design drawings created by a consultancy for a client, are owned by the consultant and not the client (unless the parties have contractually agreed otherwise in writing). A licence would not generally be appropriate and the client would typically require that all IP in whatever is created is assigned to the client. In relation to patents, an assignment would also be more appropriate where the rights holder wishes to withdraw entirely from a specific field, or in the context of the sale of part of the business.

The key benefit for assigning ownership of a patent is that the original owner does not retain responsibility for paying renewal fees for the right and typically will receive an up-front payment for the sale of the right. The third party, on the other hand, gains control of the IP right on which they are relying. On the other hand, there are costs involved in registering the change of ownership at the applicable registry and the parties should agree who should bear those costs. In the UK in relation to patents, for example, there is no statutory requirement to register an assignment; however the Patents Act provides that an assignee who does not register the assignment within six months cannot claim costs or expenses in proceedings for an infringement that occurred before registration of the assignment, unless he can satisfy the court that it was not practicable to register it in that period and that the transaction was registered as soon as possible.

Competition law can be an impediment to the exclusive licensing of patents, and advice should be sought to ensure that the licensing arrangement does not fall foul of competition law. However, there are a number of benefits to licensing over assignment of the rights:

- Licensing may be more practical if the value of the patents has yet to be determined.
- Licensing is often preferred where exploitation of the right requires substantial investment and the owner does not want to commit to that.
- Licensing allows for the exploitation of the right to be divided up by field of use, potentially by market etc, so the licensor can engage multiple exclusive licensees for different purposes.
- If the licensee is ineffectual in exploiting the patent, becomes insolvent or undergoes a change of control (particularly to a competitor of the licensor), the licensor may be able to terminate the licence and regain control of the patents.

Often the decision will come down to means of payment: up-front payment or royalty payments (or a combination of the two). Technically, it is possible to assign the patent and be paid in royalties, but there are two key risks: (i) the assignee may not exploit the patent fully; and (ii) if the licensee becomes insolvent, the patent may be irrecoverable. For these reasons, if the owner of the patent wants to be paid in royalties, a licence is preferable. Tax may also be a consideration: an assignment of patents may give rise to a capital gains liability, whereas royalties under a patent licence are treated as income or trading receipts. VAT or sales tax may be chargeable.

For more information, please contact Carina Badger, Senior Associate, on:
Tel: 020 7269 8550
Email: CXB@dyoung.co.uk www.dyoung.com

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Mechanical Design Engineer

Location: Cork
Type: Permanent
Salary: £35k-£60k per annum

Mechanical design engineer with top-class academics is required for this centre of excellence in medical device design in Cork, Ireland.

The role includes the development of medical device products from concept to production, participation in multi-functional product development teams, and liaison with marketing for the development and specification of new concepts for medical device products.

You will work with a highly creative design team to invent and develop innovative new product concepts. Create smart, innovative solutions to mechanical design challenges. Conceive plans and conduct research in problem areas of considerable scope and complexity. Evaluate and optimise concepts for mechanical function and manufacturability, developing product designs and creating prototypes from customer concepts and/or specs to test and validate ideas.

Minimum of 2 years' related medical device or mechanical design experience in a fast-paced, high technology environment.

For full details online, enter reference: EngDes151112

CAD Engineer

Location: Andover, Hampshire Type: Permanent
Salary: £20-£23k

Integra is a world leader in developing and marketing high quality surgical instruments, as well as innovative devices and products, for use in neurosurgery, reconstructive surgery, general surgery and soft tissue repair.

In the UK, it employs 80 people, based at its manufacturing facility at Andover, Hampshire, for the manufacture and distribution of neurosurgical medical devices.

This role is to be a member of the engineering team, utilising computer-aided design (CAD) skills to produce technical drawings for a wide range of products and components. You will be working from drawings, models or computer models and using specialist computer software to create accurate 2D drawings and 3D computer-generated models.

To perform this job successfully, you must be able to perform each essential duty satisfactorily, including being capable of creating and revising manufacturing drawings, in line with relevant standards, and maintaining the document management system.

For full details online, enter reference: CadEng151112

Senior Controls Engineer

Location: Coventry, Leamington Spa, Northampton, Bedford, Oxford, Swindon, Luton, Cheltenham
Type: Permanent
Salary: £50k per annum, plus benefits

A senior controls engineer is needed to provide complete controls design. This will include electrical design, software design and commissioning for a material handling project. The role will encompass electrical design, software design and commissioning. Your responsibilities as a lead engineer will require you to:

- Co-ordinate and ensure consistent approach across a project for electrical design and software design
- Take responsibility for controls budgetary and time restraints on projects
- Hold controls design reviews for relevant project
- Develop special and new standard solutions to suit specific projects and new markets
- Innovate, wherever possible, to improve the delivered product to the end customer
- Provide technical backup to the service team as required, including bug fixes, enhancements and modifications.

For full details online,enter reference: SnrCon151112

Mechanical Design Engineers

Location: South Yorkshire, Nottinghamshire
Type: Permanent. Salary: Negotiable, by experience

This national, mechanical, electrical, instrumentation, control and automation (MEICA) contractor has a vacancy for a site based mechanical engineer, based at Worksop. You will report to the lead mechanical design engineer and be a key member of the delivery team. The main duties will include responsibility for the following:

- Generation of detailed site layout drawings in CAD
- Completion of P&IDs
- Production of pump and pipe calculations to enable designs.

Desirable: Experience of designing sludge treatment facilities to include(primary sludge transfer & screening, sludge thickening, acid phase and gas phase digesters, hot water circuits and heat exchangers, gas systems, boiler house, CHP, flare & vent, sludge dewatering and liquor treatment plants.
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- An industry-applicable ONC/HNC/M.Eng or NVQ equivalent
- Working knowledge of sludge treatment facilities
- Proficient in AutoCAD.

For full details online, enter reference: MechDes151112

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Engineering support manager

Location: Gateshead Type: Permanent
Salary: £45k-£50k per annum, plus benefits

This established supplier of high speed rotating motors is rapidly expanding its portfolio into rail, energy, transport, defence and aerospace applications. The engineering support manager will need to direct a team of approximately 8-10 mechanical/electrical design and document controllers, graduate design engineer, to senior mechanical design engineers.
If you are an experienced mechanical/electrical engineering manager, and have first-hand experience in electro/mechanical build in a low/medium volume manufacturer in product design and project management, please apply now.
The successful engineering support manager will be responsible for:

- Operation of the documentation function
- Standards definition
- Existing Product support
- Product Reliability analysis & support
- PCB Design function.

Main duties & responsibilities will include:

- Manage, supervise and train documentation team
- Manage CAD systems, both implementation and standards definition.

For full details online, enter reference: EngSupMan151112

Principal Engineer – Mechanical Design

Location: Cambridge, Cambridgeshire
Type: Permanent
Salary: £40k-£50k per annum, plus benefits

This leading manufacturer of aerospace components is seeking a principal engineer - mechanical design. The successful candidate will be involved in meeting both project and statutory requirements, with the goal to improve the effectiveness of the mechanical design function. The successful candidate will also provide technical expertise and guidance to projects, and mentor junior engineers within the skill area.
Key responsibilities will include achieving assigned engineering objectives, solving technical problems and providing effective solutions, while ensuring timely delivery to both internal and external customers.
You will also effectively support the engineering manager, as required, complementing the mechanical engineering team in supporting future projects and marketing opportunities, and ensure engineering activity is carried out in accordance with engineering procedures.

For full details online, enter reference: PriEng151112

Senior Mechanical Design Engineer

Location: Leicester, East Midlands, West Midlands, Birmingham, Nottingham, Nottinghamshire.
Type: Permanent Salary: Up to £45k per annum, plus benefits

Ridgway, the world-leading manufacturer of taping machines for the electrical, conductor and oil pipeline industries, is looking for you a senior mechanical design engineer with understanding of an industrial/automation environment in special-purpose machinery, bespoke and turnkey engineering solutions.
The principal role is to undertake design and engineering support activities on the many exciting projects within Ridgway. This involves a thorough understanding of the design processes and working in a truly multi-disciplinary role, liaising closely with colleagues across a number of functions, including operations, purchasing and manufacturing as well as external customers. This exciting position requires an experienced senior design engineer. Also, as 80% of its projects are international, the successful candidate could be required to travel internationally on an occasional basis.

For full details online, enter reference: SnrMec151112

Mechanical Design Engineer

Location: Leicester, East Midlands, West Midlands, Birmingham, Nottingham, Nottinghamshire.
Type: Permanent
Salary: Up to £35k per annum, plus benefits

Ridgway Machines – a Great British 'success story' that is going from strength to strength – is seeking a mechanical design engineer with understanding of an industrial/automation environment in special-purpose machinery, bespoke and turnkey engineering solutions.
The principal role of the design engineer is to undertake design and engineering support activities. This involves a thorough understanding of the design processes within Ridgway, working in a truly multi-disciplinary role, liaising closely with colleagues across a number of functions, including operations, purchasing and manufacturing, as well as with external customers.
This exciting position requires an experienced design engineer. Also, as 80% of Ridgway's projects are international, the successful candidate could be required to travel internationally (US, Asia, Brazil, South America, Europe) on an occasional basis.

For full details online, enter reference: MDes151112

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Making steady hands

The reason why most people hate receiving potentially lifesaving jabs is because of bad experiences or hearing about the problems others have encountered. So how can injections be made less painful?

That moment that makes you grimace, as the stabbing pains shoot into your arm, intensifying with every little movement. Even worse is when there are several attempts, each as unsuccessful as the last.

Whether at school or at the hospital, most of us have been the victim of a painful injection. There can be for a number of reasons for this, but unsteady hands have a lot to answer for, as does slight variation in getting the needle in the right place.

Everyone shakes, even the most skilled surgeons have hand tremors that typically range from 50- 100µm, and although this may not seem like a lot, it can be the difference between a moment of displeasure, and minutes of pain followed by a sore arm for hours after.

Micro-surgery is even more critical for steady hands. Operating on a nerve fibre, or a retina, requires very precise movements. Even the slightest unintended movement can make surgical tasks impossible to complete, or worse, result in catastrophic injury to the patient.

The Challenge

The challenge this month is to therefore come up with a less painful method of injecting medicines and vaccines in to the arm. Though Star Trek-style hypo sprays might be ideal, the technology doesn't really exist yet, so a hypodermic needle is still likely to be needed.

The key design driver for this challenge is therefore to remove the shake or tremors from a person's hand, no matter how minute, as well as to help nurses and doctors carry out an injection with literally pinpoint accuracy.

Although there are robot arms that can be used either to steady a person's hand, or replace it all together, that is not the aim of the game for this challenge, as the device still needs to be easily handled, relatively low cost, and operated by hand in a confined space.

The solution is not so much about getting the hand to shake less as it is about sensing these tiny movements and compensating for them in one way or another. The solution to this challenge uses off-the-shelf technology and is about clever integration rather than developing new technology.

While the sensing equipment is mainly used to counteract tremors, it should also have the ability to improve the aim of where an injection will be placed on the body. The components and equipment used are well known but have been assembled with not inconsiderable elegance. When you see it you may consider it obvious. In the meantime, see if you can come up with a solution.

The solution to last month's Coffee Time Challenge of how to produce more flexible batteries can be found in the Technology briefs section on page 13

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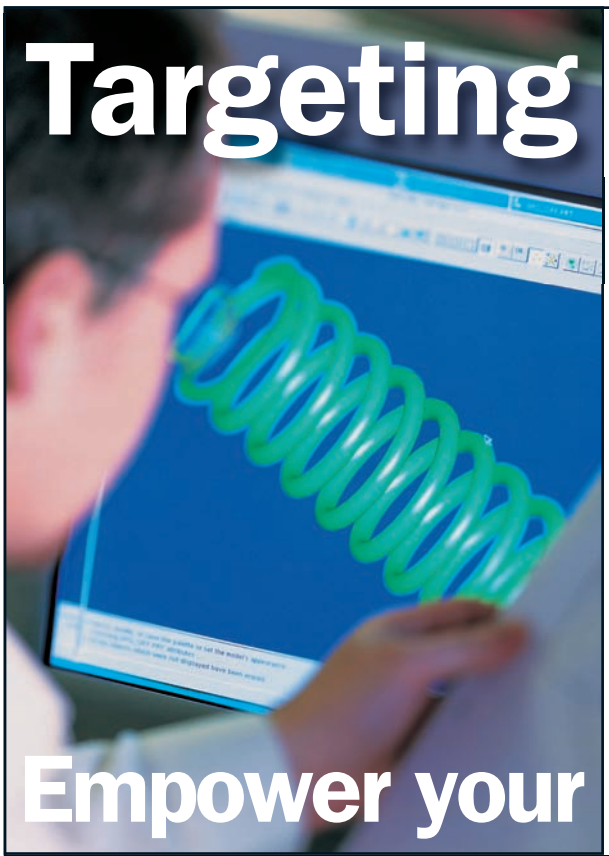

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