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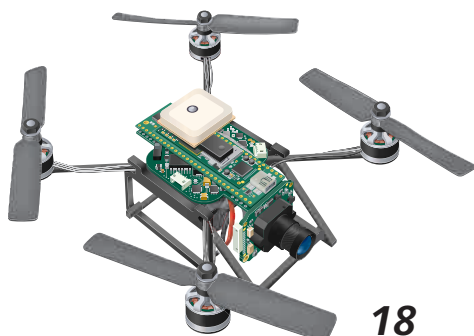
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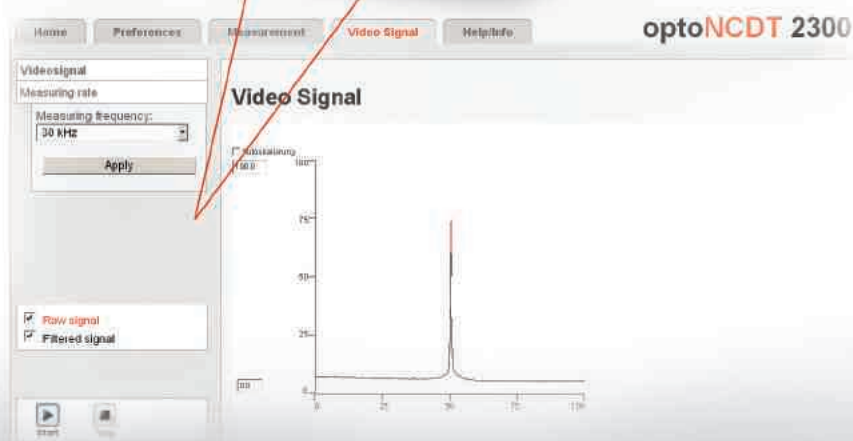
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This month's challenge is to devise an improvement to the aluminium drinks can



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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 Director
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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Eyes on the Prize



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

The winner of the Queen Elizabeth II Prize for Engineering is due to be announced this Spring. Whoever wins this unprecedentedly prestigious Prize will be the recipient of £1m: a sum that, whatever else happens, will ensure that the mainstream media will have to focus on the concept of engineering success – at least for a short while.

A year ago, I wrote that one of the most significant benefits of the Prize was that it would create an association in public perceptions between engineering and financial success. This association, I suggested, would do more to inspire future generations than any high-flown talk about engineering as a vocation.

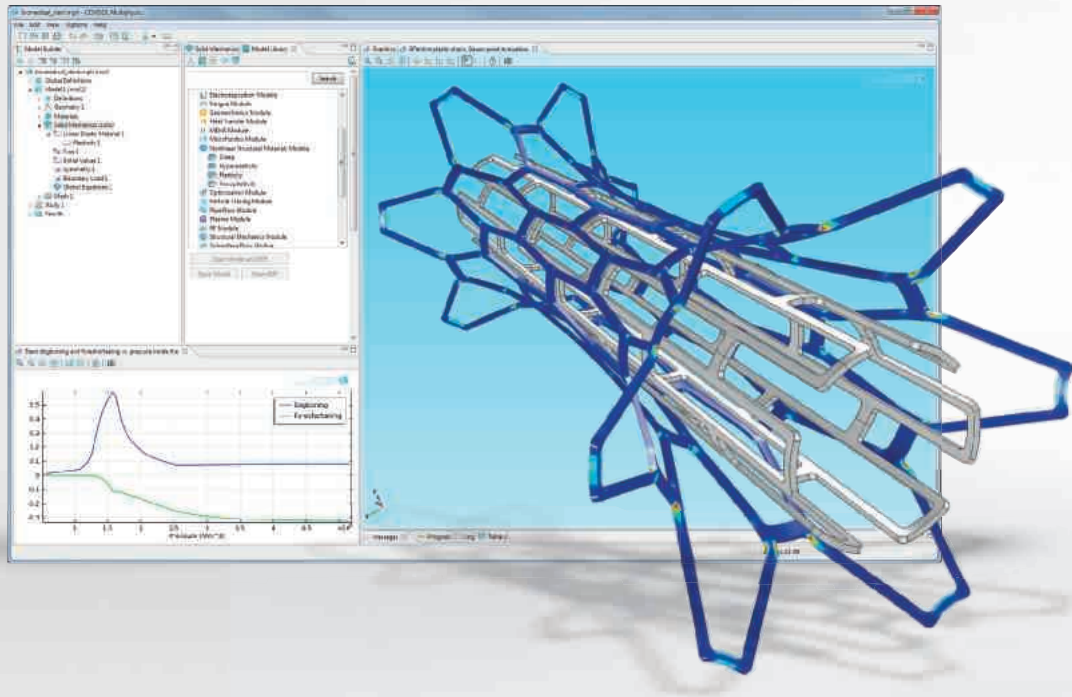
Since its launch, however, there has been some criticism of the competition. One regular complaint is that – as a global Prize open to all – it is likely to be won by a non-Briton and therefore not work to the benefit of UK engineering. Instead, it is argued, a foreign company or individual will walk off with the prestige and the Prize, leaving no lasting legacy for the UK.

This seems a myopic argument on a number of levels. First of all, it presupposes that UK engineers will not win the Prize. This supposition ignores the many world-class and highly innovative engineers in this country and does UK engineering a huge disservice.

The more pertinent issue, however, is that merely by offering a reward of this magnitude for engineering success, the Prize will create a legacy that inspires future generations from the UK to aspire to win it themselves.

Only by creating a genuinely prestigious competition and opening it to a truly global base of engineers can the UK really hope to give engineering the value it deserves. Whoever wins this Prize – wherever they hail from – will be a deserving recipient of £1m and, as such, an inspirational figure.

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Competition aims to support sustainable materials innovation

The Technology Strategy Board is to invest up to £5million in collaborative R&D projects that encourage the development and application of sustainable materials, products and processes.

The aim is to support materials technologies that meet urgent and difficult environmental and social challenges and that could create a boost for the UK economy.

Proposals must be collaborative and business led and include at least one SME. The TSB expects to fund mainly industrial research projects in which a business

partner will generally attract up to 50% public funding for their project costs (60% for SMEs).

Projects must last between 12 and 24 months and have a value of between £250 and £750k.

The competition opens for applicants on 4 March 2013. The deadline for registration is at noon on 17 April 2013 and the deadline for expressions of interest is at noon on 24 April 2013.

For details see <http://www.innovateuk.org>. For free support in applying and finding partners, get in touch with the Knowledge Transfer Networks.

Frazer-Nash retained on CETO project

Engineering consultancy Frazer-Nash has been retained to continue working with Carnegie Wave Energy on the fourth stage of its CETO wave energy system as part of the Perth Wave Energy Project (PWEF).

Carnegie Wave Energy is currently working towards commercial deployment of CETO so the key objectives for the development team is to demonstrate the viability of the system, taking experience from deploying and operating multiple test CETO units and the complete system.

To date Frazer-Nash has used its experience in defence and marine sectors to develop a systems engineering management plan to assist the Carnegie design team in developing CETO using sound engineering processes to help meet project objectives. The consultancy has also prepared a failure modes and effects analysis on part of the system that can provide evidence that no single failure should cause major problems for the system.

www.fncaustralia.com.au.

BEEAs 2013 judging panel announced

The judging panel for the 2013 British Engineering Excellence Awards has been announced.

The panel, which will judge the shortlisted entries on 4th September, will once again be chaired by Eric Wilkinson, chief operations officer of Cambridge Consultants and will include Andrew Burrows, chief technology officer of i2O Water and James White of Caterpillar UK, both of whom are winners of the Design Engineer of the Year Award in 2010 and 2012 respectively.

Other members of the judging panel will include: Philip Mayo, managing director of Premier EDA



Solutions; Ashley Evans, chief executive officer, Electronics Technology Network; Philippa Oldham, head of transport and manufacturing for the Institution of Mechanical Engineers; Graham Pitcher, group editor, Findlay Media Engineering Design Division; Paul Fanning, editor, Eureka; and Justin Cunningham, editor, Engineering Materials.

The first call for entries for the BEEAs will be issued in April and the closing date for entries will be the 31st July.

The awards ceremony itself will take place on 24th October at Number 8, Northumberland Avenue, London.

Engineering design show

Among the many new exhibitors at this year's Engineering Design Show will be producer of electrical engineering software EPLAN.

Explaining the company's reasons for taking part, EPLAN's UK director Ken Christie said: "EPLAN is passionate about voicing innovation and development within the engineering sector. The Engineering design show offers an ideal opportunity for companies to network, develop, and discover how they can advance and enhance their products and processes. We are therefore looking forward to demonstrating to visitors how EPLAN can help businesses move towards the automation

and standardisation of their engineering processes, whilst still eliminating project errors and saving valuable time on design. As the show encompasses many aspects of engineering it will enable us to showcase the full 'EPLAN Platform' – from process and control engineering to 3D wire harness design and 3D control cabinet construction. With a variety of top quality exhibitors, the Engineering Design Show is definitely a date to add to your diary."

For more details on the event or to exhibit at the Engineering Design Show, contact Luke Webster on lwebster@findlay.co.uk. Should you wish to take part in the Conference, contact Paul Fanning at pfanning@findlay.co.uk.

To register to attend, visit www.engineeringdesignshow.co.uk

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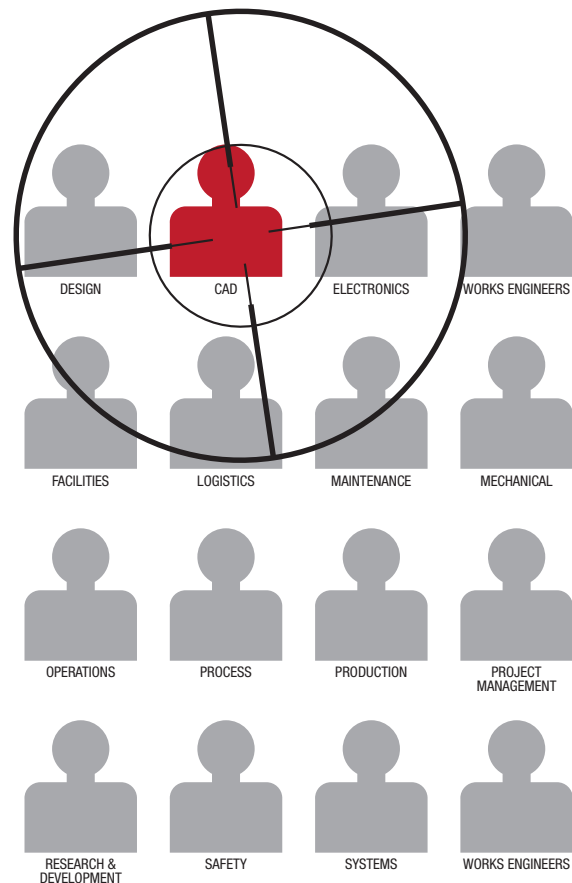
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P1 to be "most advanced" UK production car

McLaren Automotive is claiming that its soon-to-be-unveiled P1 will bet the most technologically advanced and overall fastest series production car ever to come from the UK.

The race-inspired Instant Power Assist System (IPAS) means that the P1 will go from zero to 100km/h in less than three seconds, zero to 200 km/h in under 7 seconds, and zero to 300 km/h in no more than 17 seconds. Putting that into perspective, that's 11 seconds faster than the legendary McLaren F1 road car. Top speed is electronically limited to 350 km/h.

The P1 will have the combined force of two highly-efficient powerplants, offering the optimum mix of superb throttle response, day-to-day drivability and top speed. A mid-mounted 3.8-litre twin-turbo V8 petrol engine is substantially enhanced featuring, for example, larger turbochargers and a highly effective electric motor, to give a combined output of 916PS (903 bhp) and a maximum

torque figure of 900Nm. This ensures instantaneous throttle response through the rev range, more akin to a naturally aspirated engine. Emissions of less than 200g/km on the combined cycle are reduced to zero in full electric drive mode, while the Formula 1-derived DRS and IPAS technologies offer an increase in straight-line speed and an instant boost of power.

To rein in the power produced by the twin powerplants, the McLaren P1 is designed to offer braking performance more associated with a GT3 or sports racing car. Developed by McLaren's Formula 1 partner Akebono, the system features a new type of carbon ceramic disc, which has previously seen service in space, but never before used on a road car. Stronger than conventional carbon ceramic, the material dissipates heat more effectively, giving the highly efficient braking system exceptional stopping and cooling capability. The system also boasts significantly reduced weight.



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Masters funding scheme aims to boost aerospace industry

A £6million bursary fund opening today will allow 500 new graduates and employees to study Masters level degrees in aerospace engineering.

Launched as part of the Aerospace Growth Partnership, the initiative is aimed at helping the sector develop the high level skills it needs to compete globally.

The scheme will support the up-skilling of current aerospace employees already qualified to graduate level, and BSc students currently studying at university.

Those students will be encouraged to make direct links with aerospace businesses to undertake projects to address the challenges faced by industry, and secure opportunities for work experience and future employment.

UK companies sponsoring the scheme are BAE Systems, Bombardier Aerospace Belfast, EADS/Airbus, Finmeccanica, GKN, MBDA Missile Systems, Messier-Bugatti-Dowty, Rolls-



Royce and Spirit AeroSystems.

Business Secretary Vince Cable said: "There is a serious shortage of engineers in the UK. Our aerospace industry is a world leader, but unless we create a new generation of engineers we'll struggle to keep ahead of the competition.

"Today's announcement will help us meet this demand. The funding will further train quality engineering graduates, widening access to the industry to talented people from all backgrounds."

SHARK SKIN COATING COULD REDUCE AIRCRAFT DRAG

Researchers in Germany have developed a technique to emboss the structures of shark skin into aircraft paints.

The team, from the Fraunhofer Institute for Manufacturing Technology and Advanced Materials, believes the new state-of-the-art coating could reduce fuel consumption by about 1%. The researchers first set out by gluing sheets of plastic imitation shark skin to the aircraft's exterior, but found that this added too much weight.

"It was also difficult to stick the foil to curved surfaces without creasing and wrinkling," said project leader Volkmar Stenzel.

As such, the team set about on a two year trial with Germany's biggest airline, Lufthansa, to test the properties of shark skin in flight.

For the trials, eight 10 x 10cm patches of the new coating were painted on to the fuselage and wing edges of two Airbus A340-300 jets.

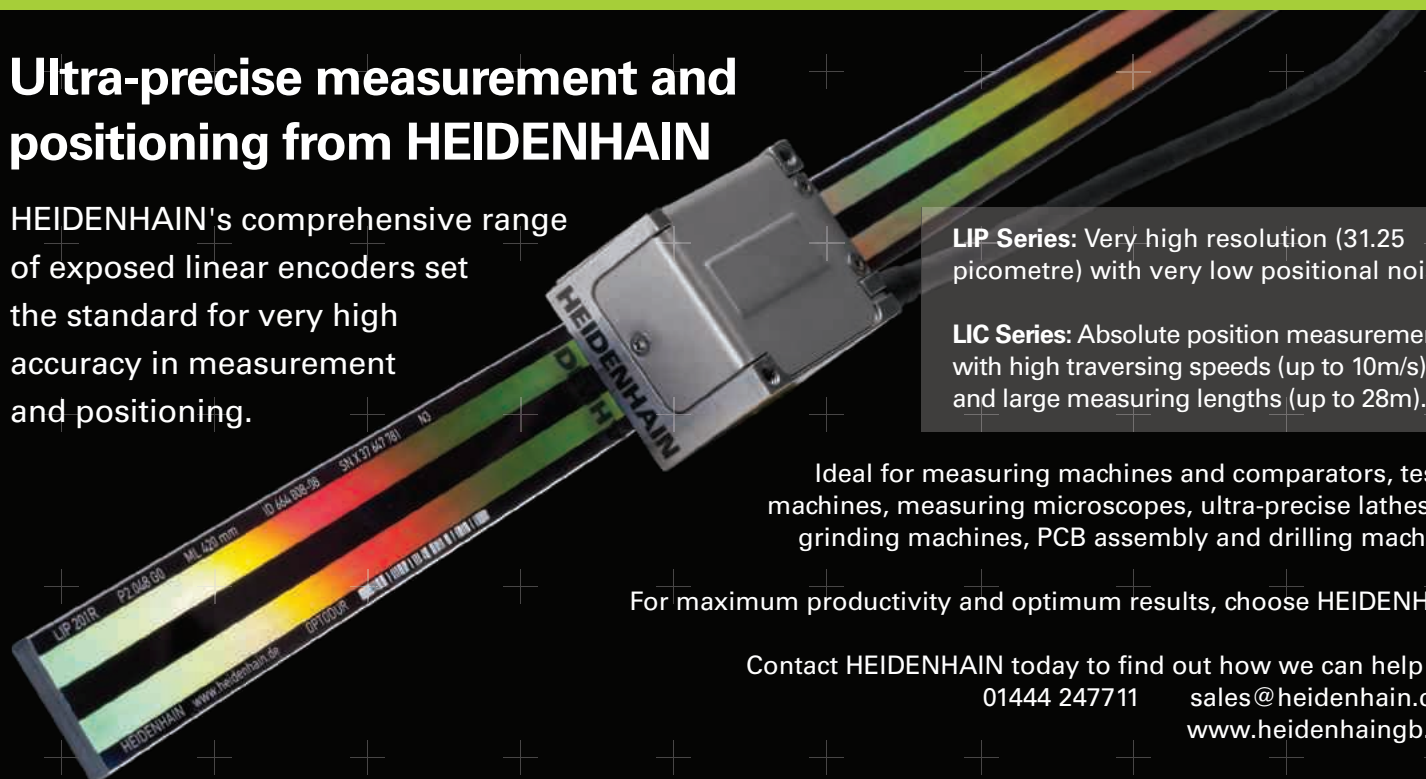
"The expected results have been achieved in terms of performance," said Denis Darracq, head of research and flight physics technology at Airbus. "It's now a matter of measuring operational efficiency and durability."



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New report highlights lack of women in STEM industry

A new report launched by WISE (Women into Science and Engineering) reveals the latest statistics on women's involvement in science, technology, engineering and mathematics (STEM) in the UK.

The report provides a snapshot of the current position of women in the STEM sector and identifies that positive figures around STEM subjects at school and university are not translating into an increase of female talent in STEM industries.

There are a number of positive trends that emerge from this report. For instance, figures show that the number of women taking STEM subject at secondary and higher education have increased since 2008. In addition to this, the number of women achieving Engineering and Technology and Mathematical Sciences degrees increased significantly between 2008 and 2011, by 21% and 27% respectively.

Despite this, the number of women pursuing a career in Engineering and ICT fell by 1.4% and 0.6% respectively since 2008 – indicating that despite the increase in take-up of STEM subjects among women at secondary and higher education level, women are still not choosing to pursue careers in STEM industries.

Helen Wollaston, director at WISE, commented: "Fewer women in the workforce means STEM industries struggle to find women for senior roles or board appointments. If we can turn this situation

around, it will open up new and rewarding career pathways for women as well as bringing huge benefits to STEM industries and to the UK economy at a whole. Our vision at WISE is for at least 30% of the UK STEM workforce to be female by 2020, but we cannot do it alone."

In response to this, WISE, supported by Arup the independent firm of designer, planners, engineers and consultants, held a knowledge-sharing breakfast meeting today to discuss the impact this latest information has on the UK economy.

Alan Belfield, director and Arup's Global Diversity Champion, commented on the results: "We take our role as ambassadors for women working in the built environment seriously and we are committed to creating an environment based on fairness, respect and merit for all our employees. The fact that 32% of our graduates in were women in 2012, against an industry average of 18% recognises that we are actively recruiting and nurturing female talent."

WISE would like all STEM sector businesses in the UK to emulate the commitment Arup has demonstrated and give their support to the campaign to increase the percentage of women in STEM sector employment. For more information, to support the campaign or to become a corporate or individual member please visit www.wisecampaign.org.uk



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Timken bearings perform under pressure



Timken spherical roller bearings have lasted up to five times longer than competitor bearings in a leading European sawmill business that recycles sawdust and wood chips into pellets. This process involves pulverising wood debris into a dough-like consistency, which is then pushed by two friction rollers through holes into a perforated drum to create the pellets.

Challenged by heavy loads, impact and vibration, other manufacturers' bearings originally used by IBV in their pellet mills

needed to be replaced about every 500 hours.

This resulted in frequent and costly downtime. IBV contacted its supplier, Brammer of Luxembourg, for a more durable solution. Brammer arranged for Timken engineers to analyze the entire production system. They solved the problem by specifying Timken two-row spherical roller bearings, which now keep the operation running for about 2,500hrs. The Timken bearings run about 5-8% cooler than the competitors.

www.timken.com

Solution to last month's Coffee Time Challenge

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The solution to last month's Coffee Time Challenge of how to develop a more child-resistant nozzle for spray bottles comes from researchers at The Research Institute at Nationwide Children's Hospital, in partnership with The Ohio State University. They have developed a prototype for child-resistant spray bottles for household cleaning products. If produced, the prototype would provide an alternative to current, more harmful child-resistant spray bottles while still meeting U.S. Consumer Product Safety commission standards for child resistance.

To develop concepts and design a child-resistant spray bottle, Dr Lara McKenzie's research group partnered with Professors Carolina Gill, MS, BSID, and Scott Shim, MA, BFA, from the Department of Design at The Ohio State University and Professor Blaine Lilly, PhD, from the Department of Mechanical and Aerospace Engineering at The Ohio State University. Together, they developed a distinct method for making spray bottles essentially unusable by children younger than six years of age.



Most notably, the prototype features a two-stage trigger mechanism that must be sequentially engaged in order for the spray mechanism to function. The spraying mechanism then automatically returns to a locked state after each use without requiring the user to consciously apply a locking feature, setting it apart from any other existing technology.

Check valves improve pump design

Valveforce's a new range of flat-disc check valves can benefit pump designs by providing up to 300% less power consumption than traditional valves.

When compared size-for-size with conventional swing and lift-type check valves, Valveforce's Check Valves give a very compact installation because they are designed to fit between flanges. With a buffered cone that enables excellent resistance to flow, these new Check Valves allow flow in one direction only when installed in pipeline systems. The flow is then 'checked' if the flow direction is reversed.

The Valveforce range includes Double Disc Check Valves for very low pressure drops. The split disc design overcomes all size and pressure drop limitations.

www.valveforce.co.uk

Maxon delivers 4mm micromotor

maxon motor was challenged to deliver maximum power in the smallest possible space and the result is the EC4 brushless motor.

Often with micro drives, the power output is too low for the application, due to the physical dimensions. maxon increased the performance of this tiny motor using the latest winding technology, the most powerful magnets and optimum use of the air gap. Integrated encoders make it possible to fully utilise the motor potential from a standstill.

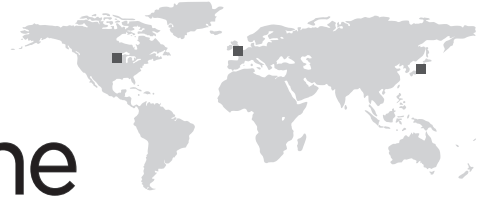
This is unique for motors of this size. maxon also incorporated a high quality gearhead to ensure optimum continuous running. High-performance ceramics are used for the gearhead carrier to make the motor capable of high input speeds and drive torques. It is the ideal partner for the miniature ESCO 36/3 brushless motor controller.

The speed/torque gradient of the EC 4 is an impressive 50,000 rpm mNm⁻¹ with a continuous torque of 0.4 mNm. There are options on the windings and encoders as well as different reduction ratios on the new 4 mm planetary gearhead.

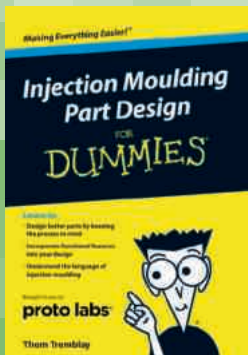
The motor is also available in two lengths. The 4 mm brushless DC motor is a great fit for applications in the fields of micropumps, analytic and diagnostic devices, ophthalmic surgical devices, laboratory robots, endoscopes and anywhere where size is an issue.

www.maxonmotor.co.uk

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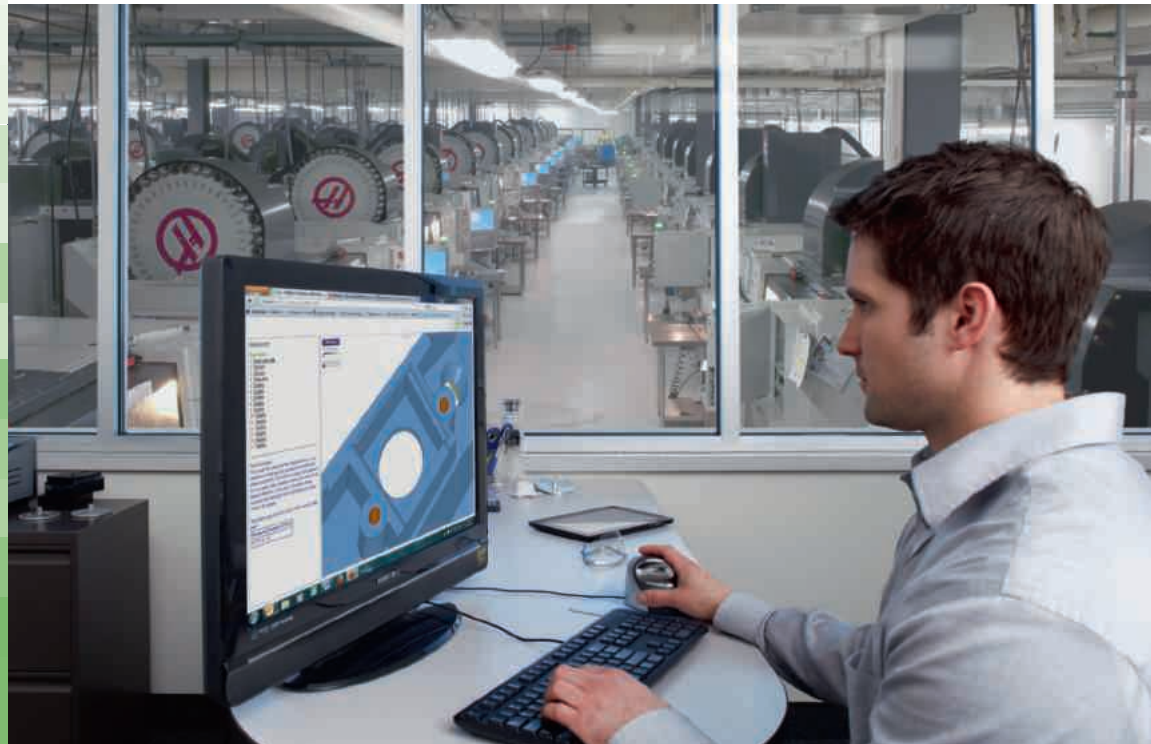


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Self-reversing machined screws

A traditional lead screw and nut combination requires the driven screw to change its direction of rotation to enable the nut to return to its original start position. In certain applications, such as in the reliable winding of cable and hose to winch drums, it would be advantageous to maintain a single direction of rotation of the screw but have the nut return to the start point.

With the self-reversing screw product available

from Abssac Limited, only one direction of rotation is required to achieve reciprocated bi-directional lateral movement. This is achieved by using a follower blade in the nut that is matched to the particular groove width and screw turn round on the screw.

The follower blade material is usually phosphor bronze, aluminium-bronze or in some cases hardened steel and can be replaced if worn.

www.abssac.co.uk



NSK solution gives improved bearing life



NSK has improved the competitiveness of an OEM manufacturer of concrete head vibrators, by providing a bearing substitution and lubrication programme that is delivering operating cost savings of €306 pa on each vibrator.

NSK became involved with the project following the design and development of a new type of electric poker for concrete head vibrators. The OEM manufacturer had specified a deep groove ball bearing as an integral part of the new design. The new operating target placed upon the bearing, a unit specified with C3 clearance and a steel riveted cage, was that it should last over 1000 hours; however, most bearing types that were tested had failed to reach even 100 hours.

NSK was consulted by the customer and

asked to analyse the problems with the existing bearing specification, and to provide possible solutions that would meet the exacting specification for the new poker design. Concrete poker vibrators are used to dispel bubbles in wet concrete that can form as it is poured from the mixer truck, and air voids that become trapped in deep channels.

After an in-depth analysis, NSK first recommended replacing the oil used in the application for another specific NSK oil. Secondly, NSK also suggested the type of bearing used in the design should be retained, but that it should be supplied with a larger radial internal Clearance (C4) to allow greater lubrication and allow for increased vibration damping within the bearing unit itself.

www.nsk-europe.com

Hydraulic seals improve cylinder performance

SKF has launched a new range of hydraulic seals to meet the hydraulic cylinder industry's requirement for improved performance. By consolidating the product offers from SKF, and from the acquired companies Economos and Polyseal, SKF can now present a complementary range and catalogue of

hydraulic seals, for both OEMs and end-users, in metric and imperial sizes.

The launch introduces several new products in the range, such as the "S1S" polyurethane U-cup for heavy duty rod sealing systems and three new styles of polyurethane piston seals.

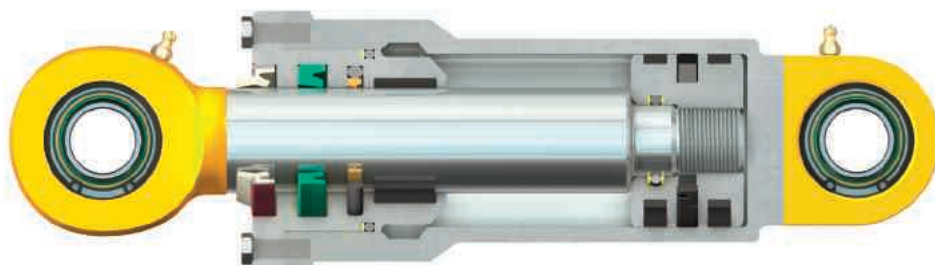
SKF developed a new grade of SKF Ecopur

polyurethane material in conjunction with the new product designs. The material was improved for seal function in heavy duty applications, with high system pressure and temperature.

The new complete SKF hydraulic seals range includes thousands of standard components from more than forty different designs of rod seals, piston seals, wipers, static seals and guide rings, plus a broad range of design and material choices for tailor-made solutions.

The hydraulic sealing solutions provide designers with the complete sealing and guiding system to develop a wide variety of hydraulic cylinders.

www.skf.co.uk





ADDRESSING THE NEEDS OF THE GROWING AUTOMATION MARKET

The global automation market is growing at twice the rate of industrial production as a whole, with scope for even faster growth in the future. These were the findings of a detailed analysis conducted last year by the Swiss Bank, Credit Suisse, which reveal the ever-increasing importance of discrete factory and process automation in major sectors such as the automotive industry.

To keep pace with this progress, and to manage the rapid changes in technology, customers across the globe are seeking more and more support from companies like RS Components to fulfil their automation product needs. The automation market contains many different areas of focus for today's engineers and technicians, such as: sensing; motion control; machine and panel building; system integration; wireless automation; process control; machine safety; control gear; fluid management; and pneumatics.

Extensive product and service portfolio

With a long history of distributing components for these applications, RS has an in-depth knowledge of the market and is constantly adding to its extensive portfolio of automation and control gear products from industry-leading brands. RS customers are assured of a continued supply for critical systems from the company's distribution centres throughout Europe and Asia, whether for planned projects or for fast response to emergency situations.

The RS automation offer goes beyond the

provision of an efficient, reliable supply of products direct from stock, to encompass a complete range of services to ease the customer's sourcing and purchasing experience. As part of its broader strategic eCommerce activities, RS is developing its online support for maintenance engineers, project engineers, machine and panel builders, and purchasing professionals, while retaining a strong human element to its customer service.

Comprehensive information resources

The Process and Automation Centre on the RS website is the gateway to a wealth of information and advice, providing access to technology centres that direct customers to the right parts for their application, covering: PLCs; sensors; logic control; timers; networking; fluid management; temperature control; and servo control.

The Solutions and Industries section offers useful information on machine safety, including a new interactive 'machine safety application finder', as well as guidance on hazardous areas, where customers can learn about the legislation and control of products suitable for explosive environments.

The online panel products selector is designed to help panel builders through the entire process from design to delivery, with access to more than 101,000 RS and manufacturer datasheets, and health and safety documents. The tool enables customers to select the required items and get a quote for the bill of materials

(BOM), providing a single point of access to components from all of the market-leading manufacturers.

Customers with a BOM exceeding £500 can save money through a negotiated discount. There is also a free online quotes service that enables the customer to upload a list of parts and search the entire range of products automatically.

Added value

RS also stocks the fixings, cables, connectors, and tools required to complete the build, together with test and measurement equipment for verification and functional testing.

To assist the customer at all stages of the selection and purchasing process, an expert technical help team can be contacted either through the online chat service or by calling the technical helpline.

The rising importance of automation within global industries is resulting in an increasingly competitive environment, where engineers and technicians are under pressure to find solutions for their applications ever more quickly. RS addresses this by offering a vast range of leading-brand product options from one source, direct from stock, backed up by strong technical support and innovative online ordering capabilities to ease the customer's sourcing and purchasing experience.

rswww.com/automation-control-gear



Swarm feelings

Large swarms of autonomous robots performing collaborative tasks is not an image of the future, but of the present. Paul Fanning reports.

The prospect of 'swarms' of robots behaving autonomously and collaboratively to achieve complex industrial tasks is one that can excite and alarm in equal measure. On the one hand, of course, the sheer technical achievement is remarkable and the possibilities almost endless. On the other hand, the sight inevitably calls to mind the spectre of various sci-fi dystopias to mind where robots act independently of their human 'masters'.

These contrasting emotions were doubtless felt by many attending the recent SolidWorks World event in Florida, at which Professor Vijay Kumar, Professor at the School of Engineering and Applied Sciences, University of Pennsylvania, gave a fascinating presentation on his work in this area.

Professor Kumar drew the comparison between his robots and Unmanned Aerial Vehicles (UAVs) such as the drones used for military purposes. While these two things may be mechanically similar in certain ways, he said, UAVs were not robots in the sense that they are remotely operated – often by a team of people. By contrast, Kumar's swarms are made up of autonomous robots capable of acting both independently and collaboratively to achieve a set task.

The other key difference between these quadrotors (so called because they are helicopters with four rotors) and UAVs is their size. UAVs are big – sometimes weighing hundreds of kilos – while the robots developed at the University of Pennsylvania are at most a metre in diameter and at most a couple of kilos in weight. Indeed, the smallest of these robots weighs just 75g and is approximately 21cm in diameter.

The dynamic capabilities of these robots are impressive. For instance, their size makes them incredibly agile – capable of performing flips and double flips in the space of just half a second. This is possible because an onboard computer carefully monitors signals from onboard

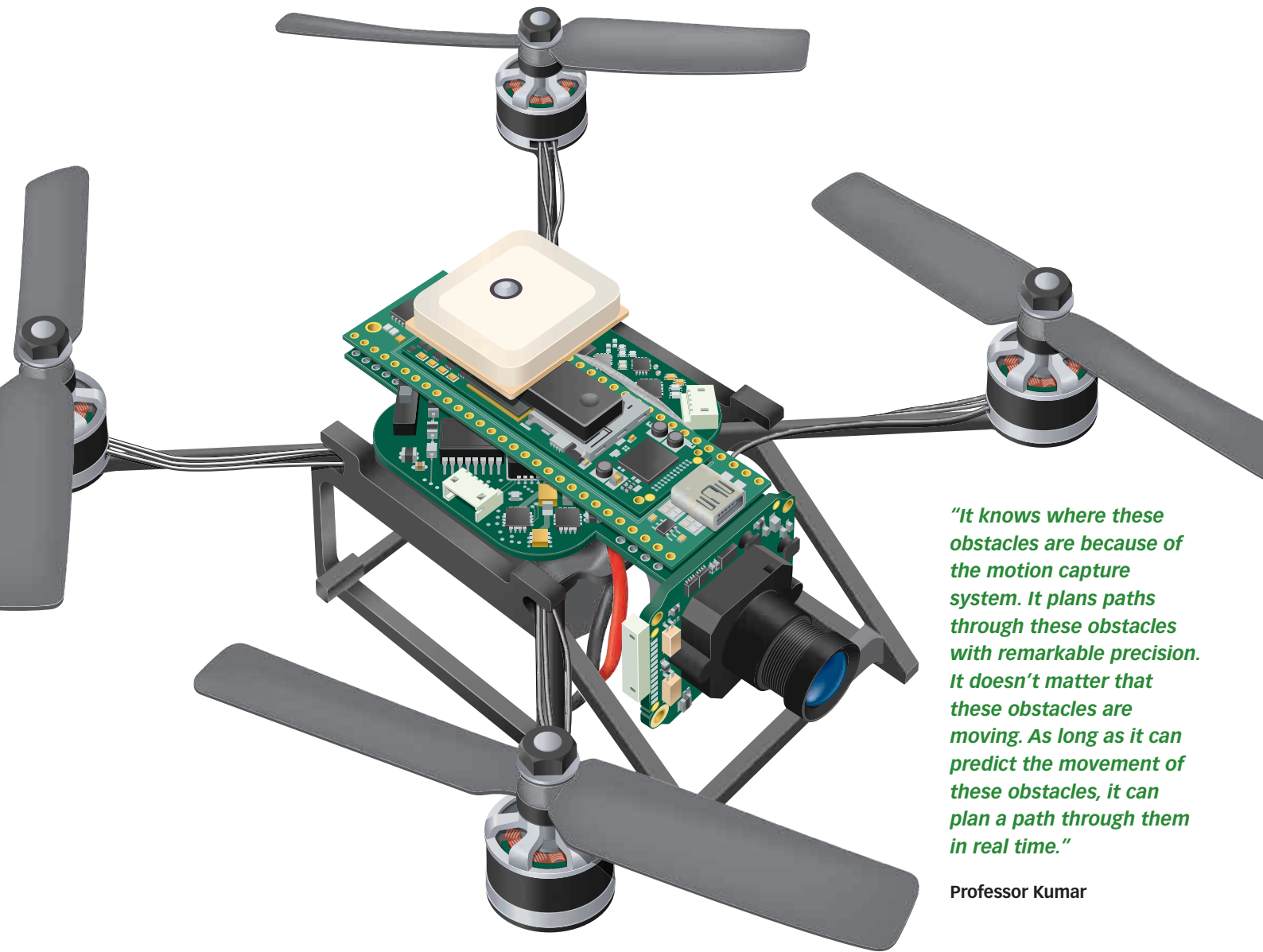
gyroscopes and accelerometers to stabilise the aircraft in such a way as to hover. This means it is possible to throw the robot into the air and, no matter from what position, it will stabilise to a hover.

However, the question of autonomy is less easily explained. While the quadrotors may have pre-programmed flight paths, the question of motion planning in this instance is still key – in other words how the robots learn to get from point A to point B. Says Professor Kumar: "The dynamics of a robot like this can only be described in a 12-dimensional space and, furthermore, that space is curved. The reason for this is that if you write down the equations of motion, they have all kinds of non-linearities. What we have to do is plan motions for this in real-time. So if you consider the problem of getting from Point A to Point B and you want to perform all these computations via onboard processors, this is quite hard. So there's a trick that allows us to transform that 12-D space into a flat, 4-D space and to perform this trick, all you have to worry about are the x,y and z angles and the yaw angle. If you can find sufficiently smooth trajectories in this 4-D space – trajectories that avoid obstacles – then it's possible to take that and transform it back to the 12-D space and that's the trick that our robots perform to plan motions in realtime."

Aggressive Trajectory

Thus, a robot going from A to B via an intermediate wavepoint will describe an aggressive trajectory that starts from a hover position. This movement is undertaken autonomously and the feedback is obtained by a motion capture system overhead in the lab that provides realtime information 100 times per second (calculating flight-control commands for the rotors 600 times per second). But the planning is done at 20Hz, so 20 times a second it can calculate 'minimum snap trajectories'





"It knows where these obstacles are because of the motion capture system. It plans paths through these obstacles with remarkable precision. It doesn't matter that these obstacles are moving. As long as it can predict the movement of these obstacles, it can plan a path through them in real time."

Professor Kumar

(smooth trajectories designed to find the right path). Professor Kumar was also able to demonstrate the robots' ability to avoid obstacles – both static and moving. In one highly impressive video, he showed a quadrotor flying through a hoop thrown in the air. In another clip, a robot was confronted by a window just three inches wider than its diameter. Starting in a hover position, it twisted its body into a vertical axis and then recovered – having worked all this out by itself.

Says Kumar: "It knows where these obstacles are because of the motion capture system. It plans paths through these obstacles with remarkable precision. It doesn't matter that these obstacles are moving. As long as it can predict the movement of these obstacles, it can plan a path through them in real time."

While these displays of autonomy are impressive, perhaps more significant is the capability demonstrated by the quadrotors to act collaboratively. Again, of course, this requires the robots to be cognisant not merely of their surroundings, but of their fellow members of the 'swarm'.

To achieve this, said Kumar, his team turned to the examples of nature. In particular, he pointed to the behaviours of flocking starlings and ants engaged in a particular task. Work with biologists, he claimed, had brought his team to the conclusion that there were three aspects of animal behaviour they had identified in relation to 'swarms'.

The factors identified, said Kumar are that "[animals in swarms] operate solely on sensing local information. It is not possible for the



individual at one extreme of a group to know what the person at the other extreme is doing. Secondly, the individuals have to act independently. No individual is going to tell you what to do to achieve a particular co-operative task.

"Finally, there has to be a notion of anonymity. An individual has to be agnostic to who their neighbour is. That's very important if you want to perform a collaborative task. The ants have no identities and the robots don't care which robot is next to them."

Appreciating these factors has allowed the quadrotors to be used in a number of impressive collaborative actions. These have included the creation a 20-robot swarm. Flying in formation, they are all aware of their neighbours, but are told by their human operator to create these formations, which they do in a safe way, keeping a track of their fellow robots. The formations can be two- or three-dimensional and can change dynamically to avoid obstacles. Control has to be very precise in these formations, particularly as the individual robots are buffeted by the aerodynamics of their neighbouring vehicles and the downwash of the rotors.

The size of these robots, though, would appear to limit their practical value. One of the limitations of scaling down is the question of payload. It therefore follows that a lot of robots will be needed to collaborate to

"The robots decide between them which robot is going to pick up which part and where they're going to assemble it. The high-level specification is very simple, but the robots essentially make all the decisions in order to satisfy it."

Professor Kumar

carry payloads. Whether the payloads are objects to transport or sensors to map a particular area, collaboration is the key.

Professor Kumar then showed a video of robots collaborating to build simple structures. He said: "The robots decide between them which robot is going to pick up which part and where they're going to assemble it. The high-level specification is very simple, but the robots essentially make all the decisions in order to satisfy it."

However, the great limiting factor would appear to be the fact

that these robots still rely on the motion capture system within the lab. But Professor Kumar pointed to an application where the robot carried a Hokuyo laser scanner and a Microsoft Kinect RGB depth camera. Using these sensors, the robot can distinguish features in the environment and triangulate those features.

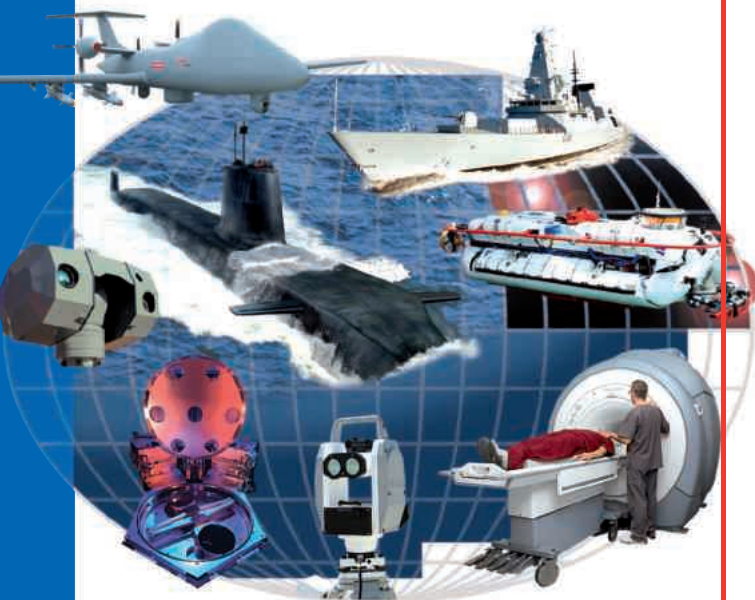
A video was then shown of a robot taking off outside a building it had never seen before and mapping the features. It then triangulates its position in relation to these features a hundred times a second. The onboard cameras thus provide roughly the same information as the motion capture cameras in the lab. 'Roughly' because these robots don't have any access to a global coordinates system like GPS or a motion capture system. What they have to do is triangulate based on features that they have captured, giving a relative sense of how fast they are moving.

In the instance shown, the robot was completely autonomous. Its operator only being able to direct it based on the map it had created as it moved around.





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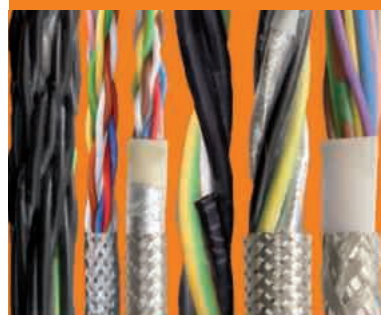
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The transfer window

The successful transfer of technology from academia to industry is a holy grail for UK plc.

Paul Fanning talks to a man who thinks he knows how to achieve it.

Throw a figurative stone in any gathering of senior engineers and you are bound to hit someone with a strongly-held opinion on how best to increase the successful transfer of technological innovation from universities to industry.

However, when the president of the Institution of Engineering and Technology talks on the subject, one pays attention. And when that person has the track record that Professor Andrew Hopper does, one is bound to take it more seriously than most.

Professor Hopper is professor of computer technology and heads up the Computer Laboratory at the University of Cambridge. With a long history of turning innovative research and technology into commercial success he has co-founded 13 start-ups, three of which have floated on stock markets. He is also Chairman of RealVNC and Ubisense, both born of research by Cambridge University graduates and both winners of two Queen's Awards for Innovation and International Trade. So, as he puts himself: "[Mine] is not a fatuous perspective on this subject."

The question of increasing the number of successful university spin-outs has exercised many minds, of course. These have included Government, academia, industry and any number of intermediary groups.

This push, of course, has led the universities themselves to make increasingly high-profile efforts to translate intellectual capital into its monetary equivalent. These efforts have usually taken the form of University-owned technology transfer offices such as Oxford's Isis Innovation or Cambridge Enterprise, whose brief is to undertake technology transfer and exploit the intellectual property developed by the university.

Prof. Hopper's assessment of this landscape, however, is less than positive. Indeed, he is very clear about the fact that, in his eyes, the model for successful technology transfer as it currently exists is structurally flawed.

"I think universities are in a very difficult position," he explains. "They are trying to sell IP for as much as possible, so they look within the university for what they perceive to be of value and try to get the best price for it. But the thing is that I haven't yet found a person on the planet who can definitely pick winners."

Instead of this way of doing things, Prof. Hopper endorses what he calls "a volume approach". He says: "The core point is that the market is in the wrong place... [The universities] are trying to sell everything for as much as possible and I think they would probably be much

better off going for a volume strategy, by which I mean getting as many innovative ideas as possible out there and maybe make a bit less on each one. That way, you get as much out there as possible and let the market pick the winners. The market needs to be pushed somewhere else, because the universities themselves are not the people who should be trying to pick winners."

The consequences of such a shift, he believes, would be a 'win-win' for all concerned. "As a consequence of shifting the market to a later stage, everyone wins," he says. "The universities will make more money and at the other end, you've got much more activity, so the marketplace is busier, more competitive and there are more innovative ideas in circulation."

In addition to creating greater levels of innovation, Prof. Hopper believes that such a relationship is only reasonable given that the so

much university research is already largely funded by the taxpayer. He says: "The taxpayer has already paid for the research once. Why should they have to pay again?" He also believes that, by making

such IP available to industry, it would help to engender better and closer relationships between academia and the commercial world

If such a relationship sounds rather one-way, however, he believes that it would not leave the universities empty-handed. Indeed, in his Inaugural address as President of the IET, Hopper suggested a model that gave the university a set percentage of the company in return. Alternatively, he suggested the possibility of the university retaining 1% of the company 'dilution protected' (meaning that notwithstanding further investment the university is entitled to keep its 1%). He said: "If this were to work I would be very happy to be a vice-chancellor – not that I am one – and have lots of companies in which I have a small stake, especially if it was dilution-protected."

For all that, however, Hopper feels that no system can guarantee innovation or success, saying: "The most important thing that comes out of universities walks out on its own two feet." For this reason, he also believes that any artificial attempt to create an environment that produces innovation is doomed to failure.

"The whole world is trying to industrialise innovation," he says. "But you can't industrialise innovation any more than you can industrialise a painting or any other piece of art. It can only come from individuals."

"I haven't yet found a person on the planet who can definitely pick winners."



Biography

Born in Warsaw, Poland in 1953 and a UK citizen since 1964, Professor Hopper received a BSc degree from the University of Wales Swansea and a PhD from the University of Cambridge.

He is a Fellow of the Royal Academy of Engineering and the Royal Society, and in 2007 was made a Commander of the Order of the British Empire (CBE) for services to the computer industry.

His current research interests include computer networking, pervasive and sensor-driven computing and using computers to ensure the sustainability of the planet.



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Yes, we scan!

A British company is using crowdfunding to aid the development of a new, affordable, 3D scanner.

Paul Fanning reports.

A British company is using crowdfunding to raise the money to launch an affordable 3D desktop scanner.

Chester-based CADScan was formed in 2011 by Alastair Buchanan and Tony Rhoades, who were "motivated by a desire to make 3D scanning easy to use and accessible to all." Its product – CADScan 3D – is an affordable, desktop 3D scanner and software that creates a full 3D mesh for use in CAD or 3D modelling.

Able to scan objects up to 250mm x 250mm x 250mm, CADScan 3D uses optical scanning technology to create high-quality, full-colour models.

What sets the CADScan 3D apart are its ease of use and price point. It is priced at just £650 and there is no post-processing required, no training, no calibration and no alignment – just push the button. A typical scan takes around five minutes – speed depends to some extent upon how powerful the computer running the scanning software is, and how large the object is.



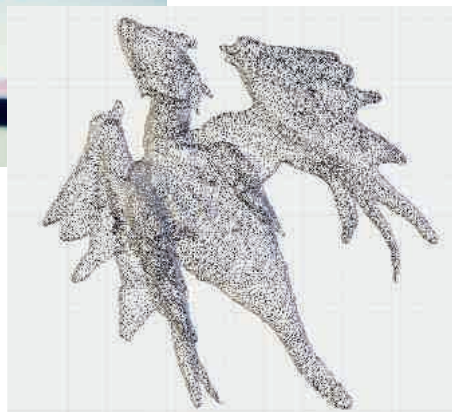
The system has a resolution of 0.2mm (when close to the centre of the turntable, and improves as objects pass by closer to the scanner head). It produces a watertight, 3D mesh of objects that it scans. It does this by automatically combining multiple surface and profile measurements as the object rotates on the turntable. This mesh can be saved in a



number of formats and is suitable for 3D printing without any further processing.

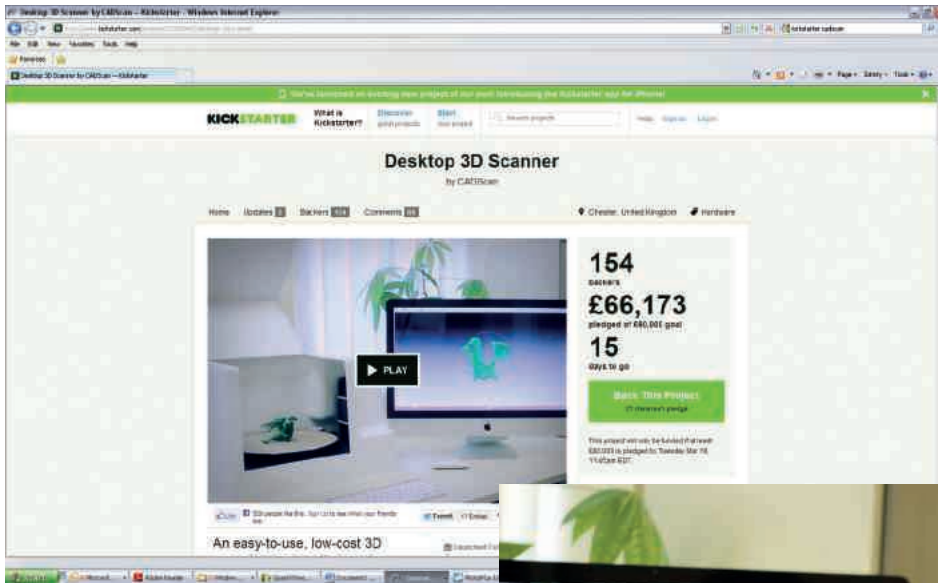
For users who wish to perform their own meshing or manipulation of the model, the data can also be saved as a point cloud.

CADScan 3D is able to scan objects up to 250mm x 250mm x 250mm and uses optical scanning technology to create full-colour models.



The system software has been developed using both the prototype scanner hardware and CADScan's own simulation software. A complete system simulation has been created which allows CADScan to test and validate system performance and to optimise the configuration of the scanner for several different applications. The first version of the scanner has been designed for general purpose scanning of small objects.

CADScan's approach has been specifically developed for 3D object scanning. It uses a combination of low-resolution and high-resolution scanning methods to minimise problems associated with surface reflections. For robustness we use the object profile to rapidly build an approximate model, while it uses a novel white-light scanning technique to capture surface detail. The company has also developed its own scanning head, which does this without the use of expensive projectors or complex optics, meaning we can position our scanner head close to the object. This improves the resolution of the captured data and is key to



the compact and low-cost design.

Asked what market CADScan is designed to meet, Alastair Buchanan says: "CADScan's target audience ranges from engineers and CAD designers to hobbyists. It's not uncommon for an engineer to be creating a 3D model of a small object by measuring a part on his or her desk. CADScan 3D is affordable enough that almost any design or drawing office could have one to scan those parts quickly – saving engineers time and reducing the risk of manual measurement error."

Because the CADScan 3D is designed to be affordable, it opens up the possibility for reliable, easy-to-use scanning for many applications where alternatives have been either too expensive or too difficult to use effectively.

The CADScan scanning technology can be scaled and optimised for specific applications in different industries, bringing usable, low-cost scanning to many sectors. The scanning technique also has potential for further development to improve both performance and cost.

This scanning envelope of the machine is similar to that of many 3D printers, making it the ideal companion to such equipment.

Unsurprisingly, then, Buchanan is keen to emphasise that this market is one that CADScan sees as key to its future development.

"The rapid growth of the 3D printing industry already means that many small engineering, technology or creative businesses have already invested in their first 3D printer, he says.



Alastair Buchanan and his partner Tony Rhoades have used crowdfunding website Kickstarter to generate capital for the product

"However, few have the skills or training required to create 3D content, so it has also created a need for new tools to create and manage this. This need will drive the 3D scanning market which, until recently, has been the preserve of the larger firms who have been able to invest in the expensive products currently available, or the skilled hobbyist."

As to the markets in which he believes it will have success, Buchanan says: "Industries such as the technology and electronics sectors are crying out for a high-quality 3D scanner that is quick and simple to use while hobbyists and art communities are excited about the prospect of an affordable 3D scanner that they can use at home, without any training being required."

However, the technology aside, one of the

remarkable things about CADScan 3D is its current funding model. CADScan received seed investment from The Matrix Model Group, and successfully applied for grant funding from the UK government's Technology Strategy Board to develop the concept into a pre-production prototype.

CADScan is now using crowdfunding to help bring its first product, CADScan 3D to market. Interested parties can pledge anything from £5 to £5,000 or more via Kickstarter for a range of rewards including different versions of the 3D Scanner.

The funding goal is £80,000 (US\$ 124,000)

needed to get the scanner ready for production. The deadline for raising this amount is Tuesday 19th March. At the time of going to press, CADScan has already hit over 80% of the goal with more than £66,000 pledged].

Although the company is ready to take the product into low-volume series production, there are a number of steps which it needs to complete before it is able to manufacture and sell the CADScan 3D.

These are where the hoped-for Kickstarter funding will come into play and include a need to make some refinements to the prototype hardware and software and finalise the performance parameters; designing and building production tooling; subjecting the product to a certain amount of one-off conformance testing and certification to allow it to be sold in the UK and the establishment of an effective supply chain for manufacture and testing.

cad-scan.co.uk
www.kickstarter.com

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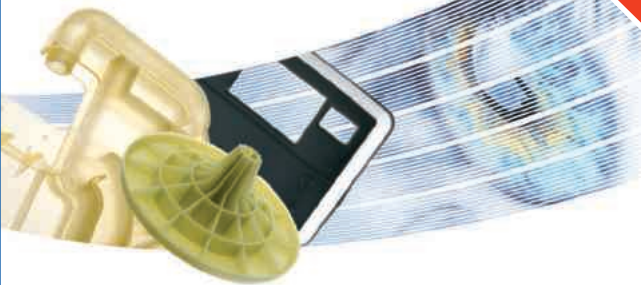
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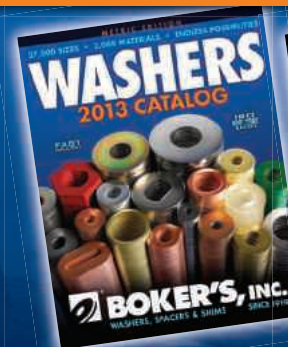
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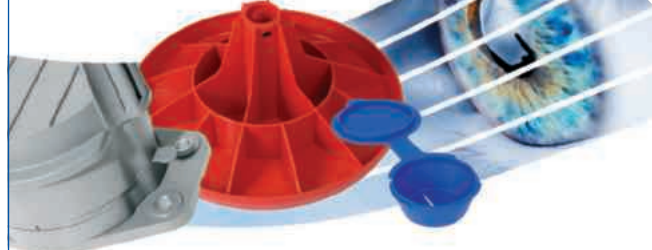
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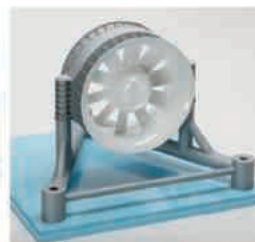
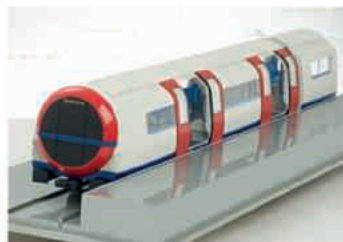
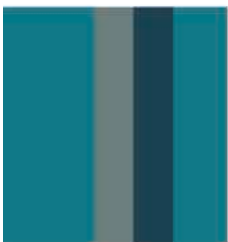
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3D printing creates artificial ears

Bioengineers in the US have created artificial ears using a 3D printing technique and injectable gels made of living cells.

The prosthetic ears are said to be almost indistinguishable from natural ones, and could be the solution reconstructive surgeons have long wished for to help children born with ear deformity.

"A bio-engineered ear replacement like this would also help individuals who have lost part or all of their external ear in an accident or from cancer," said Lawrence Bonassar, an associate professor of biomedical engineering at Cornell University.

Replacement ears are usually

constructed with materials that have a Styrofoam-like consistency, or sometimes, surgeons build ears from a patient's harvested rib.

This option can be painful, however, and the ears rarely look completely natural or perform well. To make their 3D printed ears, the Cornell University team started with a digitised 3D image of a human subject's ear and converted the image into a mould using a 3D printer.

They injected the mould with collagen derived from rat tails, and then added 250m cartilage cells from the ears of cows.

The high-density gel is said to have a similar consistency to jelly,



with the collagen serving as a scaffold upon which cartilage can grow.

Bonassar asserted: "It takes half a day to design the mould, a day or so to print it, 30 minutes to

inject the gel, and we can remove the ear 15 minutes later. We trim the ear and then let it culture for several days in nourishing cell culture media before it is implanted."

Proto Labs seconds that ReMotion

The ReMotion Knee, a low cost prosthetic knee joint, is the latest winner of the Cool Idea! Award from Proto Labs, the world's fastest manufacturer of CNC machined and injection moulded parts.

Proto Labs launched the Cool Idea! Award to give product designers the opportunity to bring their innovations to life by presenting up to \$250,000 worth of prototyping and short-run production services to award recipients. D-Rev, designer and manufacturer of the ReMotion knee, is 2013's first Cool Idea! recipient. Proto Labs is providing



D-Rev with injection molded parts to fulfill its next round of testing.

The ReMotion Knee project started in 2008 as a project in a graduate bio-medical engineering

class. The class collaborated with the JaipurFoot Organization, India's largest provider of low cost prosthetics, and later teamed up with San Francisco-based designer Vinesh Narayan.

"About 10m above-the-knee amputees live in developing countries, and the ReMotion Knee allows them to walk stably on uneven or unpaved terrain typical of the developing world. It also helps them return to work, and remain independent," says Narayan.

To date, more than 4,600 amputees have been fitted with a ReMotion Knee.

Micrometre-scale 3D printer is 'world's fastest'

German start up Nanoscribe has developed what it claims to be the world's fastest 3D printer of micro and nanostructures.

The new Photonic Professional GT uses laser lithography, but the technology is based on two-photon polymerisation with a galvo mirror system.

This combination is said to allow for unmatched precision, but also blazing speeds.

Martin Hermatschweiler, CEO of Nanoscribe, said: "We are revolutionising 3D printing on the micrometre scale.

"The demands for precision and speed at the same time are met by industrially established galvo scanners – a quantum leap in nanofabrication.

"Our product benefits from more than a decade of experience in photonics, the key technology of the 21st century."

Magic Arms nominated for design award

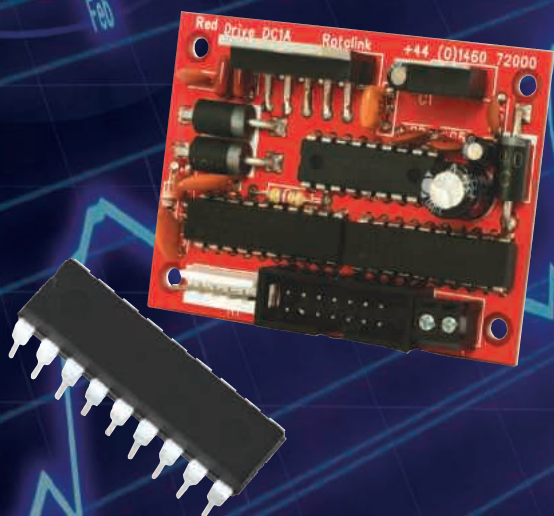
The 'magic arms' WREX exoskeleton, designed by Nemours/Alfred I. duPont Hospital for Children, has been nominated for the Designs of the Year 2013 awards by London's Design Museum.

Using a Stratasys Dimension 3D Printer, researchers at the Alfred I duPont Hospital for Children in Philadelphia were able to help four-year-old Emma Lavelle overcome the limitations of a congenital disorder, allowing her to use her arms for the first time. The 'magic arms' device is a custom-designed robotic exoskeleton that enables her to conquer greatly limited joint mobility and underdeveloped muscles.

The Designs of the Year is an international awards programme, showcasing the most innovative and imaginative designs from the past year.

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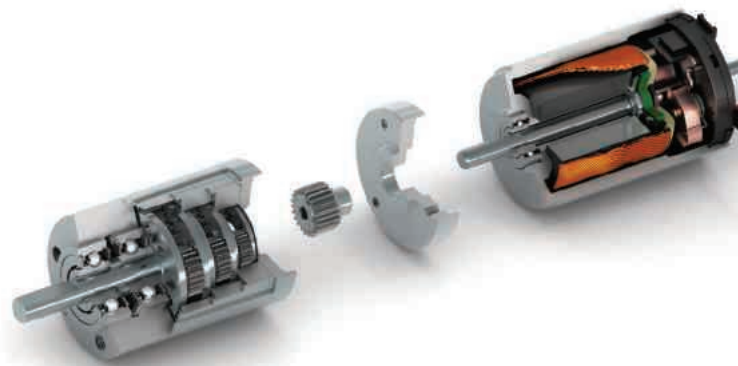
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Making the link

Harting's Fast Track Switching technology recognises, prioritises and accelerates important frames in automation applications.

Industrial Ethernet continues to find wider adoption in automation systems. By Graham Pitcher.

Ethernet is making inroads into the industrial sector as system builders and manufacturers look to improve communications between machines and with the back office systems which run their operations.

According to a recent report from IMS Research, there were more than 30million networked nodes in industry, with 23.2% of them using a variant of Ethernet. These figures are predicted to increase by 2015 to 26.2% and 45.1m nodes respectively. Yet while Ethernet is making inroads, it isn't achieving a dominant position.

The interesting word in the IMS report is 'variant'. Since the emergence of fieldbus technologies in the early 1980s, the sector has been typified by a blend of proprietary protocols and 'flavours' of Ethernet. While the report says the dominant industrial Ethernet technology is TCP/IP, it lists another seven variants before it gets to the inevitable 'other' category. The reason? Many controllers still require the use of a particular protocol – the concept of open architectures remains an unachieved goal.

Gavin Stoppel, applications manager with Harting's Smart Networks Infrastructure Product group, says: "Ethernet is making itself the de facto

standard for a lot of industrial communications." But he also noted that Ethernet brings with it the need for higher quality components. "There is a growth in demand for resilient networks in the industrial automation environment and reliability is one of the biggest requirements. That's about making sure there are high-quality connections; even the basic RJ45 connector needs to be of high quality. Then there's Ethernet shielded cable and the devices themselves."

Stoppel sees a merging of communications environments from the office through to the factory. So too does Dr Wiren Perera, VP corporate strategic marketing and LAN solutions. "Industrial Ethernet has been used in corporate networks for some time, but it's moving towards the shop floor," he said. "They have chosen a standard means of communication because more important data is being transferred from one environment to the other. The communication has to be seamless, so companies such as Harting are now looking at developing products that start to manage data."

Harting has developed Fast Track Switching as a means of supporting all protocols based on Ethernet. According to the company, the switching method ensures that all performance and

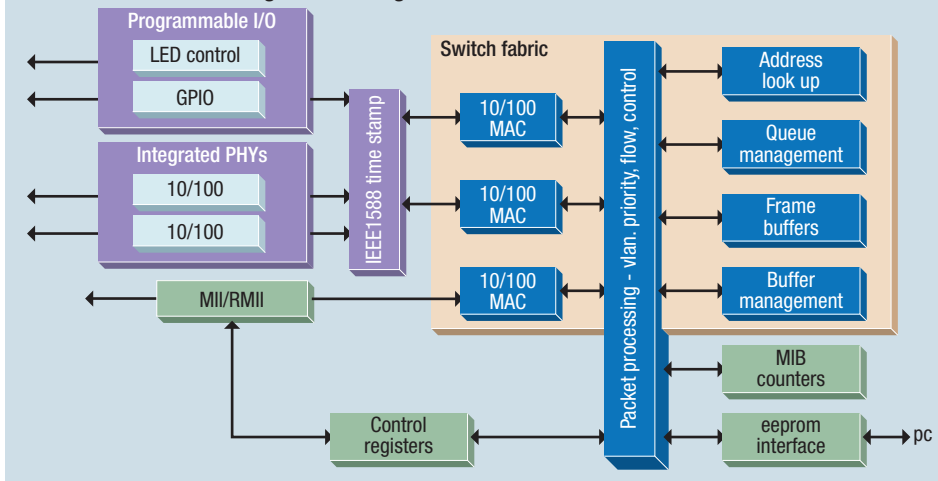
determinism requirements are met. "Fast Track can recognise the different protocols in use," Stoppel noted, "and give them priority over standard Ethernet messages. This gives more control over latency and allows the product to meet the requirements of an automation network."

Fast Track has a three-step approach to networking. In step one, automation frames are detected based on the header information in the Ethernet frame. The next step is acceleration. Harting says that, unlike 'store and forward' approaches, the complete frame does not need to enter the switch's memory. Once an automation frame is detected, cut-through switching technology forwards the frame to the appropriate output port.

Detected automation frames are always given preference, which makes sure that IT frames always have to yield to automation frames. Once the automation frame has been sent, the IT frame is resent. Harting claims these mechanisms guarantee the levels of determinism and performance required by automation systems.

He believes it's an approach that makes Ethernet more flexible in the industrial

Fig 1: Block diagram of Micrel's KSZ846x switch



environment. "There are different degrees of resilience," he offered. "You won't find an exclusive Profinet network, for example; there will be a mixture of protocols. That means the devices need to be able to switch themselves and for them to be capable of handling and transmitting data without extended latency."

Micrel's Dr Perera is particularly interested in latency and pointed to the company's recently launched KSZ846x range. These devices use Micrel's EtherSynch technology, which integrates IEEE1588v2 distribution synchronisation, Ethernet switching and precision general purpose I/O. "IEEE1588 allows you to string devices together," he explained, "and to synchronise them to allow for time delays."

Micrel says EtherSynch technology combines Ethernet communications, IEEE1588v2 distributed synchronisation and precision general purpose I/O in an integrated, energy efficient solution. The

synchronisation and communications processing abilities offload the host cpu, while the general purpose I/O allows locally connected devices to take advantage of synchronisation. KSZ846x parts are suitable for use with cpus which don't feature an Ethernet MAC."

Micrel says the parts can be used in distributed networks and adds the architecture reduces the synchronisation and communications processing load on system CPUs. "By integrating IEEE1588 time stamping as close to the physical layer as possible," Dr Perera noted, "synchronisation performance of less than 100ns has been demonstrated. In fact, we've shown jitter of less than 58ns.

"It's a cost-effective solution for implementing industrial Ethernet networks which reduces size and power consumption when compared with

fpga based designs. A high level of integration reduces costs, making IEEE 1588v2/Ethernet a viable contender for FieldBus applications by replacing point to point serial interconnects."

Stefano Zammatio, product manager with Altera Europe, says: "We see [industrial networking] moving towards industrial Ethernet, but the progress hasn't been as swift as was predicted. Even so, it is getting there slowly."

One of the attractions of industrial Ethernet for Altera is the fact the technology continues to evolve. "This makes it ideal for FPGAs," Zammatio claimed. "When Altera first started looking at the market, there were a range of vendors offering particular features. Since then, most of them are offering additional functionality – redundancy, for example. This makes the market hard to approach from an asic perspective and this will continue."

Zammatio sees vendors still being aggressive in what they are looking to achieve. "All are open to adding new features but, because the market is

not 90% industrial Ethernet, fpga designs with new features can be turned round quickly. But our challenge is dealing with multiple vendors and that's why we've started working with Softing."

Stoppel: "Ethernet is making itself the de facto standard for a lot of industrial communications."

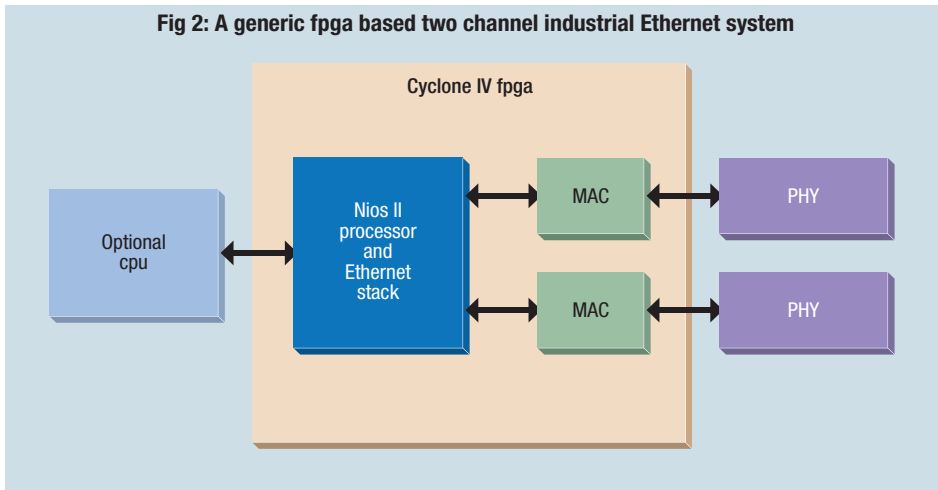
In partnership with Softing, a leading supplier of Industrial Ethernet protocols, Altera can offer an FPGA with an integrated software stack that is said to provide an easy and inexpensive way to develop industrial Ethernet and fieldbus connectivity platforms.

Harting, meanwhile, is still looking at IEEE1588. "However," Stoppel noted, "while we realise that timing is becoming a more important issue, we don't think that certain protocols have got to that level as yet. The standard has been around for some time, but has yet to be implemented widely by automation manufacturers."

Stoppel added that, from a real time control point of view, there is a move towards protocols that support real time messaging. "Profinet IRT – isochronous real time – is one such protocol," he pointed out. "Harting isn't tying itself to a particular protocol, rather it's developing devices which have multiprotocol capability and customising them."

Concluding, Dr Perera said: "System builders often have a lot of problems when building systems. We are making it easier for them."

Fig 2: A generic fpga based two channel industrial Ethernet system



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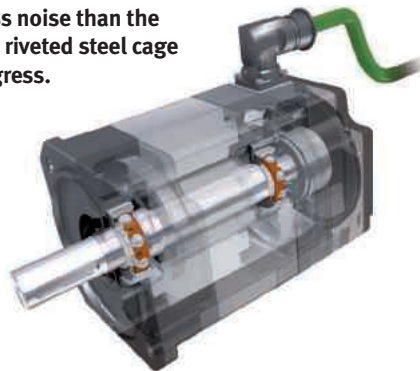


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Driving down energy costs

Full implementation of variable speed drives could save UK industry up to £2.5bn. Paul Fanning looks at some of the technologies available.



The fact that fitting variable speed drives to electric motors can offer significant cost and efficiency savings in industry is hardly news. However, a new report from Siemens Financial Services illustrates the enormous cost-saving potential in the industrial sector through the use of energy-efficient technologies.

Industrial enterprises across the world could save billions of pounds on their electricity bills by implementing variable speed drives (VSDs) on motors in their production environment. Indeed, the report from Siemens Financial Services has calculated that up to £2.5 billion of energy cost savings could be gained in UK industry with the full implementation of VSDs over the next five years.

Geared motors with integrally-mounted frequency inverters have been available for a long time, of course, but many such units have a limited functional range. Nord Drivesystems, however, equips its SK 200E inverters (below right) with the same wide functional range as the centralized SK 500E series of cabinet-installed inverters. The decentralised frequency inverters not only provide an ample overload capacity of 200%, but also enable users to position the drive precisely.

The relative positions (incremental or endless axes) or absolute values (rotary tables/fixed, repeatable positions) can be controlled with binary values through the SK 200E's inputs and stored within the drive. Alternatively, they can be set via a fieldbus system. Positions can be detected via incremental encoders (an onboard referencing function is included in the inverters'

basic equipment), or position values provided by a CANopen absolute encoder may be directly imported.

For lower power drives, typically up to 7.5kW, machine designers can choose their inverter drives either panel- or motor-mounted. By mounting the drive on the motor a decentralised solution is achieved that can save time and costs. The Lenze motec (see above) is a typical example, being available at rated powers 0.37 to 7.5kW either on its own or as a complete variable speed drive package with a geared motor.

Decentralised drives reduce

costs for the machine builder in more ways than simply reducing the size of the panel. Power cables can be unscreened which significantly reduces their cost, and where several motors are mounted locally, cable runs can be reduced by looping the power from one inverter to the next. The Lenze

motec comes with free software to speed commissioning. In operation a large status LED is visible from considerable distance and a port is available to plug in a diagnostic keypad.

The Lenze motec is able to adapt to individual machine requirements with IP65 enclosure, ambients up to 45°C without derating, and fieldbus options from low-cost AS- to real time EtherCAT and PROFINET. Wall

mounting is possible and plug PR-GSS-Auto-warehouse connectors can be provided for faster fitting. Another potential option is Safe Torque Off to Category 4 and Performance Level e.

The C2000 VSD from Softstart UK uses field-oriented control (FOC) as its core technology, taking drive technology to the next level. The C2000 offers speed, torque and position control modes, in a dual rating (normal and heavy-duty) design. Suitable for use with both induction and synchronous motors, the C2000 provides outstanding four-quadrant torque control

and torque limit, and smooth motion across the power range.

WEG's new range of CFW500 inverter drives (above left) has been designed to be versatile for many industrial automation applications, including centrifugal and process pumps, fans, compressors and conveyors.

The CFW500 drives are based on modular plug and play design, extremely easy to use and programme. The drive includes a built-in micro-PLC, which can be programmed according to standard protocol IEC 61131-3. It also comes with pre-programmed macros for a range of applications, for example positioning, timer and acceleration. Users can simply programme the drive using the LCD HMI display, or via a computer through a variety of interfaces (RS232, USB, RS485).

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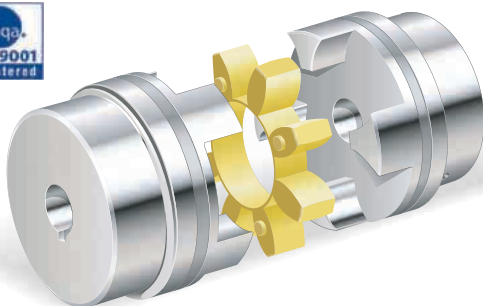


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Early engagement leads to happy marriage

One of the hottest debates among OEMs and machine builders is when to engage those suppliers whose components are integral to a machine's design. ABB's Gary Busby explains.



In my experience, the earlier in a design that the component suppliers are engaged, the less costly will be the eventual total cost of ownership.

The reasoning is simple. Every component, whether that is a variable-speed drive, electric motor, motion controller, servo drive, HMI or PLC, needs to be looked after throughout its entire time within the end-product. This means that at each of the six life-cycle stages, component suppliers must offer a service that keeps costs under control. And for this reason, getting your component supplier involved at the very outset of your design can impact every department within the OEM - from purchasing and maintenance to quality and plant management.

The six life cycle stages are:

- **Pre-purchase**
- **Order and delivery**
- **Installation and commissioning**
- **Operation and maintenance**
- **Retrofit and upgrade**
- **Replacement and recycling**

Within each of these stages there are a host of on-line and off-line tools that the designer can use to improve the performance of their machine: and most of them are free. The trick is being aware that these tools exist in the first place. And it is at the "pre-purchase" stage that the component supplier can advise the OEM of what is available.

For instance, with all the motion control products mentioned earlier, there are some excellent selection and dimensioning tools. Using these tools correctly can help avoid choosing a component that, while fit for

purpose, may be over-dimensioned. Such over-sizing can result in excessive losses which can have a negative impact on the total life cycle costs of the machine. Of course, you can always leave the badly sized technology in place, but machine quality and performance will inevitably suffer, and the losses will escalate.

At worst the component may need to be removed, leading to costs associated with re-engineering, lost production and rework from removal and replacement. All of which can be avoided with proper selection at the very outset.

Many of the on-line tools can be integrated into existing design engineering packages. This improves the documentation and record keeping involved in the design phase of an entire machine.

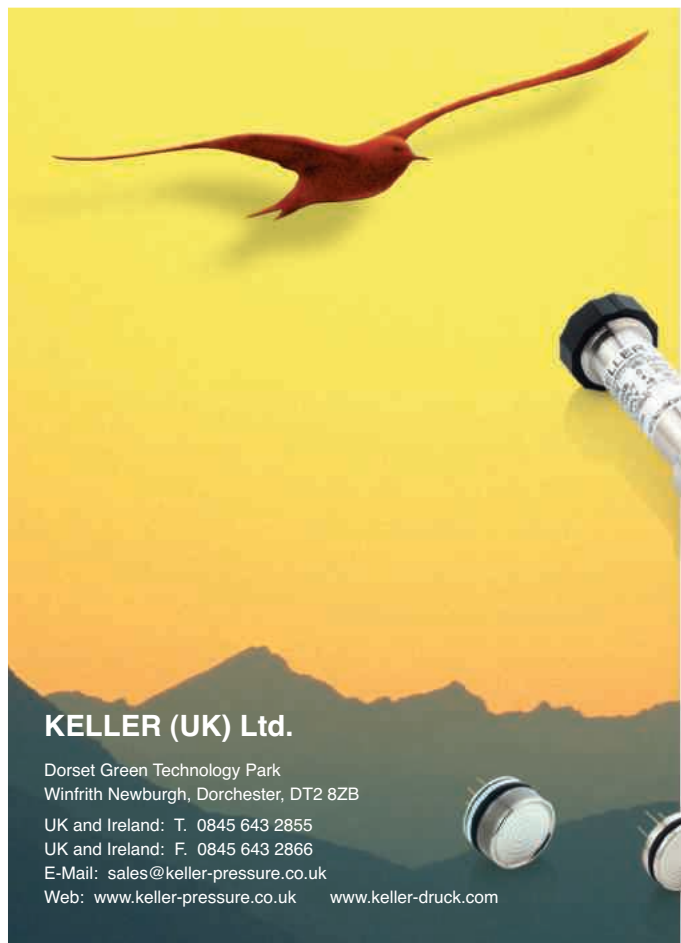
It is important that designers consider every stage of the component life-cycle. Even during "installation and commissioning", the component suppliers can offer some sound money-saving advice to the end-user. It is estimated that the majority of troubleshooting issues are the result of things that simply were not considered before the purchase. For instance, with variable-speed drives, air flow requirements are often over-looked. This can be the result of poor panel design, or the placement of, say, a PLC above a drive, thereby interfering with the air flow needs of the drive while also potentially damaging the PLC too. Such apparent basic over-sights – and there are many others – can be easily avoided by consulting with the supplier, well before even machine prototyping is undertaken. Even during

installation, the component supplier can offer techniques to further optimise or fine tune the component. A drive, for instance, may have a flux optimisation function. Knowing it exists and what it does can lead to even further energy savings. But you need to know it's there in the first place.

The "operation and maintenance" stage of a component can cost over 10 times that of the initial purchase price. Yet there are a range of tools, many of which are built-in to components, that can assist maintenance personnel while extending the life of the components themselves. Among the on-line tools are parts lists and drawings database, preventive maintenance schedules and remote monitoring while on-board tools include commissioning and diagnostic wizards, data integration with existing CMMS packages, Ethernet and wireless communications.

Working with a component supplier is a two way street. While it pays for the OEM and machine builder to engage with their component suppliers at the outset, they can also find themselves in a position to influence the next generation of components. Having a say in how the future component will be designed not only has a significant impact on your future machine's performance, it can help ease installation, reduce troubleshooting and improve the relationship with the end-users maintenance teams. And that could be the best word-of-mouth recommendation for new business ever.

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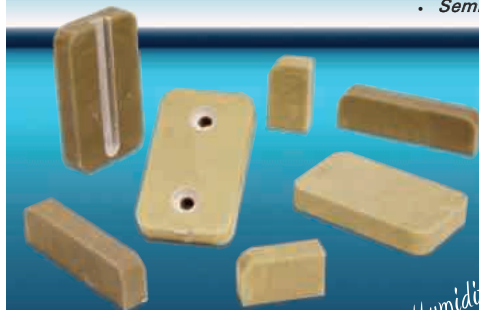
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'Sight' through sound

The use of ultrasonic sensors is giving additional mobility and freedom to the blind and visually-impaired, as Paul Fanning discovers.

Ultrasonic sensors are being used in a product that is helping the blind and visually-impaired (VI) to safely and independently negotiate the modern world.

UltraCane is an electronic mobility aid that uses ultrasound to warn users of obstacles ahead and at head height. Originally developed as a concept at the University of Leeds in around 2004, but subsequently adapted and now marketed by Yorkshire company Sound Foresight Technology.

But designing for the blind and VI community is no easy task, as Dr Paul Clark, director of Sound Foresight, explains. "It's a subtle and interesting nut to crack, helping blind and VI people. Some people have created aids that use an acoustic sense, but the problem with that is that if you're blind or VI, your primary sense becomes your hearing. So the absolute last thing you want is anything that impedes your ability to comprehend your surroundings or adds another sound signal that you need to concentrate on."

For this reason, the UltraCane is instead equipped with a dual-range, narrowbeam ultrasound system that provides a 100% hazard protection envelope in front of and, uniquely, forward of the head and chest of the user. Two ultrasound transducers provide range data on the closest potential hazards, such as plants, people, road signs, and overhanging branches. This makes the UltraCane equally practical on the street as in interior spaces.

The range data is delivered to the user by two



"We've found that if we give tactile feedback, people swiftly start to build up a spatial map of their surroundings. You're sweeping your arm around and you're picking up objects as your arm reaches certain orientations."

**Dr Paul Clark
Sound Foresight**

small, button-shaped tactile vibrators mounted in the moulded handle of the UltraCane. Says Dr Clark: "We've found that if we give tactile feedback, people swiftly start to build up a spatial map of their surroundings. You're sweeping your arm around and you're picking up objects as your arm reaches certain orientations. So people quickly learn the skill of building up a map of what's around them."

The question of how best to present this tactile feedback was addressed in a similar way to that employed on car parking sensors. Thus, users receive a tactile cadence – essentially a buzz in the hand – that increases in intensity the closer they get to something.

The use of two sensors, with one angled upwards to protect the chest and head area, means that users receive advanced warning that you're about to hit something. This means that they are able to stop and feel around with your hand to recognise any potential hazard. Just how important this can be is made clear by Dr Clark. "If you look at the hazards in a modern high street: low hanging tree branches; For Sale signs hanging over the pavement; coach wing mirrors that hang over the pavement; advertising hoardings that start as monopoles and flare out – blind people walk into all of these things, which is not pleasant for anybody."

Just how effective this technology is was demonstrated on the BBC programme 'Miracles of Nature', when Dan Smith, who is completely blind, was shown riding a bike through a

woodland pathway using ultrasound to detect trees and other obstacles whilst cycling. This 'UltraBike' uses the same ultrasound technology that is incorporated into the UltraCane and features components of the UltraCane in its design.

A number of other design issues have had to be addressed in the development of the modern UltraCane. One of these centred on the sensitivity of the receivers themselves. This was achieved despite the fact that ultrasonic transducers are very variable in manufacture. Says Dr Clark:

"They have different resonant frequencies, for instance, so we have a clever way of dealing with that automatically to allow consistency from product to product.

Because we obviously wanted to ensure that



The UltraCane has been extensively field tested for reliability and safety

every UltraCane had the same, good sensitivity going out the factory door. If you measure them, if you get a big batch of typical transducers with a sensor frequency of around 40kHz – you might get around a 10kHz spread. They're very peaky, so if you go a little way away from its natural resonant frequency, you'll find that performance drops off quite dramatically. We attended to that with an automatic detection and feedback system."

Another factor that had to be addressed was the question of ruggedness and reliability.

This issue of 'manufacturing for reliability' was attended to by addressing unit feedback from the field. Or, as Dr Clark puts it: "We went out, gave it to people and found out how they broke

it. It's a fundamental rule of life that anything that's handled by a person has a really rough life – especially if you're blind or VI. It's going to get knocked into things, so these things have to be rugged."

Safety, of course, is another key factor in the design. Thus, the low battery warning comes into effect when there is still an hour's battery life left to reduce the risk of the user being stranded. Equally, it is fitted with a simple, thumb-operated battery cover and deliberately uses non-rechargeable batteries to ensure that users can easily purchase replacements.

Dr Clark estimates the potential market for the UltraCane in the millions, but concedes that it is still relatively early days. However, he is positive about the future, saying: "The thing that keeps me going is the feedback from the owners... Look at some of the testimonials like 'It's given me back my dignity' and 'People don't believe I'm blind'. You couldn't pay for that kind of PR."

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The new A1233 from Allegro MicroSystems Europe is a dual-channel, Hall-effect direction detection sensor IC that provides digital output signals indicating the speed and direction of a rotating target. The A1233 is a highly-sensitive, temperature-stable magnetic sensing device ideal for use in ring-magnet based speed and direction systems in harsh automotive and industrial environments.

A key feature of the device is the fact that the Hall sensing elements are photolithographically aligned to better than 1 µm. This accurate mechanical location between the two active Hall elements eliminates the major manufacturing hurdle commonly encountered in fine-pitch detection applications.

The A1233 is a monolithic device containing two independent Hall-effect bipolar switches located 1.63 mm apart.

www.allegromicro.com

Zettlex announces further expansion of IncOder range

Cambridge-based sensors company Zettlex has further expanded its IncOder range of precision angle encoders. The range now includes a choice of more than 45,000 product variants, including new IP67 rated sensors for operation in wet environments.

Mark Howard, Zettlex general manager comments: "We are seeing a rapid growth in demand for our inductive encoders, especially in overseas markets. The common thread is the demand for precision position and

speed measurement in challenging environments where traditional solutions – such as potentiometers, optical encoders or pancake resolvers – are simply not up to the job or are too expensive."

The IP67 versions allow users to deploy IncOders in wet environments because the traditional weak spots from cable fittings and connectors have been overcome by the use of an integral moulded cable.

The IncOder range offers a choice of 8 sizes from 75mm to



250mm; six different mechanical mounts; eight measurement resolutions; 10 data outputs; four supply voltages and four connector options.

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Smart vibration switch is compact solution



New developments in vibration monitoring from ifm electronic are spearheaded by the VNB001, the first in a new line of vibration sensors.

For continuous online monitoring of machine condition, the VNB001 measures and displays the average vibration velocity (mm /s or in /s). Not only

can a system such as the VNB001 help maintain reliable operation, but also monitoring by vibration severity to ISO 10816 can avoid unplanned downtime.

The VNB001 is equipped with pushbuttons, making it simple to set up, requiring no PC software for parameter setting.

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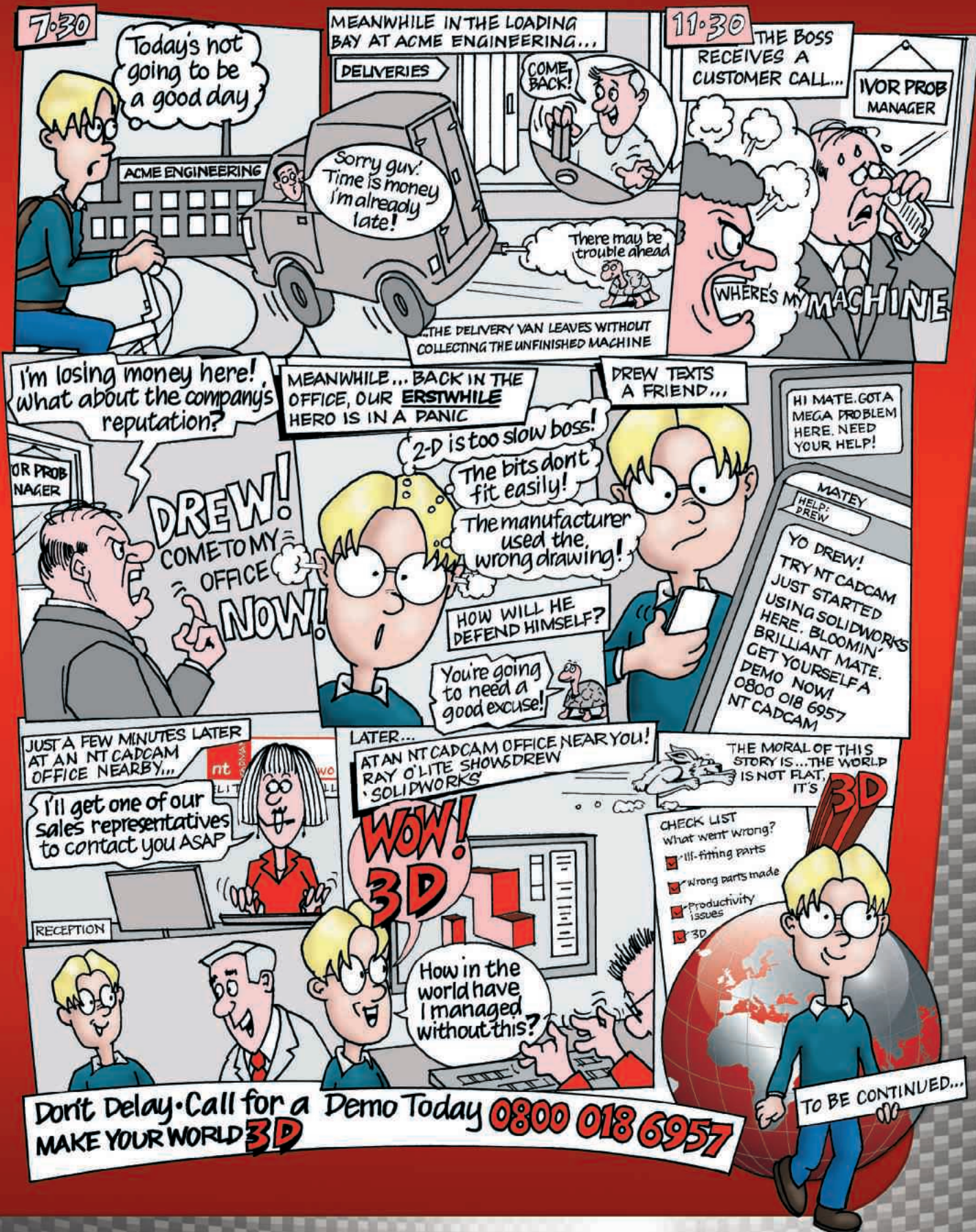


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Implants fit the bill

The use of additive manufacturing and 3D printing in medical applications is not new, but the creation of implants is gathering pace. Paul Fanning reports.

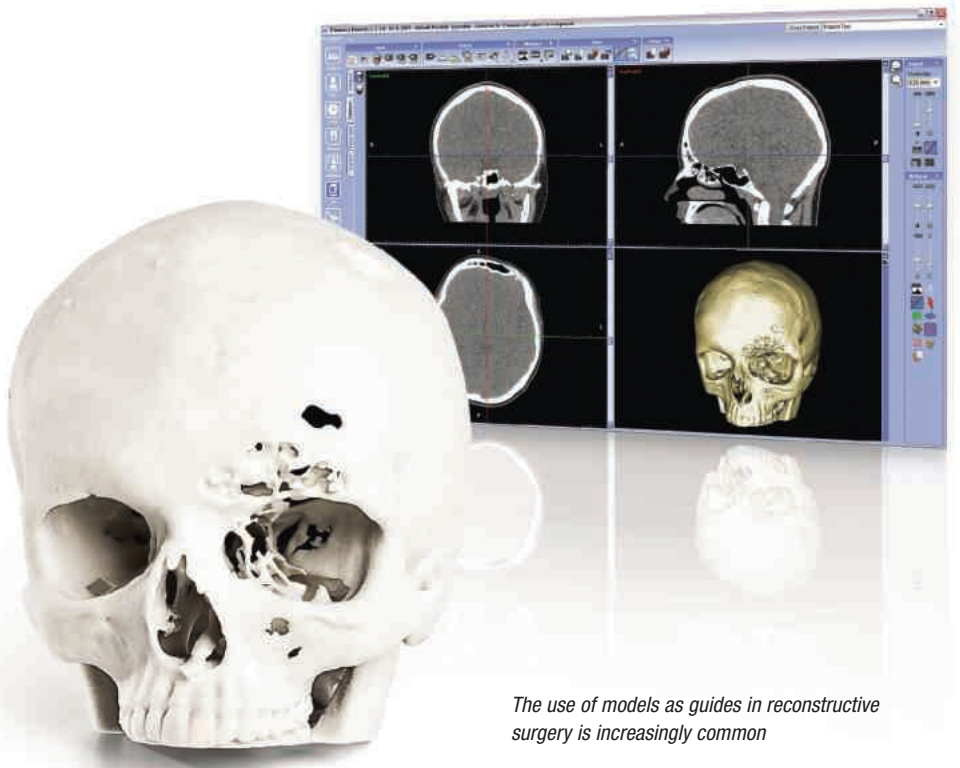
Every day, it seems, we at Eureka seem to receive a story positing a new potential medical application for 3D printing. A brief scan of the relevant stories on our website includes headlines such as '3D printed organs on the way?' and '3D printing technique yields artificial blood vessels', for instance.

However, while these applications represent a fascinating glimpse of the ways in which this technology may revolutionise medicine in the future, the fact is that 3D printing and additive manufacturing are already being employed in real-world medical applications in which the technologies' strengths are resulting in ever-greater levels of accuracy and surgical success, higher speeds and lower costs.

A natural fit

This is, of course, a fairly natural fit. After all, if one accepts that the ability to produce items in high detail at low volumes is at the heart of the additive manufacturing revolution. Just how these technologies can achieve these ends can be seen from a number of surgical examples. The use of 3D printing in surgery has paved the way for more accuracy in complicated operations, with a greater degree of success. For example, if a surgeon needs to remove a tumour from a patient but there is a chance that he or she will hit a nerve or an artery in doing so, the surgeon can create a 3D model of the tumour from the patient's CT scans using a 3D printer. The surgeon can then practise on the model before working on the patient. In this way, the surgeon will be able to make the necessary incisions with confidence. The possible harm or side effects of the surgery can also be avoided.

When a patient has suffered considerable damage to their facial features, reconstructive surgeons now make use of 3D printers to create models out of which the prosthetics or the artificial skin will be made. What reconstructive



The use of models as guides in reconstructive surgery is increasingly common

surgeons do is to create a map of the patient's face on special software and using images taken with a 3D camera. From this facial mask, the surgeons will make a mask that will then guide them in conducting the reconstructive surgery. Mapping the face of the patient in this



manner ensures a more accurate reconstruction of their bone structure.

However, such applications – although still far from commonplace – are no longer rare. Increasingly, however, additive manufactured parts are being employed as implants as opposed to models. Additive fabrication technologies have evolved towards building medical implants that provide faster delivery, much easier customisation and better fit and function than is possible using conventional technology.

Customisation of individual implants provides an immediate fit and eliminates the need of time-consuming adjustments during surgery. This saves time in the operating room and reduces operating costs as well as the risk of medical complications.

Additive Manufacturing technology provides



a means for fast and cost-efficient fabrication of implants with customised design. The fundamentals of additive fabrication also provide an opportunity to build implants in a manner very similar to the way in which nature develops bodies with lattice structures. This is extraordinarily beneficial in the fabrication of implants where a metal implant shall interface with living bone and tissue and provide quality of life for a human being. Electron Beam Melting (EBM) and Direct Metal Laser Sintering (DMLS) are both used commercially in the production of standard and customised implants.

The relative freedom of shape afforded by additive manufacturing allows the most

Dental and medical implants are increasingly being made using additive manufacturing technology

complex freeform geometries to be produced as a single part prior to surgery. As illustrated by the lower jaw reconstruction (shown on page 45), patient-specific implants can potentially be applied on a much wider scale than transplantation of human bone structures and soft tissues. The use of such implants yields excellent form and function, speeds up surgery and patient recovery, and reduces the risk of medical complications.

Until recently, however, most long-term

internal implants have tended to be metal. However, the recent announcement by Oxford Performance Materials (OPM) that it has received FDA 510(k) clearance for the OsteoFab Patient Specific Cranial Device (OPSCD) may change that.

OsteoFab is OPM's brand for additively manufactured medical and implant parts produced from PEKK polymer. The OsteoFab technology is ideal for one-of implants specifically shaped to each patient's anatomy. One very desirable use of patient specific implants and the indication for the OPSCD is cranial implants to replace bony voids in the skull due to trauma or disease. FDA clearance of this device marks the first approval for an additively manufactured polymer implant.

In addition to the importance of implant fit, implant material is a critical consideration. The OPSCD is manufactured from PEKK, an ultra high performance polymer used in biomedical implants and other highly demanding applications. OPM had traditionally sold PEKK as a raw material or in a semi-finished form, but began developing Additive Manufacturing technologies in 2006.

Biomedical facility

In 2011, OPM established a biomedical compliant manufacturing facility in to support its growing Additive Manufacturing business. As an implantable polymer, PEKK is unique in that is biocompatible, mechanically similar to bone, and radiolucent so as not to interfere with X-Ray equipment. Furthermore, OPM has recently completed testing which confirms that the OsteoFab implant surface is, in fact, osteoconductive.

"It is our firm belief that the combination of PEKK and Additive Manufacturing is a highly transformative and disruptive technology platform that will substantially impact all sectors of the orthopedic industry," said Scott DeFelice, President and CEO of OPM. "We have sought our first approval within cranial implants because the need was most compelling; however, this is just the beginning. We will now move systematically throughout the body in an effort to deliver improved outcomes at lower overall cost."

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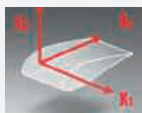


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Tuesday 12

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Application sectors

Wednesday 13

Wind Energy

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Automotive

Mass Production well established solutions



Automotive

Alternative solutions Unlimited innovation



Aeronautics

The new challenges of aircraft design

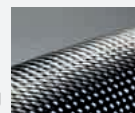


Materials

Thursday 14

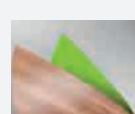
Carbon

The all process chain: market, design, manufacturing, recycling



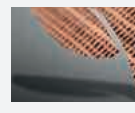
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European Patents: a **very** big change

The recently signed Unitary Patent has significant potential repercussions for UK patent law. Here, Anthony Albutt, partner with leading IP law firm D Young & Co LLP, explains.

Business secretary Vince Cable signed a very significant agreement in Brussels last month. The Government has given its preliminary backing to possibly the most significant change in intellectual property laws in 30 years: the Unitary Patent (UP).

So, what does this mean for UK business? For the benefit of those unfamiliar with patent protection in Europe, there are two basic routes to obtaining a patent in each country in Europe. Your first option is to apply for patents independently at the national patent office of each country where you want to protect your technology. Alternatively, you can submit a single European Patent Application with the European Patent Office (EPO). This is a centralised system for granting patents. Once the EPO centrally grants a patent the applicant selects the countries for protection and receives national rights just like the national application route.

So what is it that Mr Cable has signed? In short, and subject to ratification by Parliament, the UK Government has committed to bring the UK into the Unitary Patent System. The UP will fundamentally change the way the existing EPO system grants patents. Instead of granting a patent which is then converted (validated) in the countries of choice (to create separate national rights) the EPO will instead issue a single pan-european patent (a Unitary Patent) covering all of the countries that sign up to the deal.

This means that instead of obtaining a bundle of independent national patents (one for each country) you will instead be given a single patent covering all the countries that sign up to the UP.

Sounds good? There are some very different schools of thought as to whether this is a good thing or not.

On the positive side the aim is for the UP to

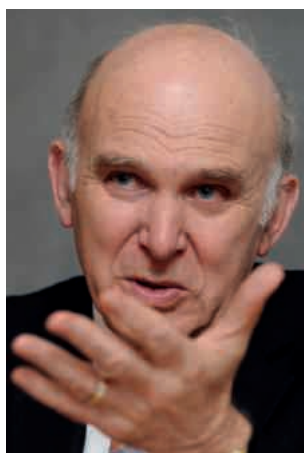
encourage investment in R&D in Europe by giving companies reassurance that their technology can be protected right across the EU. Another aim is to attempt to reduce the cost and improve the simplicity of obtaining patents in the EU.

However, a fundamental issue for many companies with the UP is that they will only have a single patent. If this is challenged and revoked then they lose all of their protection across the EU. Under the existing system they would retain rights in countries where the patent had not been challenged.

It is also by no means certain that the costs will actually be reduced. The new court system has not been put in place and there are many questions about who will bear the cost of the court and all of the translation that will be required. Many questions remain unanswered.

Perhaps the most contentious point is that the courts might adopt the German model of hearing patent infringement and patent validity completely separately and in different courts (called bifurcation). In the UK and many other countries these are brought together in a single court case. A worst case scenario for a company is to be found to infringe a patent and to be issued with an injunction preventing continued business activity whilst having to wait to contest the patent's validity.

Will the UP actually happen? You might think that Mr Cable's signature means it will but this is not necessarily the case. To come into force the agreement must be ratified by each of the



governments of the UK, France and Germany. In addition, it must be ratified by at least 10 other countries. Many large patent filers in the UK are very unhappy with the UP proposal and it is likely there will be lobbying either against the UP entirely or to modify the system (particularly for example in respect of where parties can litigate and the issue of bifurcation). However, there is considerable political momentum to make this happen and it seems inevitable.

The European Commission plans to implement the UP by 2014;

a timeframe that in the author's view is almost impossible to meet. More realistically we are looking into 2015 at the earliest, and of course subject to the necessary ratification.

Those with pending European patent applications should be aware of a very significant aspect of the agreement: the UP will be issued for all pending applications. If your European application is pending when the new system comes into force, instead of being given the option of selecting the countries you actually want patents in you will be given a single UP.

In the next article we will give some strategic advice on what you should do now to optimise your position. We will also explore your options for temporarily opting out of the system and offer some advice on revising your patent strategy.

For more information, please contact Anthony Albutt, Partner, on:
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Canning the can?

How can that highly familiar item the drinks can be made safer, more hygienic and easier to use?



The aluminium drinks can is such a familiar object that most of us probably never consider its design. It is convenient, sturdy, practical and relatively cheap to produce. Nonetheless, it has its shortcomings.

One of the key downsides to the can is that, once opened, it cannot be resealed, putting it at a major disadvantage when compared to the plastic bottle. This also means that customers who have opened a can cannot go anywhere without a risk of spillage. As a result, those using cans must either discard their drink unfinished or finish it quickly – an act that can have unfortunate consequences in the case of carbonated beverages. Equally, an open can is an invitation to the ingress of insects, dirt and other undesirable matter.

Apart from another problem associated with the can's ringpull system is the fact that it is difficult and hazardous to open with just one hand. Anyone who has ever attempted this trick with a can will be familiar with the degree of digital strength and dexterity it requires to achieve this feat without spillage or – worse – dropping the can completely.

This last is not just a frivolous problem restricted to those who only

have one hand free for whatever reason, but is a serious issue to those for whom disability may mean they only have the use of one hand. Equally, for those with conditions such as arthritis, using a ring-pull may not be feasible at all.

The Challenge

What is needed, then, is a new approach to the opening mechanism that obviates these problems. After all, this would not be the first time. The original cans were designed to be opened with a metal tool, only to be superseded by the classic ring-pull, which has latterly been improved upon with the lever systems seen on cans today. So it follows, then, that a further evolution in the technology would not be unthinkable.

So the requirements are that the device can be opened easily with one hand and that it can be re-sealed and that these changes should not involve a significantly greater cost in terms of production and manufacture.

The solution we have in mind uses a clever piece of engineering and is currently undergoing extensive consumer tests with a view to gaining widespread consumer acceptance. However, there is nothing to say you can't come up with a superior alternative.

The answer to last month's Coffee Time Challenge, how to improve on the white cane for the visually impaired, is in our Technology Briefs section on page 14

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Inserts

Automatic Pin Installation Technology Solves Surgical Instrument Assembly Problems

Spirol Industries has developed technology to install miniature pins with a diameter less than 1.5mm automatically. This dispenses with manual installation that can be a tedious and time consuming process, involving the use of a magnifying glass and very small tools. What is more, scrap rates are often in excess of 10% due to pin damage during unsuccessful installation attempts.

The advantages of Spirol's Pin Installation technology have been demonstrated with a surgical tool manufacturer looking to review an installation process for an assembly. This required a 0.8mm diameter stainless steel solid pin to affix a nylon cylinder to a shaft. The assembly consisted of an outer tube, inside of which was a smaller hollow shaft and inside that was a solid rod.



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The new Axion Polymers website has been redesigned to focus on its range of products for sale including 100% recycled polymers, recycled aggregates and SRF and the services it offers such as laboratory testing and toll processing. Of particular interest to designers and manufacturers seeking fresh inspiration for new products is the expanded product section highlighting the Salford-based plastics recycler's production of 100% recycled high quality polymers recovered from end of life products.



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position output

Users of RESOLUTE true-absolute encoders are protected from crash risks and uncontrolled movements, with benefits to yield, throughput and safety!

RESOLUTE encoders provide excellent metrology in normal service, whilst offering class-leading SDE (Sub-Divisional Error) of ± 40 nm and resolution to 1 nm at speeds up to 100 m/s.

The encoders operate in a fundamentally different way from traditional absolute encoders, allowing them to output an error flag that is certain to be set if the position output is incorrect. This provides increased levels of safety for end users of motion systems while simplifying the design process for the system builder.

RESOLUTE calculates position on demand, whereas traditional absolute encoders operate on a continuous basis. The readhead determines position by two independent methods avoiding the risk of a common cause failure. Control systems can rely on error flags sent out by the readhead; if the error flag is not set then the position output can be trusted.

Choosing RESOLUTE encoders for your machine means highly dynamic axes can be run harder, for longer; increasing work output and maximising up-time. Axes run more smoothly and less heat is generated in linear and rotary motors.

Download the white paper now: www.renishaw.com/RESOLUTEsafety