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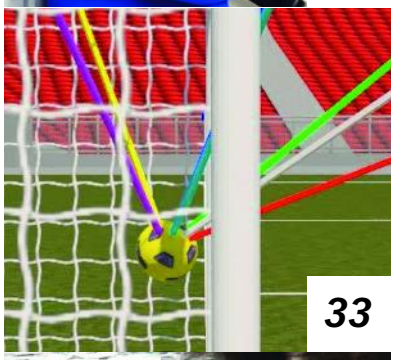
CONTENTS

Volume 33 Number 5 May 2013

16

20



33

43

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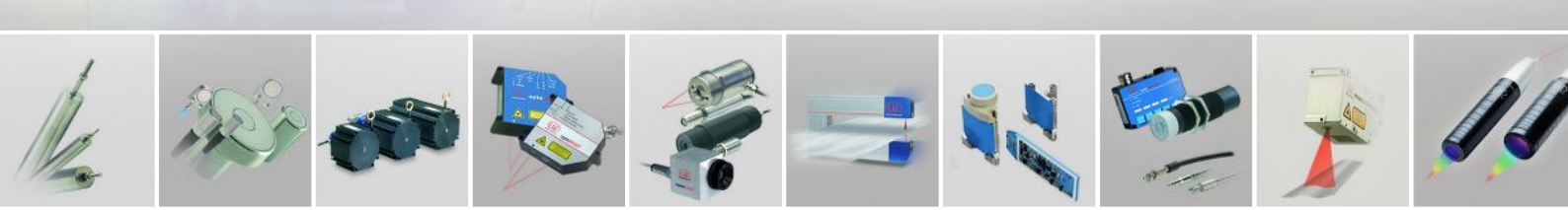

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SSN-0261-2097 (Print)
ISSN 2049-2324 (Online)

Eureka (incorporating Engineering Materials and Design and Design News) is free to individuals who fulfil the publisher's criteria. Annual subscriptions are £81 UK (£118 overseas or £153 airmail).

If you change jobs or your company moves to a new location, please contact **circulation@findlay.co.uk** to continue receiving your free copy of Eureka.

Origination
CC Media Group
Printed in UK by
Pensord Press Ltd

Published by
Findlay Media, Hawley Mill, Hawley Road, Dartford, Kent, DA2 7TJ
Tel: 01322 221144
www.eurekamagazine.co.uk

Findlay Media is a member of the Periodical Publishers' Association

The gender agenda

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

This month's interview (see page 20) is with Philippa Oldham, head of transport and manufacturing for the Institution of Mechanical Engineers. In the piece, she describes her experiences as a female engineer and makes it clear that, with a couple of isolated exceptions, they have been overwhelmingly positive and that her male colleagues have been supportive.

All of which leads one to ask why it is necessary to highlight the fact that a woman has succeeded in engineering at all? There is an argument that says that to do so is self-defeating as it only serves to emphasise the rarity of women engineers. Stressing this scarcity, it is argued, serves to dissuade other girls from joining the profession and thus the status quo of male domination is maintained.

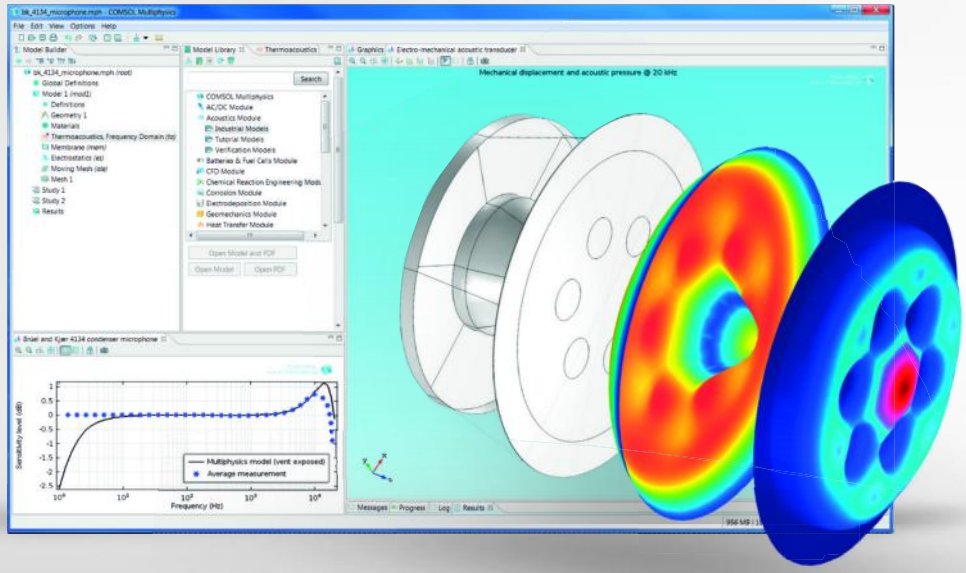
There is a certain inescapable logic to this argument. Indeed, one has great sympathy for any female engineer who rises to the top of her profession because at some point she is almost bound to be asked questions that relate to her gender rather than her skills or achievements.

Clearly this is not right. No one woman can be held as representative of her sex – no more than can any man. Equally, it unreasonable to ask every woman who makes it to a certain level as an engineer to act as a role model. For this reason, as a journalist, I have some sympathy with the argument that it is both reductive and counterproductive to focus unduly on gender when talking to or writing about a female engineer.

That said, there is no way of getting around the fact that engineering in the UK is an absurdly male-dominated profession. Estimates put the number of female engineers in the UK at a paltry 7% of the profession. Given that stark and shameful fact, it would be not only difficult, but disingenuous in the extreme to try and ignore the gender issue when talking to one of that 7% about their career. As elephants in rooms go, that is a pretty big one. One, in fact, that it would require an almost superhuman effort of will to ignore.

Of course we all hope for a time when the question of gender is no longer relevant in discussions with or about a particular engineer; when all it is necessary to mention are the person's achievements, ideas or skills. However, the sad truth is that that time has not yet come. And, until it does, it remains vitally important that the message that there are simply nowhere near enough women in engineering is iterated.

NOISE MEASUREMENT: Electro-mechanical acoustic simulation of a condenser microphone. The model shows the sensitivity level, membrane deformation and sound pressure level. Geometry and material parameters courtesy of Brüel and Kjær.



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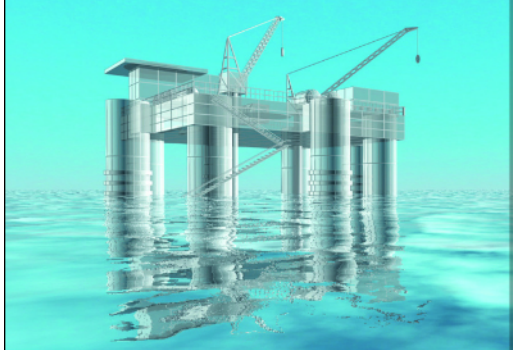
Lockheed Martin plans world's largest OTEC power plant



Lockheed Martin is working to develop the world's largest Ocean Thermal Energy Conversion (OTEC) power plant off the coast of southern China.

The 10MW offshore plant will use variations in ocean water temperature to generate 100% of the electricity needed for a green resort, which is to be built by Reignwood Group.

"The benefits to generating power with OTEC are immense," says Dan Heller, vice president of new ventures for Lockheed Martin. "Constructing a sea-based, multi-megawatt pilot OTEC power plant is the final step in making it an economic option to meet growing needs for clean, reliable energy."

www.lockheedmartin.co.uk

2013 BEEAs open for entries

beea
british engineering excellence awards

Entries are now being accepted for the 2013 British Engineering Excellence Awards (BEEAs). Now in their fifth year, the Awards aim to demonstrate and promote the quality of engineering design within the UK and celebrate those companies and individuals that have proven they can compete internationally stage.

The closing date for entries is 31 July. The Awards themselves will be presented at a lunch event, being held at 8 Northumberland Avenue, London on 24 October.

If you believe you have what it takes to win – or know of a product, company or individual that does – entry forms, detailed entry criteria and additional information on the Awards categories can be found at **www.beeas.co.uk**

Engineering design show

ERIKS UK will be showcasing its extensive range of seals, gaskets, drives, controls and automation equipment at this year's Engineering Design Show.

Explaining ERIKS' reasons for taking part in the Show, which takes place at the Ricoh Arena, Coventry on 2-3 October, Gary Price, the company's international product manager for motors, gears and drives, commented: "ERIKS Automation is delighted to be exhibiting at the Engineering Design Show. This is the perfect opportunity to demonstrate our ability to create customised solutions for our customers that deliver competitive advantage.

"This event will allow us to show visitors the depth and breadth of our experience not only when designing innovative automated solutions that push boundaries but also in associated services including installation, logistics, spare parts and traceability."

For more information about the Show or to exhibit, contact Luke Webster at lwebster@findlay.co.uk

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

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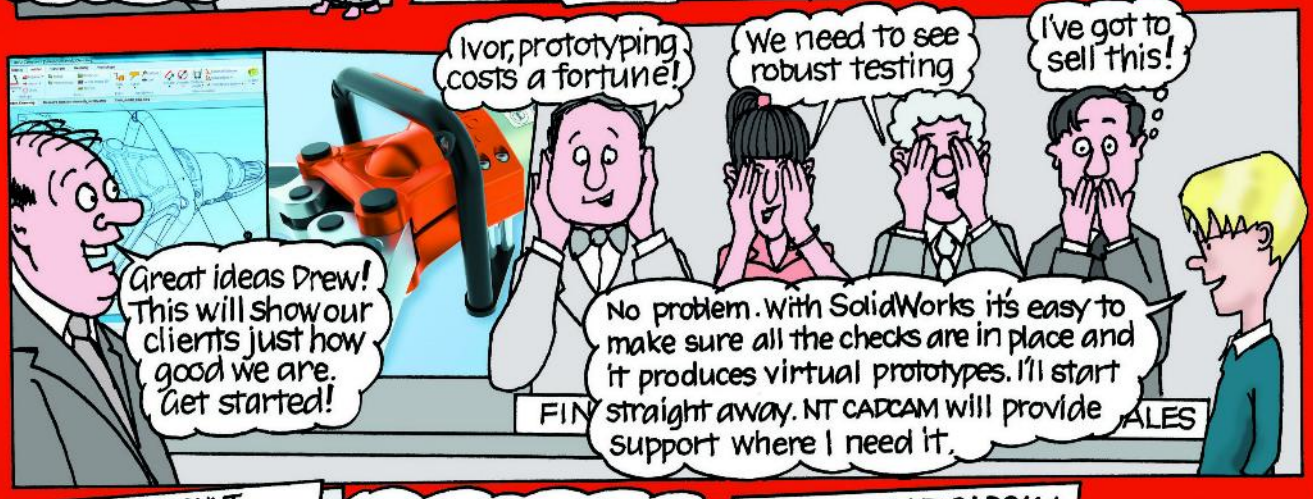

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Festo unveils BionicOpter robot

The BionicOpter can be controlled remotely using a smartphone

Inspired by the dragonfly's ability to hover in mid-air and manouvre in all directions, Festo has created a new flying robot called the BionicOpter.

The device is powered by two LiPo cells and can be controlled remotely using a smartphone or digital spectrum transmitter. Its tiny body houses nine servo motors, an ARM microcontroller and a host of sensors and actuators.

The microcontroller calculates all the parameters that can be adjusted mechanically based on the recorded flight data and the pilot's input. The processor actuates the nine servomotors to translate these parameters into movement using beat frequency, a swivel device and an amplitude controller.

Each of the robots' four wings has a carbon fibre frame covered by a polyester membrane, and can be twisted up to 90° from the horizontal. Festo says the model doesn't need to tilt forward to transition smoothly from hovering to forward flight, and is capable of manoeuvring up and down, forward and backward, and to the side.

www.festo.com

Bladeless wind turbine unveiled

A new type of wind turbine that can transform wind energy into electricity without the use of moving mechanical parts has gone on display outside Delft University of Technology in the Netherlands.

The EWICON has an abstract appearance, with a flowing steel frame in the shape of a rectangular zero that is used to support a framework of horizontal steel tubes.

Within this framework, electrically charged droplets are created and blown away by the wind. The movement of the droplets creates an electric current, which can be passed on to the grid.

Its developers claim the EWICON offers zero emission noise pollution and costs significantly less to maintain than conventional wind turbines. In addition, it can be installed on land or sea, or integrated on to the roof of a tall building.

http://home.tudelft.nl/en/

"This entry just fizzes with energy"

Think you've got what it takes?

Michael Aldridge
4c Design

Young Design Engineer of the Year 2012

Now in their fifth year, the **British Engineering Excellence Awards** has given many products, people and companies the recognition they deserve!

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Six-legged walking machine built in UK

A giant hexapod robot with hydraulic legs has been unveiled by British inventor Matt Denton.

The product of more than four years' intensive R&D, the Mantis Hexapod weighs in at a staggering 1,900kg, stands 2.8m tall and is powered by a Perkins 2.2 litre turbo diesel engine and hydraulics. Denton first came up with the idea for the robot in 2007. He secured private funding in 2009 to start the project and – after three years of design, build and testing – the Mantis made its first successful test drive in the summer of 2012.

"It's an entertainment vehicle," Denton conceded."But I hope it will inspire people."

www.mantisrobot.com

James Dyson Award now open for entries

The annual James Dyson Award is now open for entries. For 2013 the challenge remains the same – design something that solves a problem – but this year sees a tripling of the prize money from £10,000 to £30,000.

The award is open to product design, industrial design and engineering university level students (or graduates within four years of graduation). The aim is to inspire the next generation to be creative, challenge and invent. "I want to celebrate young, inventive problem solvers who are unafraid to question," said Sir James Dyson. "It's these minds that will solve the challenges of the future." If you think you've got what it takes to win, enter now at **www.jamesdysonaward.org**. The deadline for entries is 1 August. Finalists will be announced on 12 September.

NETWORK AIMS TO ADDRESS RAW MATERIALS SHORTAGE

The Chemistry Innovation Knowledge Transfer Network has launched an initiative to find substitutes for 14 critical raw materials.

The CRM_InnoNet project will bring together a range of industries to identify substitution challenges and opportunities through a series of workshops and an online portal.

Catherine Joce, project co-ordinator at Chemistry Innovation, said: "The issue of critical raw materials affects a very diverse community. "Creating a network to bring these people together in a constructive environment will play a vital part in shaping the research and innovation environment to enable future development of substitutes to help address the problem of materials scarcity."

www.criticalrawmaterials.eu

Studs are ideal for thin stainless steel

PEM Type FHP self-clinching flush-head studs install permanently into thin stainless steel sheets to provide ideal solutions for attachment applications requiring superior corrosion resistance. They will install more easily and at less cost than weld studs and additionally can contribute to thinner and lighter designs for component assemblies in the medical, food service, and marine industries, among many others.

PEM Type FHP flush-head studs mount

flush and permanently in stainless steel sheets as thin as .040" / 1mm (and greater) and become integral parts of an assembly with only a mating nut required for final component attachment. Their manufacture from A286 stainless steel imparts high hardness and the studs can be specified reliably for use in stainless sheets with hardness of 92 or less on the Rockwell "B" scale.

www.pemnet.com

Low-cost drive offers high performance

Mclennan has launched a new low-cost, two-axis microstepping drive for use with pulse and direction or CW/CCW pulse control. Exclusive to Mclennan, the Applied Motion Products (AMP) STR2M has simple dip-switch parameter set-up and many features found on much more expensive drives. These include a load inertia matched anti-resonance facility for optimal dynamic performance, and automatic idle-current reduction for increased efficiency through motor heat reduction. Along with 5-24 VDC opto-isolated I/O for pulse, enable and fault, the drive also includes microstep emulation which allows smooth microstepping motion from low pulse/rev frequency input; and its digital filter prevents position error from command signal electrical noise. With volume pricing set at extremely competitive rates, the drive will suit OEMs and machine builders looking to automate simple processes.

www.mclennan.co.uk

Solution to last month's Coffee Time Challenge

SPONSORED BY MICRO EPSILON

MICRO-EPSILON

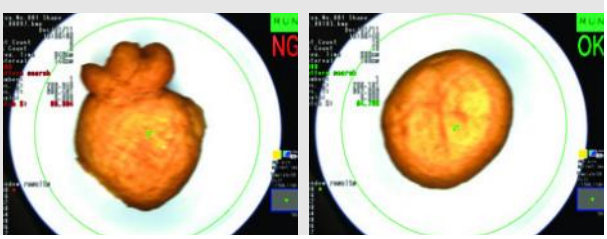
The solution to last month's Coffee Time Challenge, to come up with an automated system of checking and controlling quality of a doughnut production line, comes from Catterick-based Addington Engineers.

It designed a vision and rejection system to help a Yorkshire-based baker keep an eye on the half a million doughnuts made per day. The full solution consisted of a set of bespoke brackets, colour cameras, LED lighting, and a blow off rejection system. The colour CCD cameras can transfer 2 megapixels in 59ms and have the ability to effectively detect minute imperfection by taking dimensional measurements. The entire system is IP67 rated to allow the production line to be washed down daily.

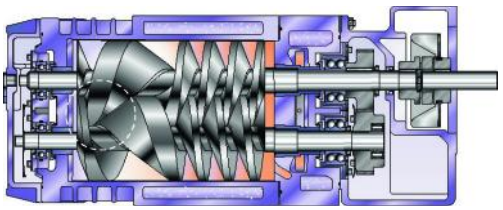
The camera is triggered when a doughnut passes it on the production line. A still image is taken, which is then inspected. Depending on the parameters and thresholds programmed, the system will accept or reject each doughnut instantly.

"The inspection system has come to the aid of the bakers," says Addington's managing director Craig Vine. "It could have applications and benefits for all businesses that need to eliminate human error in labour intensive manufacturing environments."

www.addingtonengineers.co.uk



Cobra pump charms the market



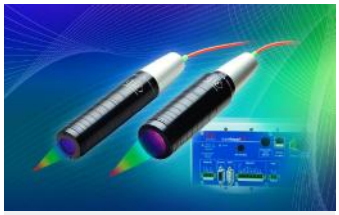
Working on an oil- and water-free compression principle, the Cobra NC series of screw vacuum pumps from Busch (UK) Limited has a proven track record in a wide range of tough environments.

Featuring an asymmetrical screw profile and free gas outlet, the pump provides improved ability to handle liquid and dust carry-over. The optimised efficiency of the pump reduces thermal load, which in turn maximises the service life of the installation. Uniform temperature distribution gives high resistance to corrosion.

Benefits include ATEX certification for categories 1, 2 and 3, fast access screws, which allow for easy servicing and a vacuum capability of between 1 hPa (mbar) and atmosphere.

Busch says the Cobra is ideal for use in many types of industries, but in different formats depending on requirements. These include chemicals and pharmaceuticals, plastic extrusion, rubber, beverage, furnaces, drying and impregnation, absorption and degassing, metallurgy, remediation and the semiconductor/electronics sector to name but a few.

www.busch.co.uk



SENSORS OFFER HIGH MEASUREMENT PRECISION

Precision sensor manufacturer Micro-Epsilon has launched a new range of confocal chromatic sensors that offers even higher sensitivity and sub-micrometre resolution, providing significant advantages for users, particularly when it comes to measuring the displacement or position of dark, diffuse, transparent and highly reflective surfaces.

The new confocal DT IFS 2405 series of confocal sensors also benefit from large stand-off distances (up to 100mm), providing users with greater flexibility. IFS 2405 sensors are designed for measurement tasks that require maximum precision – typically research and development tasks, laboratory and medical, semiconductor manufacturing, glass production and plastics processing. As well as distance measurements on reflective and transparent materials, the sensors can also be used for one-sided thickness measurement.

www.micro-epsilon.co.uk

High-precision bearings for machine tools

NSK's Robustshot series of high-precision angular contact bearings are designed to satisfy the exacting demands of motorised machine tool spindles for smooth, reliable operation, rapid acceleration/deceleration, higher speeds – over 3m dmn – and longer life.

The Robustshot series meets the requirements of the global machine tool industry for ever increasing spindle speeds to enable a wider range of machining operations to be performed on a single machine tool. Solving the technical problems experienced with conventional oil-air lubrication methods that attempt to inject the lubricant into bearings from the side using nozzles, the Robustshot series employs a system where lubricating oil is routed straight to the working surfaces on the bearing outer ring, via a circular groove and a through-hole in the outer ring. This guarantees a reliable, even supply of lubricant.

www.nsk.com

PM motor 'powerful, compact and efficient'

SyMAX IHP (integral horsepower) is a permanent magnet AC motor range with a radial flux design that delivers high-torque, ultra-high-efficiency and increased power density, compared to conventional induction motors. It is a sister product to the SyMAX FHP (fractional horsepower) motor range and is available direct from Regal.

SyMAX IHP meets IE4 efficiencies with 15% fewer losses than the equivalent NEMA Premium motor. It is lighter than a typical induction motor and features a totally enclosed fan-cooled (TEFC) construction with shielded bearings and shaft seal.

Another feature is the patented Max Guard insulation system which combines corona-resistant magnet wire and a low stress winding configuration to guarantee dependable motor life even in the most demanding applications. The motor's IP55-rated enclosure also makes it perfect for applications that require a high degree of protection against the entry of dust, water and other contaminants.

www.regal-news.com

Reinventing the

A very broad brief and a lot of creative design may have laid the foundations for a complete overhaul of the wheelchair that may offer huge benefits. Paul Fanning reports.

It is estimated that there are as many as 750,000 full-time wheelchair users in the UK, of whom a significant proportion are under 18. Clearly, while a chair for a fully-grown adult may have a lifespan as long as that of the user, a wheelchair for a child has to take account not only of their smaller size, but also of the fact that they are growing and developing physically, meaning that chairs must be replaced at regular intervals.

As children grow their physical and developmental needs change rapidly, and are at greater risk of deterioration if their wheelchair is not appropriate. Since many of these younger wheelchair users rely on the National Health Service for their chairs, the need for regular replacement of chairs represents a considerable cost for the public purse. With this in mind and following clear statements of clinical need from parents, carers, users and health professionals for a wheelchair that promotes user independence and is easily adaptable for a growing child, the NHS National Innovation Centre (NIC) launched a competition entitled 'Chair4Life'.

Aiming to revolutionise the design of wheelchairs for both children and adults, the NIC issued a competition tender to facilitate the next stage of research and development; the production of a fully working prototype for further evaluation. The project was ideally suited to organisations that could bring a range of experience, competencies and expertise to build on existing research and design work and develop a prototype that will transform the lives of disabled children and young adults.

The challenge was taken up by product design consultancy Renfrew Group International, which set about developing a powered, modular wheelchair designed to grow with the child. The new design was arrived at in a mere 18-week development cycle and is aimed at maximising mobility and independence for disabled children as they grow into adulthood.

However, the need to be adaptable to a child's development was just one of the design factors that Renfrew had to consider. Indeed, this was in one sense very much a bottom-up redesign of the wheelchair.

Factors that had to be taken into account by the design included: discretion; the ability to talk to people face-to-face; usability on uneven ground; comfort; manoeuvrability in tight spaces; smart stability control; the ability to climb kerbs; ease of customisation; and light weight.

"It was a very broad brief," says Bruce Renfrew, design director of Renfrew Group. "When we first looked at it we decided that it would be very difficult – if not impossible – to achieve all the aspects of the brief. So we decided to compartmentalise it in the sense that not only is it modular, but it uses interfaces between each module that are an assemblage of components that go to make the mobility chassis and, in the other largest module, the seat itself."

This was achieved by designing the chair around a universal, modular platform that can be readily updated and modified through a standard catalogue of attachments and bespoke components. It centres on a standard chassis that is retained throughout a child's development, which greatly reduces disruption to their lives caused by lengthy waiting times for new chair systems.

Lightweighting

Lightweighting was another major concern within the design and for this purpose, as well as the lightweight lift, the chair uses lithium ion batteries, a stressed lifting column, hub motors, and all aluminium construction. The wheelchair is 80kg, which is between 20 and 40kg less than current paediatric wheelchairs.

The seat grows with the child via the implementation of ISO Mount, a universal modular docking system that attaches the seat to the chassis lift mechanism, allowing swift replacement of successive seating modules. The universal ISO Fasten system ensures that the chair can be swiftly and easily modified to accommodate changes such as monitoring and care equipment, storage and accessories. A triangular section extrusion that runs under the bottom of the seat, around the back and over the top, it allows anything to be attached as long as the correct clamp is in place – either fixed-screw or over-centre.

This innovative system gives third party manufacturers the ability to provide a raft of

Stability

The vehicle is very stable on uneven ground. With an expanded width of 720mm and a wheelbase of 630mm an extremely stable platform is provided for children and young adults to go where they want.

wheelchair

upgrading features and components within a fixed base platform. This, according to Renfrew, means more patient choice, improved quality of products and new components to drive innovation within the industry. He says: "So Iso Mount, IsoFasten and IsoConnect all created a sort of conduit through which the whole project could be developed and meant that we could develop a snapshot of what Chair4 Life would be like… So in other words, we didn't have to design the whole system, we just showed how development could take place and things could slot into place using Iso Mount as the conduit."

The adaptability and modularity dealt with, the next stage of the process was to look at the other requirements of the design. Chief among these was the requirement that the wheelchair user should be able to sit at a height that allowed for eye-to-eye interaction with the able-bodied.

Turning radius

With a retracted width of 550mm, and wheelbase of 450mm, the Chair4Life has a turning radius of just 550mm, and is suitable for moving around school classrooms, shops, public transport and other tight indoor spaces.

Says Renfrew: "We designed the chassis to do certain things: principally to have on board a standard elevating column that would allow the user to achieve peer eye level while conversing. This was a very strong requirement that came as part of the feedback for the project from our user groups as we were doing the design." This was achieved using a lightweight 320mm vertical chair lift that employs a ballscrew.

However, with greater elevation comes lower stability. Says Renfrew: "If a user wants to travel over rough terrain with the column at a higher setting to be at a peer group eye level, there is a danger of instability." To combat this, the chair features an electronically-controlled, expandable track and wheelbase. This 'Varitrak' adjustable wheelbase allows the user to adjust the wheels to suit indoor or outdoor conditions, providing stability when it is needed and compactness for manoeuvrability in smaller spaces for greater freedom.

In fact, with a retracted width of 550mm, and wheelbase of 450mm, the Chair4Life has a turning radius of just 550mm, and is suitable for moving around school classrooms, shops, public transport and other tight indoor spaces. Equally, however, it is very stable on uneven ground. With

an expanded width of 720mm, and a wheelbase of 630mm an extremely stable platform is provided for children and young adults to go where they want.

Further stability is provided by sensors in the base, which monitor the height of the seat lift and the angle of the wheelchair on uneven ground. These either provide warnings or automatically adjust the wheelbase, seat lift or tilt to ensure safe stability if there is tipping or if the user angle from a static baseline is exceeded.

Lightweighting was another major concern within the design and for this purpose, as well as the lightweight lift, the chair uses lithium ion batteries, a stressed lifting column, hub motors, and all aluminium construction the unloaded weight of the wheelchair is 80kg. 20-40kg less than current paediatric wheelchairs.

Says Renfrew: "We're using hub motors so that the motors are in the wheels themselves and they are mounted at the end of independently-suspended arms that can be extended by 150mm. We're using a Lithium Ion battery pack, which is lightweight and compact. We've created space for the electronics that are in a slice that sits alongside the column, so again those are very compact.

"We've got suspension on the castors and what in production will be a die-cast aluminium base that carries the pivot for all the suspension mounting points and all the fixing for the column. That's pretty much it. It is very, very simple."

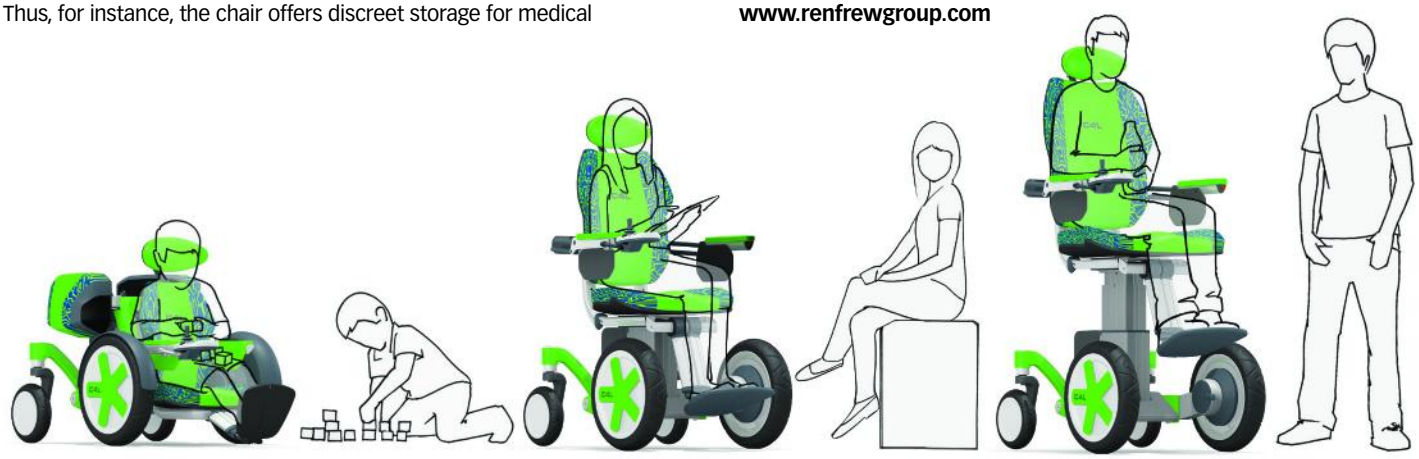
As well as technological considerations, however, there were aesthetic concerns to be accounted for. Chief among these was an idea that can best be summed up with the phrase 'Look at me not the wheelchair'. Thus, for instance, the chair offers discreet storage for medical equipment, keeping the emphasis on the user and not on the wheelchair.

"The chassis is designed to be minimal not only in terms of components, but also in terms of how it looks," says Renfrew. "Again, one of the important features to have come out of research with the user groups was that they wanted to be seen as an individual in their own right. They didn't want people to look at the chair. So we wanted the chair to blend into the background and the way for us to do that was to ensure that the bulk of the chassis in particular was as compact as possible."

Because the Chair4Life is designed to be used from aged four onwards, it is obviously desirable that it should be able to reflect the changing tastes and personalities of its users as they mature. Says Renfrew: "It has been designed with adaptation and customisation in mind. It was therefore quite important to design a chair that would allow the young person to adapt and customise it to their own tastes. So we've designed it in such a way whereby there are areas of trim and trim panels that can be adapted in that way."

Given that the design has been put together in association with the NHS, its cost is clearly a major consideration. However, claims Renfrew, while there is a rise in cost, this is easily outweighed by the chair's longer lifespan. He says: "Because this is a chair for life and therefore can be used for very much longer than a current prescription chair that is supplied to a user aged four and changed at very regular intervals of 18 months to two-and-a-half years, it has a much longer life and can have additional modules and upgrades applied to it. So, although the overall cost is rather higher than a standard wheelchair, that cost is easily amortised over the life of the chair."

www.renfrewgroup.com



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A woman's work

Increasing the number of women in engineering is an imperative. So what is the experience of a career in the profession like for a woman? Paul Fanning finds out from someone who knows.

If anything were going to put Philippa Oldham off engineering, then her early experience at a university interview would have been it. She takes up the story: "The professor in charge told me that women don't and shouldn't do engineering. He was serious. I said that I'd come here for an interview and he restated that he didn't think women should do engineering and I said 'OK, then. I'll go to the pub'. So I did."

Given that Oldham is now the Institution of Mechanical Engineers' head of transport and manufacturing, however, it is safe to say that she has emphatically proved her interlocutor wrong. However, she is at pains to point out that this experience has been very far from typical for her in what she concedes is a male-dominated profession. In fact, she cites another female engineer as the most negative voice on the subject of women in engineering she has heard in her working life.

"As a woman in engineering, you have to be realistic and accept that there simply aren't that many of us," she says. "I've been lucky in that the men I've worked with have always been very supportive and I think it's about making sure that women are given equal opportunities to have access to projects. It's about the work you do."

In fact, the first obstacle Oldham encountered in her career had nothing to do with her gender. She says: "I was in the bottom set for English and was told that I was poor at English and even that I was stupid by teachers, but my parents said that I couldn't be stupid if I was in the top sets for maths and science. Later, we did find out that I was dyslexic, but I was certainly lucky at that stage that I was so well supported."

Perhaps in part due to this experience, she is forthright on the subject of schools and their failure to encourage engineers. "I think schools are a real problem," she says. "I don't actually think there is any careers advice in many schools… All too often, advice about engineering is geared towards cars or trains or planes, whereas actually, there's bio-engineering, the medical and fashion worlds. There's so much diversity children don't get told about."

This lack of advice, she feels, is a major obstacle to girls aiming to become engineers. "A lot of the time I don't think it's that girls don't want to become engineers," she says. "It's that the people around them are likely to put them off. Parents and teachers might be unsupportive because they think it's dirty and male-dominated."

This was not a problem for Oldham, however. Citing "a passion for F1 and motorbikes" as her key reason for becoming an engineer, Oldham pursued this interest from a young age, going to work in her local garage during her GCSE years. Following this, she applied to a number of Formula One teams for work. McLaren came back to her and suggested she apply to Ilmor Engineering in Brixworth, Northamptonshire, where she worked in her summers, learning to build an F1 engine.

If stereotypes were to be believed, a shopfloor would be exactly where one might expect a young woman to have encountered discrimination, but, says Oldham, nothing could have been further from the truth. "Yes, it was a shopfloor and it was full of men," she says, "but there were never any derogatory comments. Everyone was working together and wanted to help you. It's always been very supportive because they want people to learn and they want to teach you."

If confirmation were needed that this was what she wanted to do for a living, it came at Ilmor. "One of the things people don't understand is the speed at which things get designed and built in F1," she says. "There I was, not degree-qualified – I hadn't even done my A-Levels at the time – but I was watching Mika Hakkinen's car on the track and thinking 'My God! Something I made is on that car. It's an amazing feeling to be part of something like that."

With this experience under her belt, Oldham went on to gain a Master's in Mechanical Engineering from Birmingham University, where, in her final year, she undertook a project on combating low-tech terrorism that led her on to a role as design engineer at defence contractor QinetiQ.

"Having worked at Ilmor looking at engines," she says, "I was on the lookout for everything else that was high-tech, so defence was an obvious next step, so I joined QinetiQ."

Again at QinetiQ, Oldham received great support from colleagues, but was still amused at times by the prevailing attitudes. "My name is sometimes shortened to 'Phil'," she says, "And when I was at QinetiQ, the senior design engineer with whom I used to work called John Quarrell used to take great delight in saying to people that he was going to send 'Phil' along to a job. I'd get there, they'd look at me and say 'Are you here to take the minutes?' and I'd say 'No, I'm your design engineer, but as a woman I can multi-task, so I'll take the minutes too, if you like!'"

From design engineer at QinetiQ's Malvern offices, Oldham moved to Farnborough to become product engineer and ultimately product manager for the company's £150m aerospace business. In May 2011, however, she took on the challenge of her current role with the IMechE. Here, she says, her job is: "To work within an organisation of over 100,000 members and to communicate to the media and the general public the vital role engineering plays in our society".

The subject of women in engineering therefore remains close to her heart. However, she is keen to emphasises that the only criterion on which any engineer should be judged is their work. She says: "In today's society, we're all measured by objectives and delivery… if you do a good design project, the person for whom you've done it will have you back regardless. What matters is whether you can deliver on time and to budget."

www.imeche.org.uk

"The professor in charge told me that women don't and shouldn't do engineering. He was serious. I said that I'd come here for an interview and he restated that he didn't think women should do engineering and I said 'OK, then. I'll go to the pub'. So I did."

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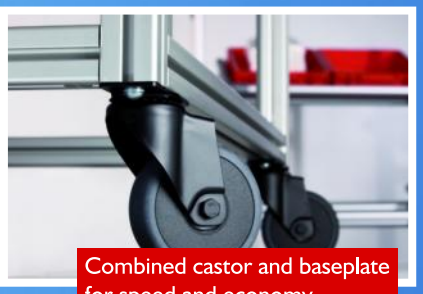

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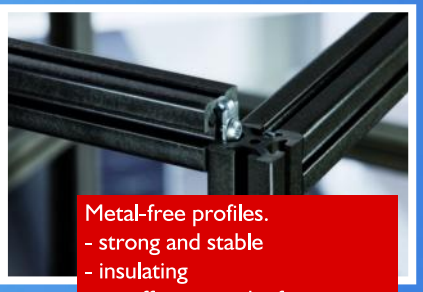

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A single-piece carbon composite prototype chassis known as a 'tub' has been produced by Future Fibres and partner Persico for RPx

Carbon fibre gets competitive

The increasing supply of carbon fibre is helping to reduce its costs, but can it ever be a cost-effective alternative to traditional materials? Justin Cunningham reports.

Engineers in general and (and those that need to take weight out of structures in particular) are becoming increasingly aware of carbon fibre. The classic example of this is in aircraft, where removal of weight saves operators millions over its flying life. And car manufacturers, too, are now taking carbon fibre more seriously in an effort to reduce fuel consumption and tailpipe emissions.

Optimisation of composite structure is reaching remarkable levels. Indeed, a recent project by two former McLaren designers shows just how light you can go if you really know what you are doing. The pair formed RPx Automotive and want to be at the forefront of the new generation of vehicles that use low weight structures rather than engine power to achieve high performance.

A single-piece carbon composite prototype structure known as a 'tub' has been produced by Future Fibres and partner Persico Spa for RPx. Amazingly the tub weighs just 35kg with the complete car expected to weigh just 480kg. Yet, the strength and stiffness remain uncompromised.

Despite being impressive, the car is still likely to come with a hefty tag. However, the concept of using a single tub as the primary structure of a vehicle is still relatively new. Doing away with much of the assembly and joining currently needed for metallic structures does pose an interesting proposition. So, could the technology ever be cost-effective enough to make it to the mainstream?

"Look at any high-spec material and over time it does filter down," says Charlie Gough, business development director at Future Fibres. "Already, the raw material of carbon is coming down as more people use it and more people produce it.

"There are newer materials that people are looking at all the time. Graphene is now being talked about and so are carbon nanotubes. Both are outrageously expensive. This is what carbon fibre was in the 1980s. However, steel has been around a long time and is still much cheaper to produce."

Though being more closely examined by many engineers on the periphery, carbon fibre is still considered too expensive by most. There are many applications that could benefit from lightweighting, but simply can't justify the cost.

However, while the material has a premium price tag, through-life costs often show a competitive benefit. Aerospace, aviation and the marine industries have already bought in to this philosophy. And, while they have paid a premium at the outset, they are finding reductions in operation and maintenance costs.

The problem lies in convincing a purchasing manager or financial director about the lifecycle cost benefit versus purchase cost penalty – or in tendering for a project with a higher initial cost but trying to convince the client of the benefits of lower through-life costs. It is a tough sell that many industrial applications have yet to make.

"Certain fields won't use stainless steel because galvanised is cheaper," says Gough. "So a jump to carbon fibre composite is just too expensive; they won't even consider it. It might be two or three times the cost at the beginning but over the life of a part, composites can work out cheaper. The benefit is quite often in the through-life costs."

Bridging the benefit

Installations costs, operational costs, longer life and lower maintenance are all potential cost savers. As a result, Future Fibres was able to introduce some of the other benefits composite material offers, alongside lightweight, to a stress ribbon bridge constructed in Cuenca, Spain.

It provided wound, unidirectional solid carbon fibre cables as the primary load bearing supports

to the footbridge that were 80% lighter and 50% stronger than stainless steel rods of a similar stiffness.

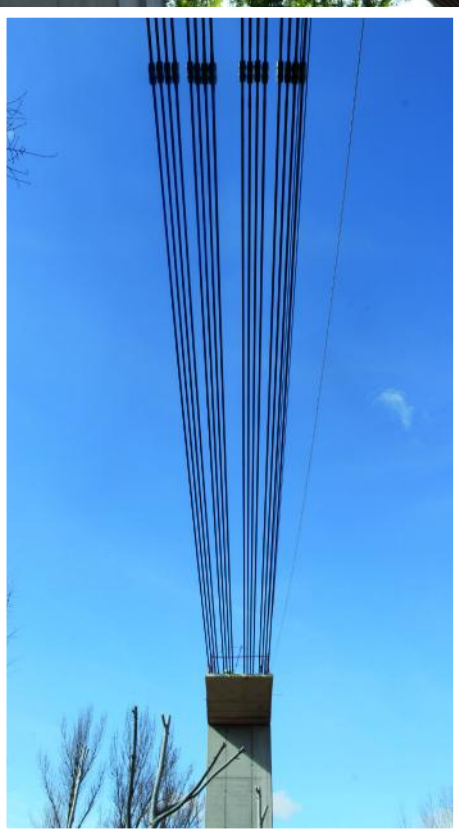
The cables support the bridge platform and needed to meet both the strength and stretch characteristics specified by the bridge designers. The bridge uses 16 lines of cables, made up of five individual cables joined with linked plates to 80 43.4m-long, solid carbon cables has a working load of around 95 tonnes but a diameter of just 42mm.

"The cables weighed less than 100kg each and could be handled by two guys," says Gough. "The rigging company normally allowed themselves three weeks to install wire cabling of a similar size but with the carbon cables they did it in two days without any heavy machinery or anything."

The use of carbon fibre cables meant the unsupported spans could be increased and supporting structure reduced. Installation time and cost was reduced by over 80%.

The maximum span was increased from 30m to 72m to add strength and reduce weight. This meant that, instead of having five vertical pillars holding the bridge up, it actually only needed two. The reduced weight also meant that around 30% less concrete could be used.

"If you compare a wire rod with a carbon rod, it is going to be a lot more expensive," says Gough. "There is an initial cost upfront which is more than the traditional route. However, there are savings. For this project I thought the big selling point was the reduction in raw materials such as the saving of concrete because of fewer pillars, quick installation and the elimination of machinery. However, despite talking to the client about all the benefits they can have right now, actually the big driver for them was the perceived 'near-zero' maintenance over the next 50 years."



Future Fibres was able to introduce some of the benefits composite material offers to a stress ribbon bridge constructed in Cuenca, Spain

Future Fibres has its roots in the marine industry where it has pioneered the use of continually wound, unidirectional composite fibres for yacht rigging. It has become an expert in composite technology and is now focussing on developing new markets, and finding new applications, where composites have not yet been considered.

As well as bridges, this brought them to identify cranes as having potential for benefit. Weight reduction and improved fatigue resistance in a composite cable offer the potential to lift 20-50% more, which may allow crane owners to charge operators a premium for their use. The cables should also outlast the rest of the structure and installation is relatively straightforward.

"It might be two or even three times more expensive than traditional materials," says Gough. "However, over the life of the crane you normally have to replace the pendant three times, and routinely carry out maintenance. Composite cables are again likely to result in very low maintenance and offer zero creep during installation. So over its life you are actually making a saving over traditional steel cables."

Composites are certainly not for everyone, but the case for them and their effective application is becoming ever more widespread. The ability to tailor the material properties and its excellent through life characteristics are making it increasingly competitive in more traditional applications, provided through life benefits are taken in to consideration at the outset.

As always, it is a case of using the right material, in the right place. However, don't dismiss what appears to be an expensive exotic material just yet, as it could offer you some unexpected cost benefits and unique performance advantages.

www.futurefibres.com

All the design, simulation and printing of some 300 interoperable parts for this chopper-style motorbike were completed within two months

The good, **the bad, and the ugly**

For all the hype and expectation surrounding 3D printing, is it really going to be as disruptive as we are told? Justin Cunningham finds out.

The hype around additive manufacturing, aka 3D printing, is reaching fever pitch. Some of those involved in the sector say that it will be 'bigger than the internet', 'you can print anything', and even that it will begin 'a new world order'. These are big claims, but what can we actually get now and expect to get in the future?

Additive manufacturing is novel and it is cool. It fascinates engineers and enthusiasts alike. There are niche applications that additive manufacturing is able to do well, but despite enthusiasm, machines can struggle to pay for themselves – particularly in the shorter term.

There is a lot of interest around augmenting conventional production processes to include additive manufacturing. However, the reality is that 3D printing is mostly used in addition to conventional processes.

The question of how much value it can actually add to a process is difficult to answer. Those that have 3D printers say they can't live without them. Ask them why and it is often some variation on the themes of 'more innovation', 'better visualisation' or 'better communication'.

Meanwhile, those that don't have one want one. Designer envy shouldn't be understated. 'I don't really know how it will help me, but I really want one' is actually quite a common standpoint.

The good

Be warned, 3D printing will make you popular. Friends you never knew existed will ask you to print absolutely everything and anything. Everyone is excited to see what the machines that have featured so heavily in recent media reports can really do.

Accompanying all the hype and excitement is real, and substantial, business growth. The technology is not going away and is going to become an increasing part of the engineering design process.

Gonzolo Martinez, director of strategic research at Autodesk, says: "If you have a 3D design in Inventor, for example, it takes literally about two minutes to bring it to the 3D printing software. That is in contrast to CNC equipment where you have to go through all the interactional tooling, tool path analysis, and generate G-code."

Autodesk has been developing its software to support 3D printing much like normal printer drivers. It is, of course, a far more complex problem that uses simulations to act like a print preview of a document to allow users to be sure that objects print correctly and what the finish will be like. However, it is not a case of pressing print and there it is five minutes later. As a guide, to print something like a single size 10 shoe takes between 14-20 hours.

However, as a designer himself Martinez finds the ability to see a 3D model as a physical object immensely attractive. "Take a latch that snaps together," he says. "In the software it looks like it will come together easily. But when you output it to the 3D printer you can see and hear them click together. There is so much you can do on the computer virtually but honestly, there is nothing that beats having the part in your hand to see how it connects."

To investigate the power of 3D printing, Autodesk has undertaken two demonstration projects. The first was a chopper-style motorbike. The project lasted just two months from start to finish in which time all the design, simulation and printing of some 300 interoperable parts was completed.

"We figured everything out in the software and then put the printer to work," says Martinez. "After 2000 hours we were able to output every single component of the motorcycle and put it together. We had absolutely zero errors of fitting."

The bad

The following year the team printed a turboprop engine with Stratasys. Like the chopper it looks great. However, despite checking form and fit and also some moving parts, the product is not a prototype, it is a 3D model.

It is a modern equivalent of (and much better than) a balsa wood or clay model. This fact raises a fundamental issue: how useful is 3D printing as a prototyping tool? At present, 3D printing probably sits more comfortably at the conceptual design end of the spectrum where ideas can be quickly printed out, passed around the boardroom and shown to directors and customers. That is useful. But it is also a costly luxury that perhaps only the higher end of the engineering fraternity can afford. The high capital cost of professional machines and the accompanying cost of materials are making it difficult to justify to financial directors.

The alternative is companies such as Proto Labs that offer rapid production of parts using conventional injection moulding and CNC machining. The unit cost is similar but parts are available in production-ready materials, can be physically tested and used for low-volume production.

"A compromise with 3D printing is material choice," says John Tumelty, managing director of Proto Labs. "It is limited and sits closer to concept modelling than prototyping.

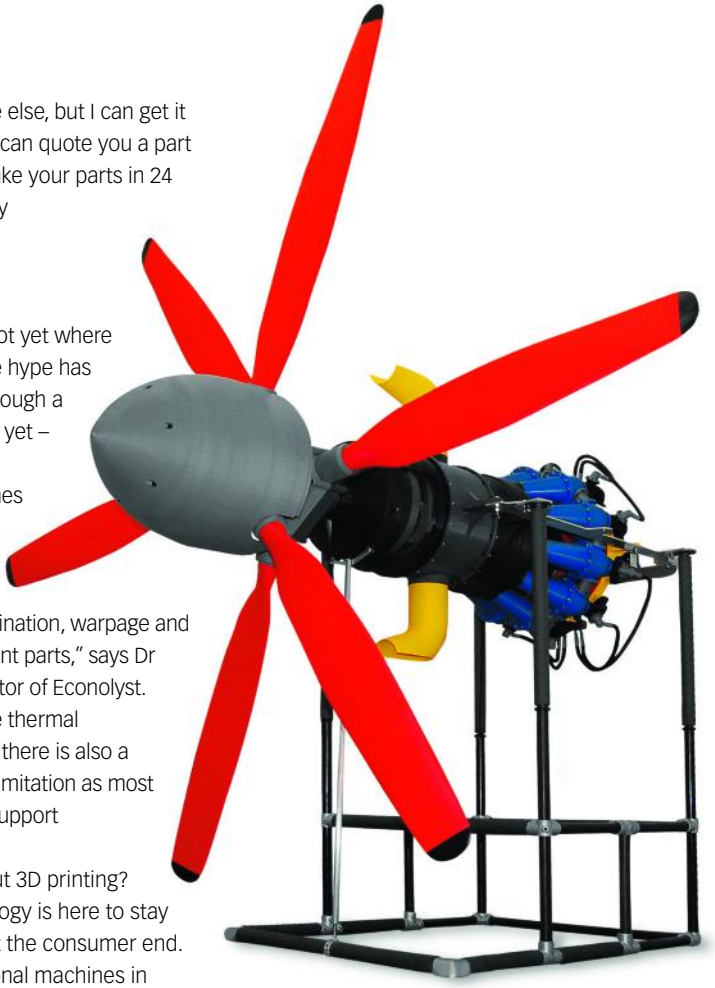
"We've created software that can take almost any 3D CAD geometry and produce a part. I can't machine faster than anyone else, but I can get it into the machine faster. We can quote you a part in a couple of hours and make your parts in 24 hours, and the price is pretty comparable to 3D printing."

The ugly

Additive manufacturing is not yet where everyone wants it to be. The hype has exceeded the reality and, though a lot is possible, it is not there yet – either in price or capability.

Those lower-cost machines on the market also need more development. "There can be an enormous amount of delamination, warpage and distortion in those component parts," says Dr Phil Reeves, managing director of Econolyst. "Consumer 3D printers have thermal management problems and there is also a huge amount of geometric limitation as most of them don't have quality support structure."

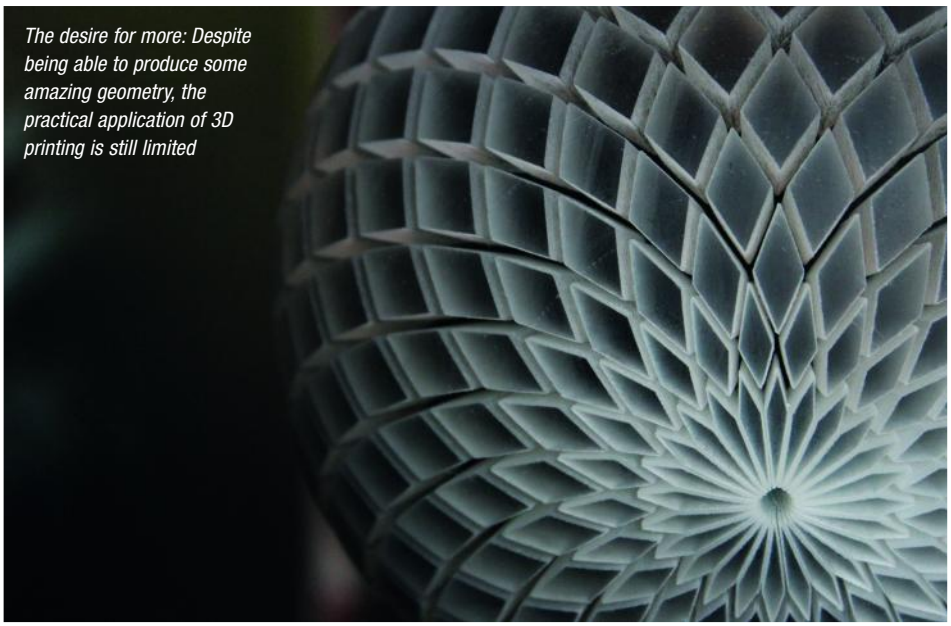
So should you care about 3D printing? Yes, absolutely. The technology is here to stay and is developing quickly at the consumer end. And this is driving professional machines in terms of cost, capability, speed and materials. Although additive manufacturing will increasingly be used by design engineers, it is essentially another tool in the growing 'smart' toolbox. It may replace some processes where it offers distinct advantages, but it will not make traditional manufacturing, as we know it, redundant.



Econolyst works with both end users and technology vendors to find competitive uses for 3D printing and ensure machines are fit for purpose. It has carried out numerous studies to predict where the technology can be used, when it will become more effective and truly accessible to the masses.

"By about 2015 you will be able to make a metal iPhone case cheaper than machining it," says Dr Reeves. "Take additive manufacturing seriously if you are engaged in activities involving high-value, low-volume manufacture. However, medium volume is only around the corner. This technology fits perfectly in to the whole world of customisation. There is no point in bringing in 3D printing as a disruptive technology to replace injection moulding or CNC machining. You have got to do more and personalisation is perfect."

www.autodesk.co.uk
www.protolabs.co.uk
www.econolyst.co.uk



The desire for more: Despite being able to produce some amazing geometry, the practical application of 3D printing is still limited

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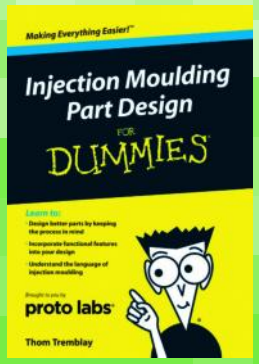

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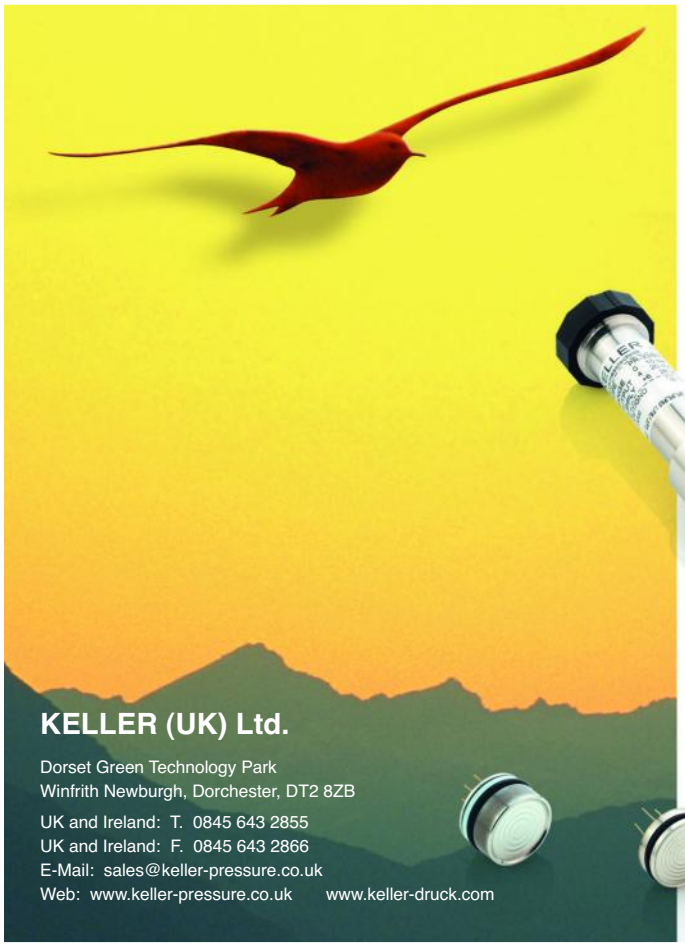

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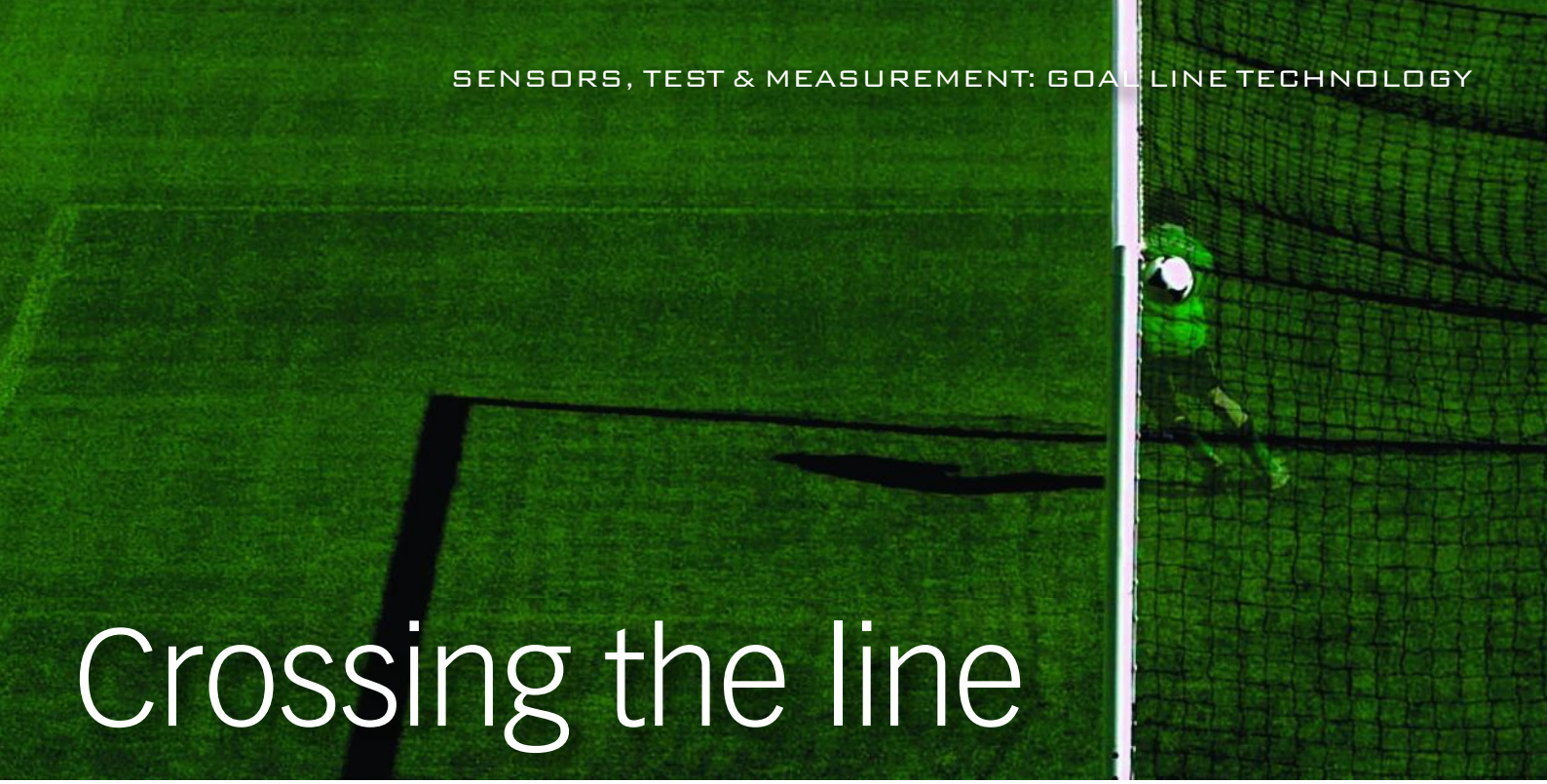


Crossing the line

What are the details behind the goal line technology that will be used by the Premier League next season? Justin Cunningham finds out.

It's an uncomfortable thought for any England fan, but the fact is that goal line technology could well have meant Germany winning the World Cup in 1966. However, while we may be grateful that it's happening now and not 50 years ago, the fact is that goal line technology finally seems to be here and able categorically to state once and fopr all what is, and is not a goal.

Football stirs primeval passions in many supporters. Bad calls on the pitch unleash an onslaught of abuse towards the referee and his assistants, both at the ground and at home via the television. However, while goal line technology won't eliminate such discontent completely, fans in the future should at least have a lot more confidence about goal line decisions.

This is because in July 2012, FIFA (international football's governing body) after many years of delay finally took the decision to adopt goal line technology across the world game.

This decision came after an extensive study was undertaken to test the accuracy and reliability of various goal line technologies, the implications for stadium infrastructure and the associated costs. And, while FIFA has chosen to trial the German technology GoalControl for the Confederations Cup with a view to using it in the 2014 World Cup, the English Premier League has instead adopted UK-developed technology Hawk-Eye.

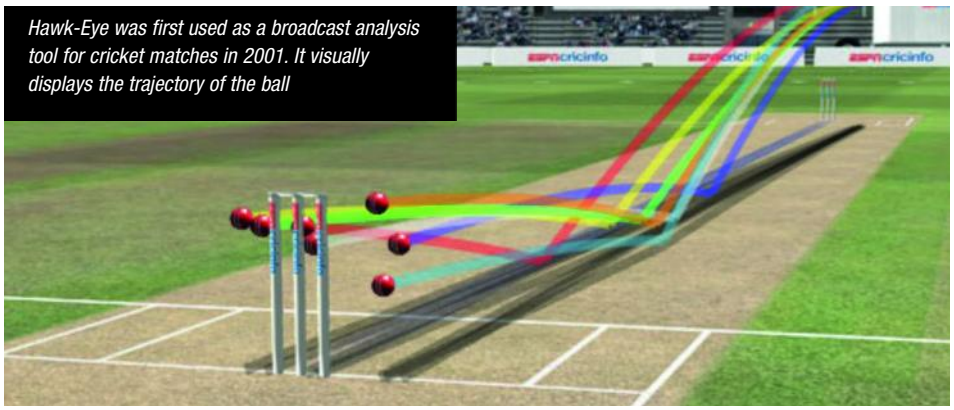
After two years of trials and testing it was announced last month that Hawk-Eye has been awarded the contract to provide, implement and operate goal line technology across the 20 member clubs of the UK Premier Football League and all 380 matches in the 2013/2014 season starting in August.

"The Premier League has been a long time advocate of goal line technology, and at times it didn't look like it would be something we would be able to introduce," says Premier League chief executive, Richard Scudamore. "However, since FIFA took the decision to permit it, we have been working hard to get a system in as soon as possible. Of the four companies that are currently licensed by FIFA, Hawk-Eye stood out for their excellent track record in delivering for sport over many years."

Hawk-Eye was first used as a broadcast analysis tool for cricket matches in 2001. It visually displays the trajectory of the ball and then its most likely path as a moving image. This was originally used to determine whether an LBW decision had been correctly given, as well as to correlate the trajectory of all the balls in a given over or by a particular bowler.

It was initially used as an insightful analysis tool by broadcasters and became an instant hit with punters, pundits and players alike. It has since become commonplace not just as a broadcasting tool, but as an officiating aid in tennis, snooker, Gaelic Football with future possibilities including baseball. Its success saw Hawk-Eye Innovations bought by Sony in 2011.

Steve Carter, managing director of Hawk-Eye Innovations, says: "Hawk- Eye has many years' experience of successfully deploying its innovative technology for high-profile sports globally and can be trusted to provide a reliable long-term service to the game of football."



Hawk-Eye was first used as a broadcast analysis tool for cricket matches in 2001. It visually displays the trajectory of the ball

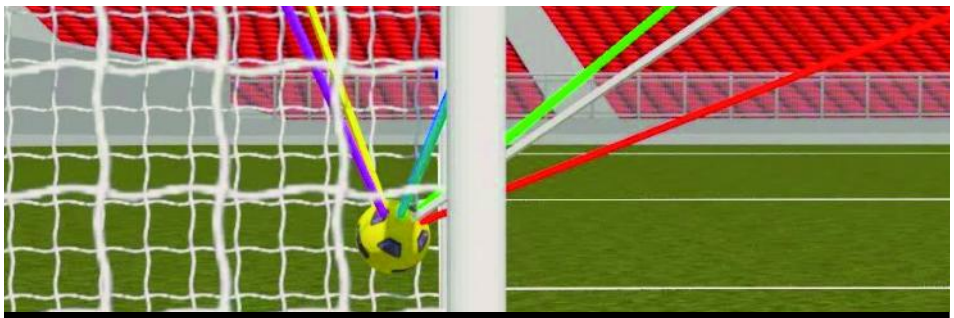
The system uses seven high frame rate cameras and an advanced vision processing technique to instantly, accurately and reliably determine the location of the football. The cameras are usually located on the roof of a stadium, but there is flexibility around where the cameras can be installed without compromising accuracy. By relying totally on cameras and no modification to the ball or goalposts, it is totally non-invasive so will have absolutely no impact on any aspect of the game.

Seven cameras installed at each goal end track the ball to within just a few millimetres. The images from each camera are processed instantaneously with each frame locating the ball. Extensive trials have shown the system to be so good at locating the ball, that even if only a small part is showing, it can still be tracked.

The system is unaffected by mud on the ball or adverse weather conditions and the accuracy of the system is also not affected by any variances in the painting of the goal line or if the posts are not perfectly vertical. The system developed by Hawk-Eye can be set up to work with any pattern football and specific vision processing techniques have been developed to distinguish between different patterns on the football and manufacturers.

"Football is fundamentally a simple game; whichever side scores the most goals wins," adds Scudamore. "So, when one is scored, or indeed not scored, and we have the ability through technology to definitively know whether the ball crossed the line, we should absolutely use it."

In addition, the system uses a high-speed camera that is capable of removing players from the image, to allow the ball to become fully visible on replays. This feature gives broadcaster's immediate tracking graphics to show just where the ball was for close calls. It also gives broadcasters a new set of tools when it comes to analysis to show the trajectory of free kicks and the 'scatter' of shots on goal.



The Hawk-Eye system is based on seven high frame rate cameras placed around the stadium focused on each goalmouth. These monitor the incoming ball's trajectory when it is close to the line. The data from the cameras is fed into a central processing unit that analyses the position of the ball relative to that of the goal line.

"The fact it was a camera-based system was critical," says Scudamore. "Replays will be made available to all our host broadcasters and we are examining the feasibility of them being used on the in-stadia big screens. It's essential that fans see the system in action to know that it is working."

As soon as the system detects that the ball has crossed the line it sends an instant message to a watch worn by the referee to indicate a goal has been scored. This happens within a second. If the ball didn't cross the line the watch will send the referee a 'near-miss' message for clarification that the ball did not cross the line, allowing him to signal play on or make another appropriate call.

Hawk-Eye says that, 'there has never been a goal line incident where the ball would not have been seen by its cameras' and the accuracy is so good that no broadcast replays could, or would, disprove a decision. In other words, the replays offered by the system promise unequivocal proof the decision made is correct every time.

Paul Hawkins, inventor of Hawk-Eye, says: "We understand the responsibility that we have been given, and that the real challenge lies ahead in consistently delivering the technology that football deserves."

FIFA is keen to state that goal line technology is the only area where technology is going to be used. Offside decisions and other controversies are going to continue, probably until the Hawk-Eye technology proves useful and reliable beyond any doubt, and offers the potential to assist the referee in other aspects of the game.

But England would have still won in 1966 regardless…wouldn't they?

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Precision Rolled

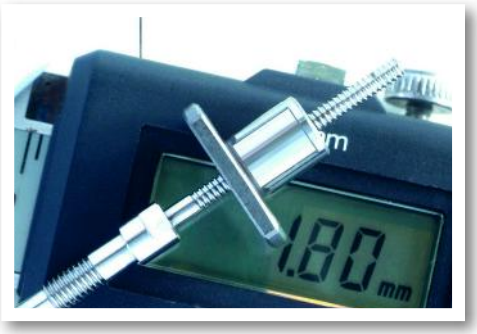
Put simply, the rolling process forms a thread for less cost than a ground one. Ball screws that have been cold rolled formed are ideal for applications that do not require the finite accuracy of the ground ball screw equivalents, but are still required to reliably transmit an axial load with a high degree of accuracy. Precision rolled ball screws still achieve accuracies of C7-20 (that's 52 microns per 300mm of cumulative lead accuracy - 20 microns of axial backlash).

Precision Ground

Ball screws that have been formed by a grinding process are used where acute linear accuracy is paramount within the application. We offer a quality program of diameter and lead combinations with a variety of ball nut styles.

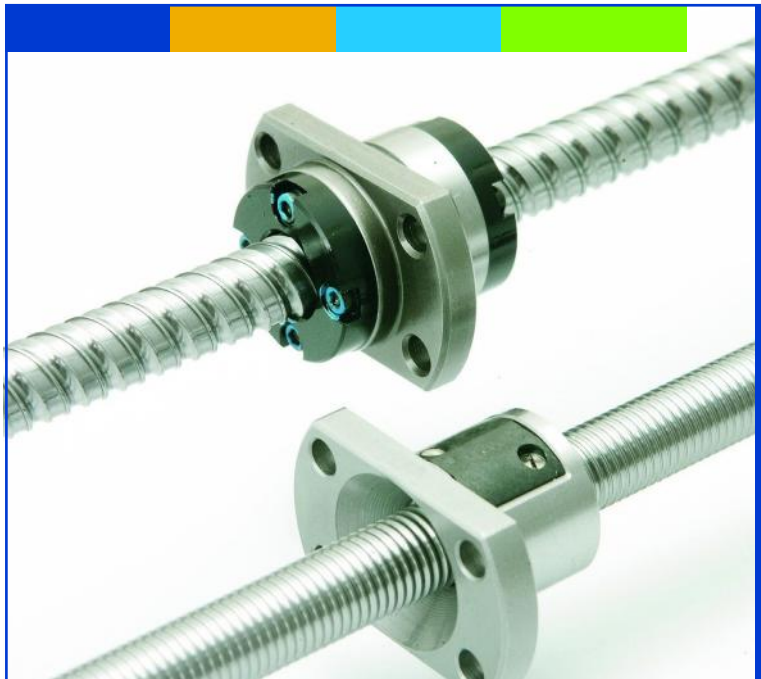
NEW An end deflection series, which recirculates the ball bearings in the end plate of the ball nut has recently been developed. This design reduces the diameter of the ball nut. The new FEB and FDB series are available in diameters of 6, 8, 10 and 12mm with leads ranging from 2.5 to 10mm. As standard this new series offers a lead accuracy of C3 and C5 in a ground format or C7 and C10 in the rolled format.

NEW A stainless rolled steel ball screw available in 6, 8 and 10mm diameter with leads of either 1 or 2mm called the SUS series, capable of transmitting dynamic loads up to 2300N, the standard product is hardened to HRC55. Standard screw lengths which can be supplied machined ready to fit into an application are 300mm for the 6mm diameter and 400mm for the 8 and 10mm diameters.



NEW Abssac is now supplying what is believed to be the world's smallest precision ball screw and nut assembly. With an amazing screw diameter of only 1.8mm and lead of 0.5mm, the new miniature ball screw range is ideally suited to the ever-smaller requirements of medical, optical and military application requirements. Using a ground screw format, the hardened steel ball screw can be supplied complete with machined journal ends.

A standard 6mm diameter nut body is used to house the 0.4mm diameter ball bearings, which are captivated in a recirculating ball nut design. Remarkably, the new product range offers a C3-05 accuracy grade (i.e. 0.005mm axial play). Fixing the nut to the application is made simply by a range of nut flange sizes.



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Linear actuators vs linear motors

How can the need for fast, powerful and accurate linear actuation be met? Here, with help from Maxon Motor, *Eureka* finds out.

Factory automation and robotic application engineers are often faced with the challenge of requiring fast, accurate and powerful linear actuation within a small allocated volume. In these circumstances, the two most commonly available technologies are rotary DC motor-driven actuators and linear DC motor actuators.

There are of course advantages and disadvantages with all technologies and they are sometimes easily overlooked.

First of all, it is probably important to define terms. An easy way to think of a linear DC motor is to take a standard DC motor and lay it out flat. For example, it could take the shape of a line of motor stator coils over or along which is passed the permanent magnet sliding actuator. Equally, they can also be manufactured as a rail of magnets with a moving coil. These can be flat or circular shapes.

The main advantage of a DC linear motor is speed, as smaller, high-quality units can achieve outstanding acceleration rates. The other advantage offered is operational life. Because there is no gearing and the only friction points are the required linear guides, the lifespan is therefore relatively long.

However, linear DC motors also come with a number of downsides. One such is that they offer a very low force. In particular, they offer a very low speed force gradient compared with DC linear actuators.

It is of particular importance in this instance to compare the same figure. Manufacturers from different parts of the globe often use a completely different standpoint from which to select catalogue ratings related to force: Peak force; stall force; rated force; holding force; and back driving force to name a few.

The most comprehensive test is to use a force gradient, which can either be calculated or informative companies will supply you with the figure representing metres per second per Newton (m/s/N). The gradient of this speed force line represents how much the unit slows down for every Newton of load that is applied and this is a true test of its strength.

Another disadvantage of DC linear motors is current draw.

Because linear motors are a direct drive solution and there is a higher level of current rise with the required feed force, a geared solution will be proportionally lower.

But what of the linear actuators themselves? For the purpsoses of comparison, in this article we are looking at DC motor-driven linear actuators only. These are supplied in many forms, from in-line OEM-style units to off the shelf self-contained units.

OEM units are designed specifically for integration into a product being developed from the ground up, where the actuator section of the unit becomes part of the product itself. This is done in the interest of keeping the overall size and weight to a minimum. This could be a system as simple as a DC motor driving a threaded section using an actuation nut or a more robust design of an integrated ball screw, thrust block, DC motor, gearhead and encoder assembly.

Self-contained units, on the other hand, are commonly-available linear actuators that typically have a DC motor mounted beside the threaded section driven by a belt and pulley. The threaded or spindle section is contained in a tube. A fixed nut is connected to an overtube that pushes an actuation rod in and out. These are bolt-on units typically used on applications such as hospital beds and low-duty cycle

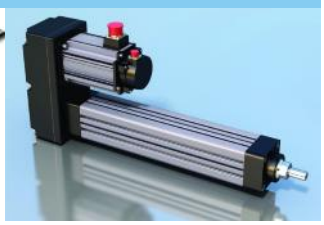
The most used technologies for powerful linear actuation are rotary DC motor-driven actuators and linear DC motor actuators

The latest in linear

• Olsen Engineering has launched the Exlar K90, a larger 90mm frame version of the K60 low-cost electric "rolled" linear actuator, which employs satellite roller screw technology. Exlar's K series provides long life and is available as standard in an IP65-rated ingress protected enclosure. Roller screw linear actuators provide an efficient modern alternative to hydraulic or pneumatic units in a much more compact, low maintenance format, without the contamination or noise problems. The K series offers the option of two grades of planetary roller screws "rolled satellite M and X grades" along with an option for an ACME screw.

• Festo has launched an intelligent linear actuator for process automation applications. The DFPI combines the functions of a linear actuator, a positioner and displacement encoder in one, easy-to-install unit. As a result, users can increase operational efficiencies as well as saving time and costs associated with specifying and installing equipment. The DFPI solution is ideal for controlling knife gate valves and shut-off valves with regulated strokes and for use with all linear-actuated process valves.

• A new linear motor which brings significant benefits to systems designers and machine builders that is claimed to be the first ever tubular linear motor with an integrated amplifier and controller has been introduced by Dunkermotoren. The ST11 range of linear motors has been extended with an integrated controller option that offers ease of integration with significantly reduced and simplified wiring. It features a range of analogue and digital inputs and outputs, with CAN, Profibus and EtherCAT communications protocols available as standard. Once programmed only power is required to operate in stand-alone mode, with programming completed using Dunkermotoren's own proven and established Drive Assistant.



applications. At first glance, these may appear to offer a good solution, however they are bulky and inefficient compared to an OEM-style spindle drive. The low-cost DC motors commonly used in this style of actuator can have quite high radial load applied from the belt and pulley mechanism. This can result in premature failure of the motor bearings.

For automation and robotic design engineers, the OEM style is likely to be far more applicable in terms of space, power, efficiency and reliability. Given that, it probably makes most sense to compare the advantages and disadvantages of the OEM style actuators and linear motors.

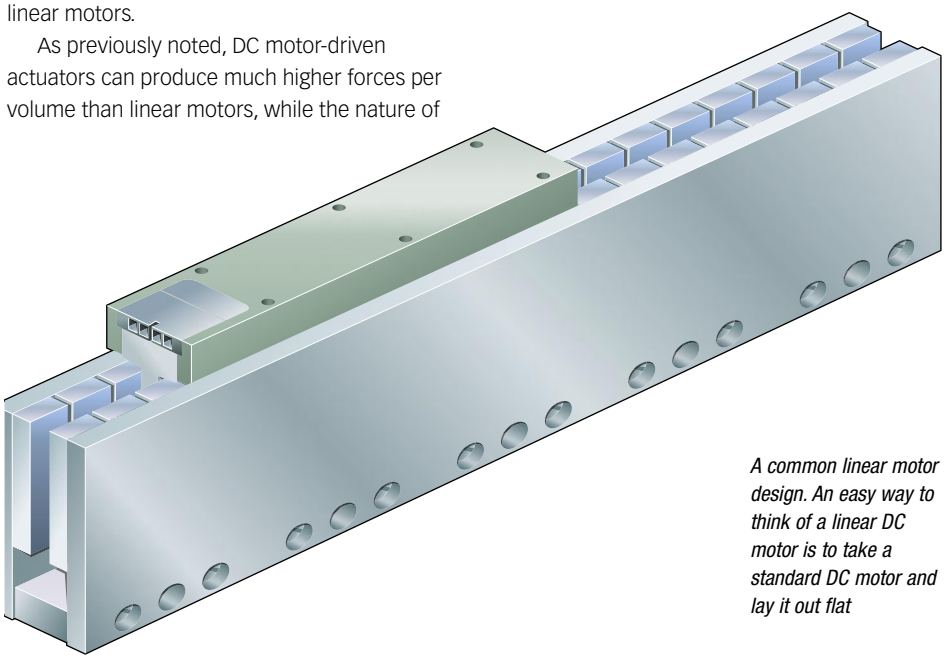
As previously noted, DC motor-driven actuators can produce much higher forces per volume than linear motors, while the nature of the thread or spindle section gives both self-locking and free running options. These units also offer high efficiency, particularly with the recent advances in ceramic and other high-grade running materials.

With DC motor-driven actuators, controllability is very easy thanks to the simple mounting of standard encoders on the rear of the motor. Combined with the gearing ratio and the thread pitch, this gives a very high positioning resolution from standard motor position controllers.

Finally – and, it might be argued – most importantly, there is the cost advantage offered by such units. However, it is vital to compare like-for-like. One must compare the additional system components required for the same overall result. Linear encoders, linear guide rail, limit switches, etc are typically required alongside linear motors. Much of this additional cost can be avoided with integrated OEM-style units that do not require all of these add-ons.

When it comes to disadvantages, however, the main one suffered by DC linear actuators as opposed to linear motors is speed. Top speeds of around 180 to 200mm/s are typical. The second main disadvantage is integration. In order to reduce the overall machine size and by design, the fixation of the spindle nut is part of the application load itself and, as such, a certain level of system design and integration is required from the customer.

www.maxonmotor.co.uk



A common linear motor design. An easy way to think of a linear DC motor is to take a standard DC motor and lay it out flat

igus launches custom bearing service

igus UK has launched a new manufacturing service dedicated to supplying customers with bespoke and complete bearing assemblies.

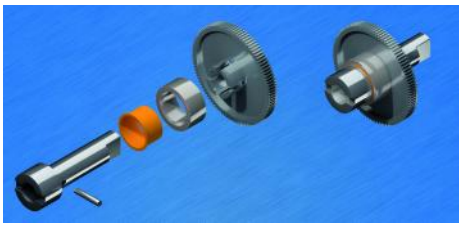
Called speedifit, the service works by taking a standard or custom iglidur plain bearing and fitting this into a bespoke housing machined to a customer's drawing and specifications.

Any igus bearing can be fitted into a housing, which can be manufactured from materials including aluminium, anodised aluminium, mild steel, stainless steel, titanium and a number of common engineering plastics.

The customer sends igus the assembly and housing drawings and then receives a quote, typically within 24 hours, which includes fitting of all bearings.

Once ordered, the speedifit manufacturing and assembly centre produces the custom part and the complete assembly is delivered ready to install.

Delivery timescales depends on the material, complexity and quantity, but parts are usually delivered within five to 10 working days.



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Bearings offer new design opportunities

Schaeffler has extended its premium quality X-life range of cylindrical rolling bearings to include larger size bearings with outside diameters up to 1,600mm.

Previously, X-life cylindrical rolling bearings were available with outside diameters up to 320mm. The new extended range includes both full complement cylindrical rolling bearings and cylindrical rolling bearings with cages.

X-life provides totally new design opportunities for applications that require large-size cylindrical rolling bearings. By using its in-house design calculation software and improved manufacturing technologies, Schaeffler has been able to optimise the contact geometry between the roller end faces and the bearing ribs, resulting in a more uniform surface over the contact area between the rolling elements and raceway. This improved internal design results in more uniform internal load distribution.

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A black and white issue

Photo: SINTEF

Expansion of oil and gas operations deeper into the northern hemisphere now seems certain. But can the industry effectively respond to an oil spill in this remote environment? Justin Cunningham reports.

Graphic pictures of wildlife covered in black gloop are the obvious symbols of the environmental devastation that can occur when large amounts of crude oil are spilt. It is a situation in which nobody wins. The environment is severely damaged and the oil and gas companies lose millions in lost revenue, cleaning costs and fines.

These occurrences are rare, and the industry takes considerable measures to avoid spills. While many though massive oil spills were a thing of the past, events in the Gulf of Mexico in 2010 proved different. So, there is a lot of trepidation from environmental groups around taking operations further north and in to the Arctic. Yet, with global demand making the price of fossil fuels ever greater, progress is almost certainly going to continue. It is a black and white issue for many that polarises those that argue for or against.

The oil and gas industry is taking steps to deal with the eventuality of an oil spill and wants to find out how the unique conditions of the Arctic will affect any response. To help understand the challenges, members of the International Petroleum Industry Environmental Conservation Association (IPIECA), Oil Spill Working Group (OSWG), Industry Technical Advisory Committee (ITAC) and the American Petroleum Institute (API) Emergency Preparedness and Response Program Group (EP&RPG) set-up the Arctic Oil Spill Response Technology Joint Industry Programme (JIP) in January.

Photo: SINTEF

The consortium is supported by nine international oil and gas companies including BP, Shell, Statoil, and Total. It is to build on existing research and improve the technologies, and methodologies, for dealing with a potential oil spill in the Arctic. It will carry out 10 in-depth research projects around six key areas including computer modelling of oil behaviour in Arctic conditions to help map and predict the trajectory of spills, the effectiveness of chemical dispersants in Arctic waters, mechanical recovery, detection, the actual environmental impact and in-situ burning.

The Arctic also offers some particular operating challenges such as prolonged periods of darkness, extreme cold, distant infrastructure and sea ice.

At present, oil spills are generally dealt with in three main ways. The first is mechanical recovery, second is using chemical dispersants and third is in-situ burning. However, before dealing with any oil, it must first be located.

Photo: SINTEF

"In the Arctic we are looking to develop tools that can locate oil that is underneath ice or that has been encapsulated in the ice," say Joseph Mullin, programme manager of the Arctic Oil Spill Response Technology JIP. "Advanced remote sensing, not only from the surface but possibly from the sub surface by the use of autonomous underwater vehicles, are areas we are looking at."

The Arctic is almost continually dark during winter months where vast ice sheets can spread quickly. Conversely during summer month's ice can rapidly break up in to sizeable chunks and recede.

One of the projects aims to expand remote sensing and monitoring capabilities, especially in darkness and low visibility. The project will test the effectiveness between surface remote sensing that utilises satellites, aircraft and ships to subsea sensing that will use remotely operated vehicles (ROV).

"We have to be able to send a response to where there is a 'meaningful' amount of oil," says Mullin. "We need the right equipment

Photo: SINTEF

dealing with the 'right kind' of oil. Some equipment works very well on light oil on the surface, but once it gets heavy and emulsified that equipment might not work as well."

Perhaps the most interesting aspect of the project is mechanical recovery. Ultimately this is what all parties would like to see. The oil companies would be able to recover potential revenue, while potentially damaging oil slicks would be removed from the environment.

The use of mechanical recovery is normally always favourable and usually a primary response option. Containment booms are normally used in combination with a skimmer to remove oil from the surface of the seawater. It can then be stored before further treatment.

However, Arctic waters offer both some advantages and disadvantages. Booms and skimmers deployed from ships collect large chunks of ice floating in the water. This quickly causes blockages and makes this approach almost completely ineffective.

"The more ice you have, the harder it is to use mechanical recovery," says Mullin. "If you have a spill and the water is more than 50% frozen you can't use a boom anymore.

"We currently have four sub-projects looking at better ways to separate oil, water and ice. These are looking at new ideas and seeing how effective and feasible they will be."

There are, however, some conditions in the Arctic that could actually be beneficial to any response. Waves in the Arctic do not generally reach the ferocity frequently witnessed in the North Sea, meaning spilt oil does not spread so rapidly from the source. Additionally, the temperature of the water keeps oil more viscous.

"That, too, will actually slow down the spreading of the oil," says Mullin. "If you spill oil in water that is 30°C then it will spread out quite quickly. Colder temperatures aid the responder as the oil doesn't spread as fast, and also it doesn't 'weather' as quickly. The result is that the window of opportunity to effectively respond to an oil spill is a bit longer."

Several types of skimmers and vessels have been developed specifically for recovering oil in ice-covered regions. The skimmers are often brush belts, drums or ropes rotating through the slick and capable of recovering oil while processing small ice pieces. Some skimming units are even equipped with heating systems, ice deflection frames, and advanced pumps able to handle viscous oil, water and ice mixtures.

One of the deliverables of this JIP is to access the possibility of onboard oil/water/ice separation systems. The study will evaluate the feasibility of putting theses on board vessels, and new recovery vessel design concepts.

Shell has suggested that an empty oil tanker or similar could be deployed in conjunction with a vessel that would pump an oil, ice and water mixture in to it. The modified tanker would then be able to process the mixture and separate out the oil while at sea.

However, as well as the more high-tech options, there are more common and (at the risk of punning) crude ways of dealing with oil spills. Indeed, a significant part of the JIP is to establish the use of dispersants and in-situ burning in Arctic conditions. Dispersants are either a chemical or mineral added to water to enhance the natural biodegradation process of oil in the marine environment.

"As with washing dishes, you need to agitate the water to remove the grease," says Mullin. "Dispersants break the oil down into very minor particles that you suspend in the water column and these are then available for bacteria to further breakdown and use as a food source."

The use of in-situ burning is also relatively common. The oil slick on top of the water must be about 3mm and must not be emulsified (i.e. the oil must not have taken on too much water content).

While both these methods are effective in taking oil out of sight, they do not remove it from the environment. Chemical dispersants have been shown in some studies to do more harm than good, and in-situ burning creates plumes of black, particulate-rich smoke into the air.

Responders face difficult decisions and are cleaning up oil that we all are guilty of demanding. It is a case of minimising damage as much as possible. This JIP wants to ask difficult questions so that something like the Gulf oil spill never happens in Arctic waters. Such scenes, if repeated in the white serenity of the Arctic, could potentially spell the end of operations there permanently. And that really is something the oil and gas industry is desperate to avoid.

"I don't know of any responder who wants to go out there and hurt the environment," says Mullin. "What we want to find out is the best ways of using different technologies in the Arctic, and which are most effective in a given situation."

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The shape of things to come?

Shape Marks are one of the less understood aspects of Intellectual Property. Here, Matthew Dick, partner and trade mark specialist with leading IP law firm D Young & Co LLP, explains them.

Design engineers are responsible for creating innovative and revolutionary products. If they have any knowledge of intellectual property, this is likely to have centred around patents and designs: after all, if a product performs an inventive function and/or has a novel aesthetic appearance, it may be possible to obtain monopoly rights by means of either a patent or design registration. Both rights provide valuable protection for a substantial period of time (usually 20 years for patents; up to 25 years for designs). What many design engineers may not appreciate is that it is also possible to protect 3-dimensional shapes as trade marks; and trade mark registrations can potentially last forever.

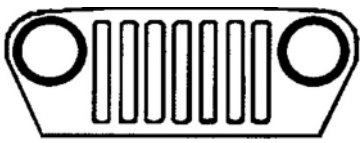
It has been possible to register shapes as trademarks within the UK and EU for nearly 20 years, though it can be a difficult endeavour. All registered marks must be distinctive of the goods/services in relation to which they have been registered – i.e. capable of distinguishing them from those of third parties. For shape marks there are additional requirements, to prevent products being the subject of a perpetual monopoly when their patent/design protection has expired. Any mark which consists exclusively of a shape required to obtain a technical result may not be registered (patents should be used instead – the fact that the well-known shape of a LEGO brick had previously been protected by patents assisted the highest Court in Europe in invalidating a trade mark registration for the shape); and any mark consisting exclusively of a shape which gives substantial value to goods will also be excluded (if it's aesthetically pleasing to look at, use design protection instead).

Assuming that a design engineer's new product creation does not fall into such excluded categories, it may be possible to obtain registered trade mark protection in the form of a 3-dimensional shape mark.

As noted above, all registered marks must be distinctive of the owner, capable of distinguishing its goods/services from those of competitors and acting as an indication of trade origin. Traditionally, European Courts have taken some convincing that consumers are able to identify shapes as origin indicators. The owner of a shape mark must usually prove that he has used the mark to such an extent that it has become distinctive of his goods/services. An important element of this is that the shape in question must generally depart significantly from the norm or customs of the relevant industry sector. Hence the owners of the well-known brand of torch MAGLITE were unable to register the shape of their product as a trade mark because – as recognisable as MAGLITE torches may be – their shape is essentially a cylinder with a bulbous end, much like any other torch.

Ultimately, members of the relevant public at whom the product is directed, must – without analytical examination – immediately and with certainty distinguish goods of the shape in question from those of another commercial origin. Although this can be a difficult hurdle to overcome (and substantial evidence of use as a trade mark is usually required), it is far from impossible, and the reward of a potentially ever-lasting monopoly right is likely in many instances to outweigh the costs that may be involved.

One of the better-known shape marks accepted for registration is the distinctive front grille depicted below, owned by Daimler Chrysler and used in relation to its JEEP brand of vehicle.



The relevant Court held that grilles have become an essential part of the appearance of vehicles and a means for consumers to differentiate between models. Although grilles perform a technical function, they can also distinguish vehicles as trademarks – the JEEP grille was deemed to be an unusual design and not commonplace at the date of application, and was therefore accepted for registration.

A less well-known shape mark that has been accepted for registration is the following, registered for pipe junctions, fittings and couplings.

The owner was able to convince the relevant authorities that this shape was sufficiently distinctive to operate as a trademark, indicating commercial origin – and has been granted a potentially perpetual monopoly for the shape across the the EU.

The take-home message? If you design a product that has a distinctive shape, be sure to speak to a trade mark specialist to see if it may also benefit from protection as a registered mark.

For more information, please contact Matthew Dick, Partner, on:
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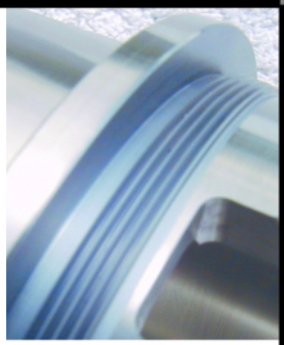

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Rockwell Automation Launches New Configuration Tool to Simplify Machinery Safety-System Design

Rockwell Automation Safety Automation Builder tool helps automate safety-system development and save machinery design time

Rockwell Automation today announced the release of a new configuration and design tool to help machinery automation system engineers save time when designing safety systems. The Rockwell Automation Safety Automation Builder (SAB) configuration software helps users navigate the safety-system design process and apply global best practices. The SAB tool is available as a free download from the Rockwell Automation website. It guides engineers through the safety-system design process by providing options for layout, safety Performance Level (PL) analysis and product selection using Allen-Bradley products. The PL analysis uses IFA's SISTEMA software tool (Safety Integrity Software Tool for Evaluation of Machine Applications) which is based on the globally accepted standard EN ISO 13849-1.

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Berlin – Ircon extends the Modline 7 series by two new infrared thermometers and a new processor box. The new 7V line has been especially designed for the semiconductor industry, while the 75 series now comprises a new high temperature model dedicated to heat treating and annealing. With these additions, the Modline 7 series includes eight distinct thermometer lines for various application fields including glass manufacturing and forming, ultra-thin glass production, semiconductor processing, and industrial furnaces. The modularity of the Modline 7 series helps users reduce installation efforts, since the installation hardware and application software is identical for all sensors and each model features an extended measured temperature range, with the entire series covering a -40..+3,000 °C range. The common Windows ModView Pro software platform facilitates multiple product configurations.

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Jabsco Toilet Fresh System is designed for simple DIY installation. Available now at marine retailers - RRP £39.99

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Spelling disaster?

Can technology ever keep pedants happy by eliminating spelling and grammatical errors once and for all?

In publishing, anything that eliminates spelling, grammatical or syntactical errors is to be welcomed. As editors, we spend a lot of our time trying to find and correct mistakes within our magazines. A completely error-free publication is the Holy Grail of our profession, but – like that mythic object – is more readily desired than attained.

As – ahem – professional wordsmiths, of course, it grates when we read a writer who doesn't know the difference between 'less' and 'fewer', 'number' or 'amount', 'disinterested' and 'uninterested', 'infer' and 'imply' or 'continual' 'and 'continuous'. And that's before we even get started on the ever-vexatious issue of apostrophes.

These examples may seem like pettifogging pedantry to some, but they are a regular source of irritation to many and can on occasion lead to considerable confusion. And, contrary to what we may once have hoped, the auto-correction, spellchecking and grammar programmes that exist simply won't do the job. After all, one has only to consider the fact that 'four', 'for' and 'fore' or 'fair', 'fayre' and 'fare' are all valid spellings with totally different meanings to see how far short a simple spellchecker is likely to fall.

Of course, it is most important to inculcate the young with a good understanding of spelling and grammar, but this is even more problematic, not least because in this age of 'text speak' (or 'txt spk'), it can be difficult to explain to a youngster why spelling and punctuating properly is important.

The Challenge

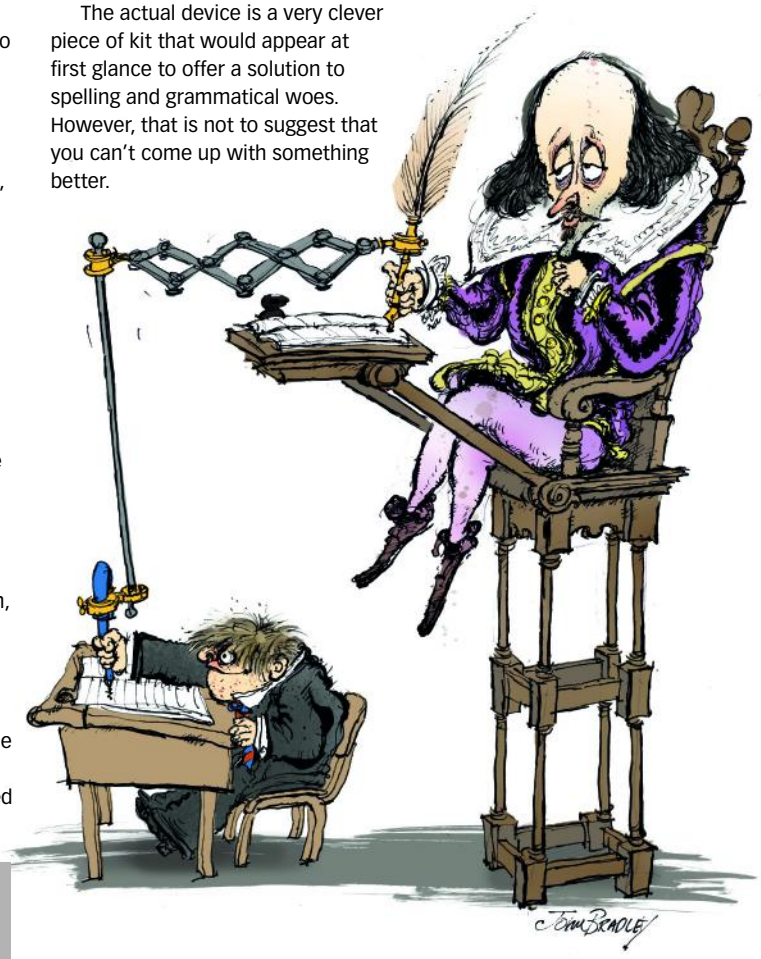
The challenge, then, is to develop a device that can eliminate such errors as or even before they happen. This would have to be easily used and affordable, but able to give near-instant feedback to allow errors to be recognised immediately.

Ideally, it should be possible to use such a device like a normal pen, as this will allow children to learn how to write legibly, as well as accurately.

Perhaps the device could take the form of a camera monitoring the pen's every stroke and relaying the pictures to a remote location staffed with highly pedantic grammarians?

However, it's hard not to feel this might be expensive and time consuming.

The actual device is a very clever piece of kit that would appear at first glance to offer a solution to spelling and grammatical woes. However, that is not to suggest that you can't come up with something better.



The answer to last month's Coffee Time Challenge, how to judge the roundness of doughnuts more accurately, is in our Technology Briefs section on page 13.

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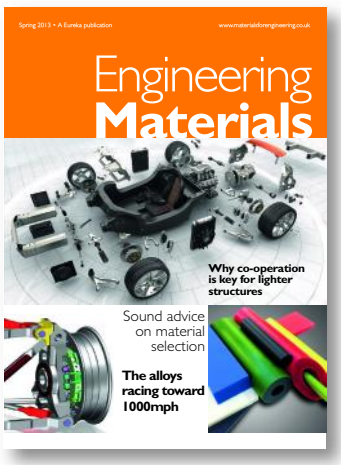

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