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THE MAGAZINE FOR ENGINEERING DESIGN

Innovation: Where British is best

New coatings reduce friction and extend service life

Microsensors take on big markets

Save carbon, save money

Dr Robert Trezona is looking to make a compelling economic case for low carbon technologies

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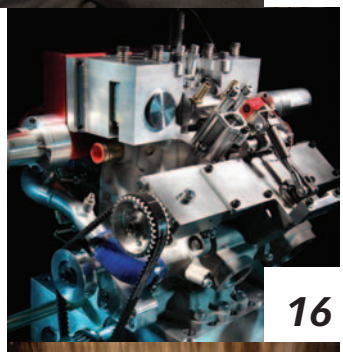
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Confocal measurement system

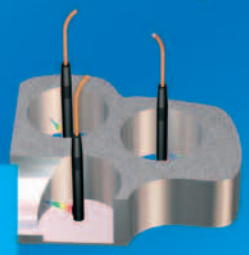
- Measuring ranges from 0.12 to 24mm
- Nanometre resolution
- Tiny, constant measuring spot 7µm
- Measure any target diffuse, specular and liquid

Typical applications:

Measuring of glass and mirrored surfaces

Measurements inside bores and holes

One-sided thickness measurement of transparent materials (e.g. glass)



optoNCDT 2402
The world's first miniature sensor with just a 4mm outside diameter

Laser profile sensors

- Measuring ranges from 25 to 245mm
- Lightweight and compact sensors
- Very high measuring rate of 256kHz
- 3D view of the target
- Micrometre resolution

Typical applications:

Position and contour measurement, edge detection, web width, groove width / depth, welding seam inspection, welding robot control

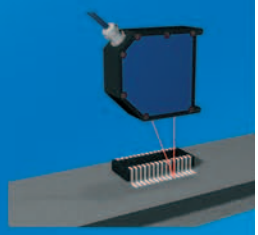
scanCONTROL 2700
Most compact design with integral controller

Laser triangulation sensors

- Measuring ranges from 2 to 1000mm
- Models with integrated controller
- From low-cost entry level models up to highest precision in class
- Analogue and digital interface
- In built synchronisation for thickness measurement

Typical applications:

High precision measurements in automation, positioningand in-process quality control



optoNCDT 1302 / 1402
Very compact sensors with integrated controller

optoNCDT 2220
Extremely fast measurement with 20kHz measuring rate

optoNCDT 2200LL
Small laser line for metallic, shiny surfaces

Compact infrared temperature sensors

-Temperature range: -40 to 1800°C

- Spot sizes as low as 0.45mm
- CTlaser with built in laser alignment
- CThot withstands ambient temperatures of 250°C without cooling
- Exposure time from 1ms
- Analogue and digital outputs incl. Profibus DP
- Specific models for glass, metals, ceramics

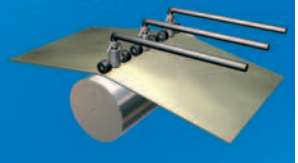
thermoIMAGER TIM
Thermal imager for inline applications
Temperature ranges: -20°C to 900°C

Eddy-current displacement sensors

- Measuring ranges from 0.4 to 80mm
- More than 300 sensor models
- Nanometer resolution
- Intelligent controller
- Robust sensor - IP67
- Pressure-resistant sensors up to 2000 bar
- Ideal for Machine builders & OEMs

Typical applications:

Harsh industrial environments (resistant to oil, dirt, dust, moisture, interference fields, etc.)



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Engineering the future

Graham Pitcher, Group Editor (gpitcher@findlay.co.uk)

There are few people in the UK's engineering design community who will not have been happy to see the back of 2009. Much of what happened – job losses, company closures and the like – was outside of the control of the industry as a whole, a consequence of the meltdown in the global financial sector. So good riddance to a bad year.

Now, economies around the world are beginning to drag themselves slowly out of recession as demand returns. And it's a great opportunity for UK companies to take advantage of demand.

As we note in one of the articles in this issue, while the UK may no longer be the workshop of the world, it certainly is home to world leading design companies and consultancies. While the manufacturing may now be done elsewhere, the IP – and, importantly, the know how – remains in the UK.

But we should not be complacent. Engineering is a people industry and the number of students looking to study engineering in university is in decline, while the average age of an engineer is increasing.

The latest report from EngineeringUK – the new name for the Engineering and Technology Board – says that while 7 to 11 year olds find art and design to be their most popular subject, with design and technology in the number three slot, the very same children perceive engineering as 'dull'.

So we have to improve the way in which engineering is presented.

The Big Bang Fair, taking place in Manchester in March is one way in which this problem is being addressed. Already, 16,500 children are registered to attend – double the number that went to last year's inaugural event.

We know that engineering is what makes things happen; let's pass that message on.

Got a story? Then drop us a line at eurekanews@findlay.co.uk or call us on 01322 221144

Briefs

UK TO GET DEDICATED COMPOSITES SHOW

With the launch of the 2010 Composites Engineering Show, UK engineers will no longer have to travel to Paris to attend a dedicated event.

The new show will be held at the NEC from 29 to 30 September, alongside the 2010 AeroEngineering Expo and Conference.

Event director Ian Stone said: "The event will be the first dedicated showcase for the composites community, mirroring the importance – and growing use – of these advanced materials ... and reflecting the Government's recent £22million endorsement of composites developments."

www.aeroconf.com/composites

HYBRID TRUCKS TO ENTER PRODUCTION

Allison Transmission and Delphi Automotive Systems have entered into a long term agreement to commercialise hybrid truck drive systems. Delphi's expertise in the manufacture and integration of electronic and hybrid system components for the automotive industry will complement Allison Transmission's product offerings.

SCHAEFFLER DEVELOPS TOUGHER COATINGS

The Schaeffler Group has developed a range of materials and corrosion resistant coatings for rolling bearings. The coatings can operate in harsh conditions to improve service life, reduce maintenance costs and minimise production downtime. The demand is being fuelled by tighter legal requirements in many industries, an increased awareness of scarce resources and the need for companies to become more energy efficient.

• **For more on developments in tribology, see the article on page 26 of this issue**.

MPs: Skills gap delaying uptake of green technology

The House of Commons Environmental Audit Committee has published a report claiming the current skills gap could delay the uptake of low carbon technology.

Tim Yeo MP, (right) chair of the Environmental Audit Committee, said: "The Government has missed a big opportunity to kick start a green industrial revolution with its £3billon fiscal stimulus.

"At the same time as cutting carbon emissions, we could be boosting employment and putting UK firms at the forefront of the huge global market for green technologies."

The Low Carbon Transition Plan sets out how it aims to decarbonise the economy, but fails to address, according to the committee, the skills that will be needed to put the engineering in place and maintain it.

Many key sectors essential for building a green economy are 'lacking adequate support' and often face 'planning, regulatory and infrastructure barriers', it claims.

The UK has the potential to take a leading global role in a number of low carbon sectors and create a strong home market in offshore wind that could ensure companies are well placed to exploit opportunities overseas.

The committee called on the Government to prioritise green skills under its new skills strategy.

www.parliament.uk/eacom

Doosan Babcock announces carbon capture project

UK based Doosan Babcock has been selected to undertake a project to capture CO_2 for enhanced coal recovery near a power plant in the US.

The initial engineering phase, which starts this month, will provide the Basin Electric Power Cooperative with an assessment to enable it to make a decision on the final project notice to proceed to the CO_2 capture plant solution at the Basic Electric Antelope Valley Station coal fired plant near Beulah in North Dakota. The project will be undertaken in partnership with the Canadian carbon capture technology firm HTC Purenergy.

According to Lionel Kambeitz, the company's chairman and CEO: "In this new project, Doosan Babcock and HTC will provide and integrate world leading

commercial ready carbon capture technology, developed at the University of Regina, in the Basin Electric Antelope Valley Station coal fired plant."

Doosan Babcock is headquartered in Crawley and designs, supplies and constructs advanced steam generation technology for the power industry. It employs around 5,000 personnel.

www.doosanbabcock.com

Software helps to estimate durability

Altair Engineering has launched software that helps to estimate product durability in real world. The aim is to help designers to eliminate weaknesses that may not be immediately apparent from finite element analysis.

HyperWorks Durability Director is integrated into HyperWorks CAE and manages such aspects as: duty cycle specification; system level testing; component analysis; and fatigue simulation.

Rajiv Rampalli, vp software development, said: "Our goal is to allow engineers to focus on improving their product by eliminating error prone manual interventions. Durability Director achieves this by providing a single, comprehensive environment to simplify, standardise, customise and automate the durability process."

www.altair.com

Published list 'omits vital standards'

The list of harmonised standards under the new Machinery Directive 2006/42/EC has been published in the Official Journal of the European Communities. However, crucial standards have been omitted, which will not only cause confusion, will also have serious consequences for machine builders, says Schneider Electric.

Peter Still, the company's industry standards manager, says: "The European Commission has omitted vital standards – in particular EN 954-1, which only last week was given an extended period of presumption of conformity, however it fails to appear in the list. Other even more important standards missed include EN 60204-1, EN 61496-1 and EN 60947-5-5.

"With regards to EN 954-1 continuing into 2010, this wasn't an ideal time to make this decision. Regardless of the rights or wrongs of prolonging its use, the announcement needed to be made several months ago, to allow machine builders some certainty about which standards could be used under the new Machinery Directive. The omission of these standards from the Official Journal leaves machine builders, as well as those that have to enforce the Directive, in a state of confusion.

"My advice for any one involved in machine building would be to use the old standards as guidance, but with no presumptions available they must carefully check the wording of the essential health and safety requirements of the directive to ensure they conform. With these vital standards missing from the list, machine builders need to know that their declaration of conformity is based on their own judgement.

"Enquiries have been instigated to try and resolve this situation and any conclusions will be publicised as soon as they are known."

www.schneider-electric.co.uk
www.bis.gov.uk

AIRCRAFT ENGINE IS PRINTED FULL SIZE IN 3D

A turbo-prop engine, 3m long and with a blade span of 3.2m has been mocked up full size using 188 parts as a demonstration.
Full sized mockups greatly assist studies of assembly, maintenance and look and feel, and the automotive industry makes such mockups out of clay and foam all the time, mostly using old fashioned hand methods.

The mocked up engine in this case was designed by Nino Caldarola, a freelance designer for Autodesk using its Inventor 2010 software and the ABS parts were made using Stratsys fused deposition modelling.

The engine's gear box includes two sets of gears that move in counter rotation to each other. The final assembly, which includes large parts such as the propeller blade, 1.4m long, was exhibited at Autodesk University in Las Vegas in December 2009.

www.autodesk.co.uk
www.stratasys.com

Controllers get connected

Siemens Industry Automation and Drive Technologies has developed four new Simatic S7-300 controllers with a width of just 40mm: the standard controllers CPU 315-2 PN/DP and CPU 317-2 PN/DP and the failsafe controllers CPU 315F-2 PN/DP and CPU 317F-2 PN/DP.

Although they are not as wide, the new controllers with two Profinet interfaces offer considerably more performance and working memory than their predecessors. The two Profinet interfaces enable line structures to be implemented easily and cost-effectively.

The new controllers execute user programs more than twice as fast, meaning bit commands now only require 25 nanoseconds and the time for word, fixed point and floating point arithmetic commands is much shorter than before.

The expanded functions of the integrated web server enable user friendly system diagnostics with automatic page update and a diagnostics buffer for up to 499 entries. What is more, the graphical representation of the Profinet IO topology has been revised. This offers a detailed tabular display of the module status of the connected Profinet stations and a direct link to their web servers.
www.siemens.co.uk

PLASTIC COMPOSITE COMPRESSION SPRINGS

Lee Spring has developed a suite of compression springs produced in a plastic composite. Called LeeP, the springs have been developed in response to customer requests for springs that combine the strength of metal with the special attributes of high performance engineered thermoplastics.

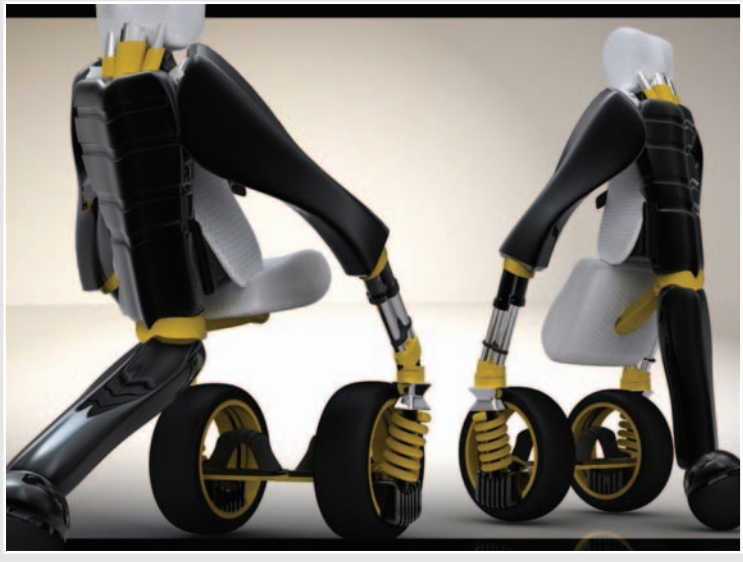
Manufactured in Ultem polyetherimide (PEI) resin, different formulations will be used to meet or exceed performance criteria. PEI was chosen following years of engineering design and materials research by the company's technical team. LeeP plastic composite springs will be available in a variety of standard sizes and six colour coded strengths: red, orange, yellow, green, blue and violet, the strongest. Custom design options to meet precise performance requirements will also be offered.
www.leespring.co.uk

Solution to last month's coffee time challenge

One of the best designs for last month's coffee time challenge – to come up with a better wheelchair design – comes from Jake Eadie, an Australian design engineer. His concept, Modiv, recently won a James Dyson Award for design.

The concept allows the user to go between sit and stand modes. The wheelchair, which is powered by electric motors, also uses an electric actuator to operate a mechanism that moves the wheelchair from a sitting down to upright position. The ride quality of the wheelchair has also been considered and larger tyres on the wheels and sophisticated suspension configuration will allow for a smoother ride. The three wheel configuration will also allow for greater manoeuvrability.

Eadie plans to construct the wheelchair from lightweight materials and is currently looking for manufacturers to take the design into production. It does, however, still have some limitation in terms of climbing stairs and has a larger space envelope. However, Eadie is looking to address both of these issues in the future.



Save carbon, save

Photos: Charlie Milligan

money

The man managing many of the UK's most prominent low carbon technology projects talks to Justin Cunningham about the need to reduce emissions

When it comes to tackling climate change, the consequence of doing nothing far outweighs the consequence of action. But for most design engineer's action means expense.

This is part of the daily battle for Dr Robert Trezona, who is currently head of research and development for the Carbon Trust. Part of his role is to introduce and steer clean technologies toward the mainstream. But despite strong moral, ethical and green arguments, he finds that for many firms – especially at the current time – it is the economic case that is most compelling.

"Ultimately, the Carbon Trust's aim is to make low carbon technologies economically viable," he says. "And a lot of what we do can – and is – saving firms money. Smart meters, for example, are a big area of growth and we did some field trials that showed installing one for a few hundred pounds has a big effect on energy usage for a variety of different business types. Typical savings were over 5%."

He cites a firm that trialled the technology and almost immediately found that its two identical production lines were using different amounts of energy. This made them aware that maintenance was needed on one of the lines and essentially reduced the firms' energy bill.

"Minimising carbon emissions needs to be at the forefront of the design process and should be a key driver, right from the outset," he says.

And although engineers are more frequently designing for lower 'point of use' energy consumption and for greener disposal, it can often be a bit of a black art to calculate the carbon embedded in a product during its manufacture, and its 'total lifecycle emission footprint'.

Dr Trezona says that minimising 'embedded carbon' in products needs to become a key factor in the design process. Embedded carbon is the amount of carbon emissions produced during manufacture and includes the energy used to make fasteners, raw materials, run the production machinery; basically everything.

The Carbon Trust is trying to get all levels of the supply chain to assess 'embedded carbon'. The aim is that each and every process, material and component will have a corresponding carbon and green house gas emission and this information can be passed up the supply chain as a product comes together, from the raw material, to the machining, to the sub assembly, and then full assembly stage.

Assessing the lifecycle carbon footprint is becoming increasingly important and Dr Trezona states the need to develop simple ways of carrying out lifecycle analysis throughout the supply chain. That makes

Principles of green and sustainable design

While the practical application of these principles varies among disciplines, here are some common pointers that should be implemented to minimise a products' impact on the environment.

Use low impact materials. This means the use of non-toxic, sustainably produced or recycled materials, which require less energy to both produce and process. Where possible, source locally.

Design for manufacture. That means designing for the optimum energy efficiency during a product's production. This does not necessarily mean compromises on quality, throughput or materials; but look for alternatives and new developments coming to market that offer better environmental credentials than the accepted industry norm.

Optimise product durability. Longer lasting and better functioning products have to be replaced less frequently, reducing the impact of producing replacements. While this may seem counter intuitive, as customers may never buy replacements, this has been shown to encourage product innovation and increase brand reputation, while encouraging customers to buy more products from the same company.

Design for reuse and recycling. More and more materials, products and industry sectors are having to comply with legislation about end of life and disposal and this is likely to be a trend that will eventually cover almost all of industry. So designing for end of life and disposal is becoming increasingly important and this should be at the forefront of the design process.

Assess your carbon footprint and do a life cycle assessment. Standards such as the Carbon Trust's PAS2050 are likely to be introduced in many industrial sectors, requiring firms to calculate the total carbon footprint and life cycle assessment of a product or process. At the moment, these are incredibly complex and it is often difficult to get a good assessment. But try to calculate what your part of the process adds to a product in terms of embedded emissions. This is likely to have to be done soon and it could yield a helpful insight about how to improve your processes.

Sustainable design standards and project design guides are also increasingly available and are being developed vigorously by an array of private organisations and individuals. There is also a large body of new methods emerging from the rapid development of what has become known as 'sustainability science', promoted by a variety of educational and Governmental institutions.

Work in a 'green' space. This is probably outside the control of most design engineers, but buildings produce a tremendous amount of carbon; most of which can easily be reduced. Insuring that boilers are well maintained, minimising air leaks on pneumatic systems, having good lighting and insulation all make a big difference.

it easier for firms to assess what its processes add in terms of embedded carbon and green house gas emissions.

Dr Trezona says: "The Carbon Trust has developed PAS 2050 which is trying to encourage firms to do just that."

The Publicly Available Specification (PAS) is designed to be a standard method for measuring the embodied carbon and greenhouse gas emissions from goods and services. It has already been extensively used as the foundation of the Carbon Trust's Carbon Reduction Label.

"The process is designed to be open and consultative and it takes into account current best practice of measuring embodied green house gas emissions of products and services. We needed to do this in order to develop a credible method that is practical for organisations to use," he says.

The Carbon Trust also has a number of accelerator programs that aim to stimulate low carbon technological development. The current list of large projects includes the development of offshore wind installations, advanced biofuel production, the roll out of marine technology (wave and tidal stream), reducing the cost of advanced photovoltaics, polymer fuel cells, facilitating the uptake of biomass heat, reducing the carbon footprint of buildings, as well as introducing microCHP and smart metering to the mass market.

"The UK is facing a massive challenge to increase its proportion of renewable energy," says Dr Trezona. "We have a directive from the European Union to reduce our emissions and it is a very challenging target. We can do it but really most of the reduction will come from cleaner electricity generation and that will need a lot of offshore wind.

"That is our single largest activity at the moment. The big issue is cost, not just of the actually kit, but the installations and required maintenance."

To help make the reduction of green house gases and carbon emissions, Dr Trezona says that there needs to be a stronger carbon pricing signal. While the European Union's Emissions Trading Scheme has been in operation since 2005, at the moment the cost of carbon remains relatively low.

"Ultimately, the Carbon Trust's aim is to make low carbon technologies economically viable."

"Carbon trading must become a real and significant factor for industry," he says. "It needs to become enough of a driver that design engineers are thinking about it from the outset. We see really big potential for the UK to use its engineering heritage, great academic strength and flexible economy to make a major contribution to rolling out these technologies globally.

"We are nearly there with onshore wind, we have the most installed wind capacity in Europe but the UK could do more and gain a lot more from exploiting this potential. We need better focus and investment, and need to leverage the natural resource advantages that we have."

Dr Trezona is passionate in his cause and argues the potential catastrophic effects of ignoring the effects of rising carbon levels and climate change is just not viable. He concludes: "Wind turbines will certainly be a lot prettier than the consequences of climate change."

www.carbontrust.co.uk

The catalyst for clean energy

Dr Robert Trezona, head of research and development at the Carbon Trust, is a material scientist by training and has a PhD from Cambridge and has been working on low carbon technologies since 2000.

He started out working on fuel cell catalysts for Johnson Matthey. "It was a large well funded corporate organisation and was just beginning to commercialise what it had been doing with fuel cells for the last 10 years, and then turn that into an entrepreneurial company."

His work focussed on the catalyst layer of the fuel cell. "Catalysts used in fuel cells are often precious metals, but it is about getting the best use out of the material, not necessarily finding a lower cost alternative," he says. "Even today, 80% to 90% of the platinum surface area is not active and not doing anything. So there is the challenge to improve this."

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www.autodesk.co.uk/beyond3d

Image courtesy of Prensa Jundiai, Brasil

Challenging the conventional view

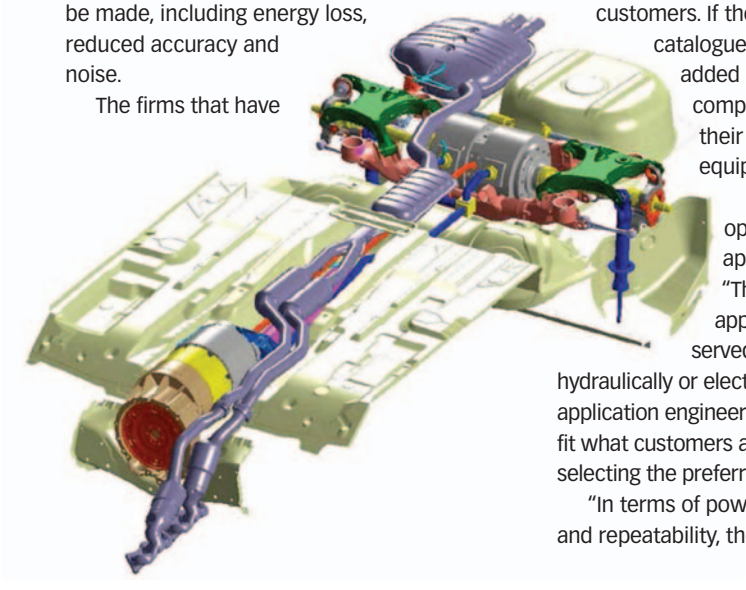
New methods of transmitting power and storing energy mean traditional approaches may no longer be best. Justin Cunningham reports.

There are many methods of transmitting and storing power, all of which have pros and cons, depending on the application. But, as new ways of doing things evolve, many of the accepted norms are being challenged.

It is often the case that design engineers will choose technologies of which they have experience. But it is always worth keeping an open mind and finding the best method of power transmission and energy storage for a given application.

SKF project manager Mike Naismith says: "Design engineers should recognise that each technology has its own strengths and weaknesses and these will vary, depending on what the application is and what the end customer actually wants."

Pneumatics have long been used by machine builders as their preferred solution to providing actuation and movement. Pneumatics is a simple, reliable and low cost technology which gives excellent power availability in a relatively small space envelope. But its use does mean compromises have to be made, including energy loss, reduced accuracy and noise.



The firms that have a traditional backbone in pneumatic actuation are not turning their backs on the technology. However, many feel that a transition towards an electric or hybrid solution is inevitable as industry looks to reduce energy consumption and improve accuracy, while maintaining good power availability.

There is a trend beginning to emerge and many machine designers are increasingly looking towards electrical actuation as an alternative. But many machines need the power delivered by pneumatics and, as attractive as increased accuracy maybe, they cannot compromise on that front.

This has led a number of companies that have traditionally specialised in pneumatic actuation to consider developing hybrid systems. The idea here is to combine the power of pneumatics with the accuracy of electric systems.

As a result, several companies are either increasing their offering of electronic actuation or are introducing hybrid systems. SKF, Festo and SMC have all experimented with the use of hybrid systems to provide bespoke systems for customers. If these have not yet become catalogue parts, they are likely to be added in the near future. These companies have also increased their ranges of electric actuation equipment products.

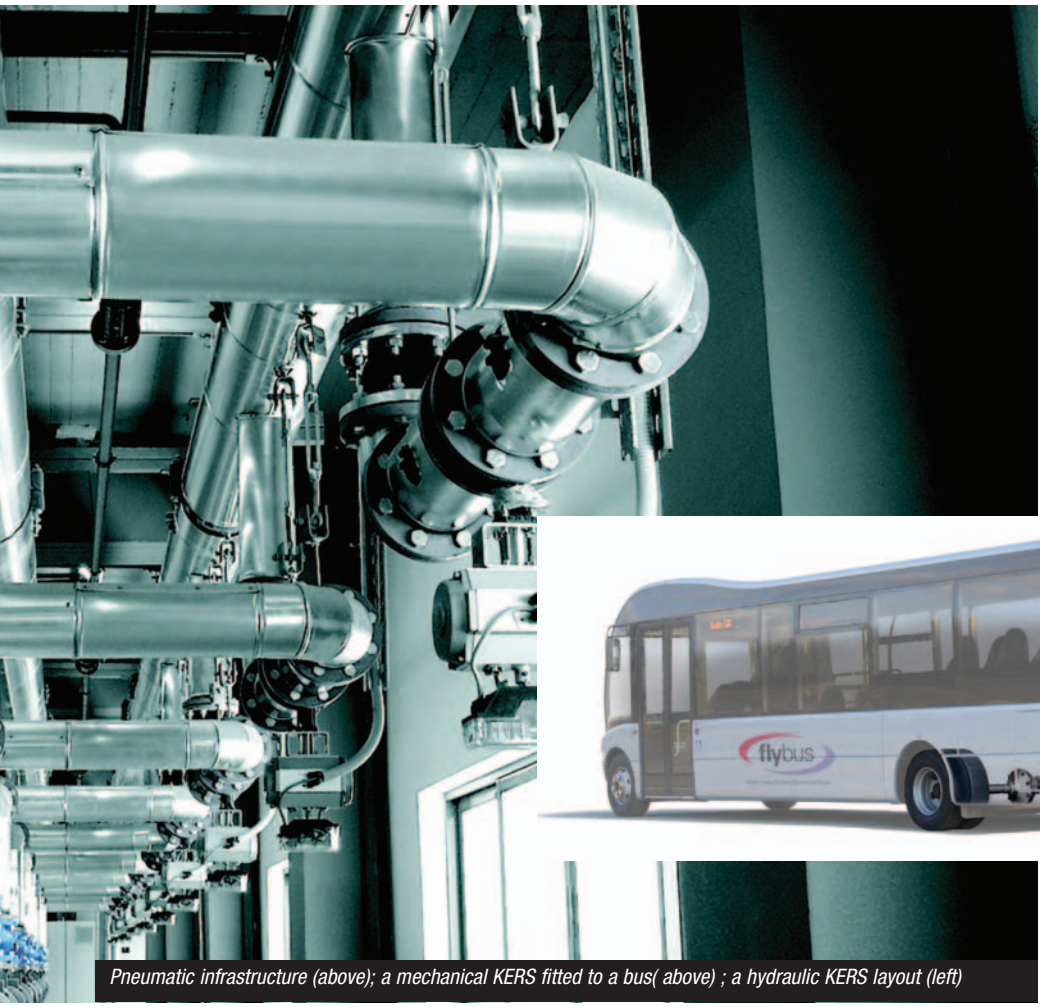
"An electromechanical option will still not fit every application," says Naismith. "There are likely to be applications that are far better served pneumatically, hydraulically or electrically. It is a matter of application engineering: creating the solution to fit what customers actually want to achieve and selecting the preferred technology for the job.

"In terms of power on demand, accuracy and repeatability, then this is done better electrically. But for really high levels of thrust, you go for hydraulics."

Although full electric actuation is a more expensive option, the price has dropped significantly in recent years and the 'through life' cost is actually less than a pneumatic solution. While power availability is not yet at the same level as pneumatics, it is sufficient for many tasks and will give machines better accuracy and controllability of movement. High accuracy is becoming increasingly important for many machines as companies seek to improve build quality to add value to processes.

And another area of potential change is in energy storage for automotive kinetic energy recovery systems (KERS). At present, most hybrid technology in production, or close to it, is based around the use of batteries. These can be spread around a vehicle to help with weight distribution and can extend fuel efficiency by as much as 30%.

However, the drawback is that battery



Courtesy: Festo

Pneumatic infrastructure (above); a mechanical KERS fitted to a bus(above) ; a hydraulic KERS layout (left)

packs are heavy and take up a lot of room. Many feel that there is still a lot of room for improvement for battery technology and this has spurred the development of alternative approaches.

The first, and perhaps most likely, to be integrated onto mainstream vehicles, is a mechanical flywheel. Several systems have so far come to market and won accolades from the automotive world. Flybrid Systems uses a flywheel that rotates at more than 60,000rpm in a sealed vacuum. The unit is small and can easily be integrated into vehicles.

And Ricardo recently announced it has developed a mechanical KERS called Kinergy, which avoids using a vacuum pump and is designed to achieve a 30% fuel reduction with a fitted cost of less than £1000. These products are very close to production, with both Flybrid and Ricardo working closely with OEMs to get the technology in to production models and on the road.

"Mechanical hybridisation using Kinergy based systems offers the prospect of enabling a wide range of energy management solutions including low carbon vehicle powertrain for applications where electric hybridisation is not considered to be cost effective," says Ricardo group technology director Neville Jackson.

But there is a growing school of thought that hydraulics could be used as a vehicle KERS device. Hydraulic systems traditionally suffer from parasitic losses, which account for up to 50% of the energy transmitted to be lost. But two companies claim to have overcome the problem and are claiming fuel savings of up to 50%.

The first is motion and control technology specialist Parker Hannifin, which announced in 2009 that it had developed a hydraulic hybrid system. Don Washkewicz, chairman and president of Parker, says: "The commercial application of our technology is recognition that our system has demonstrated several advantages over electric hybrids, including significantly better fuel efficiency."

Field testing during the past year has indicated that the system is capable of generating as much as a 50 to 70% increase in miles per gallon in 'stop and go' applications when compared with traditional diesel powered vehicles with automatic transmissions.

The second system is from Artemis Intelligent Power (AIP), which has developed a clever digital displacement technology that eliminates most of the normal associated losses. Tests on a BMW 530i showed that fuel efficiency over a typical town drive cycle was improved by some 50%. And the company is now exploring the possibility of using the same technology on wind turbines and other renewables.

As AIP's digital displacement technology is easily scalable, it can be used to smooth out the intermittent power generated by renewable energy sources. This is particularly apt for wind turbines and the company is currently trialling the technology in conjunction with the Carbon Trust. The technology is also being trialled with wave power generating device Pelamis.

Waverley Cameron, chairman of Artemis Intelligent Power says: "The Artemis Digital Displacement technology will provide cost effective solutions to some of the most challenging engineering problems facing the large scale deployment of offshore wind, wave and tidal power generation."

Despite the preconceptions, power transmission and energy storage systems are evolving and are increasingly overlapping and finding new applications as new materials, bearing technology and control systems are used to optimise efficiency and minimise losses. It is up to design engineers to find these applications, to push the technological boundaries and to make sure the best and most applicable system is always used.

www.skf.com **www.festo.com**
www.smc.com **www.aip.com**
www.flybrid.com

Where British is best

The UK is an epicentre for innovation and creativity. Tom Shelley reports on why this is key for long term prosperity

Despite what one might read in less well informed elements of the press, British engineering expertise has never been rated so high because of its inventiveness and because of its impartiality, meticulous attention to detail and integrity.

There are products that it would appear that only British minds would think of, many of which start out in the UK defence community, and there are research organisations and small companies that are either owned or carefully cultivated by foreign companies.

Many regret that Britain is no longer 'the workshop of the world', with its smoking factories in the Midlands and the North of England that turned out much of the world's industrial goods. But do we really want to try to compete with sweatshops in the Far East or would we rather solve the world's design problems and earn a somewhat greater income by doing so?

Typical of the UK's approach to using ingenuity to solve customer problems are machines for the food and packaging industries. Machine builder Jenton International has devised equipment to test the integrity of food packaging trays. The system pushing heads down onto thermoformed trays with sealed covers and measures the resistance of the nitrogen gas sealed inside.

Jenton technical director, Ross Sion, says: "Our machine is very different to most others, which usually works by pushing down a head to a known height and assumes the same amount of gas and food is in each tray. But not all packets are going to be perfectly uniform and, historically, seal testers haven't been much use because machines reject good packs.

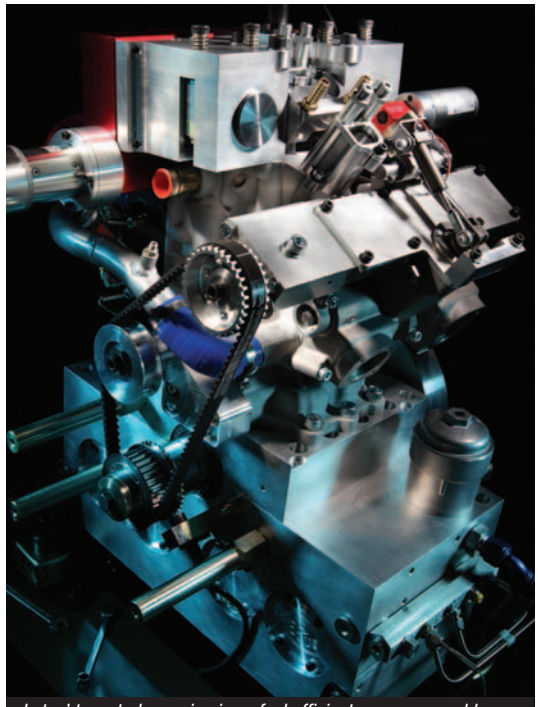
"Our machines use heads which come down and test the dynamics of a food packet by measuring the settling time. This approach is not only more accurate but also it can cope with a much greater range of packs and seals."

In the defence sector, design engineer Mike Tarbard of e2v technologies says the company's ruggedised Argus infrared camera allows what is being detected to be remotely seen by others via a wireless transmitter.

As it was originally developed for a military application, the connection is very secure and robust, and as such it is increasingly finding non military applications. Fire brigades are using it to better co ordinate the fighting of large fires. It is also useful for those concerned with security problems to remotely assess a threat. The most recent application is detecting attacks by pirates on large container ships.

Automotive engineering expertise generally is also alive and well in the UK and, apart from the work at Ford's Dunton Engineering Centre, quite a number of major world class automotive organisations take problematic design issues to Lotus Engineering in Norfolk and Ricardo in Sussex.

The two stroke Lotus Omnivore engine serves as a good example of this unique and distinguished capability. Two strokes are traditionally very polluting, but at 2000rpm the 499.6cc Omnivore produces only 20ppm NOx emissions. The hydrocarbon and carbon emissions produced are roughly equivalent to four stroke engines. Yet, two stroke engines are inherently smaller and lighter and the Omnivore is designed so it can run on alternative fuels such as ethanol and methanol, hence its name.



Lotus' two stroke engine is as fuel efficient as a comparable four stroke device

The engine is a monoblock, with no removable cylinder head or gasket. This reduces the possibility of cylinder distortion by head bolts, and achieves a variable compression ratio by using a 'puck' – a moveable piston in the cylinder head which is driven in and out by a double eccentric mechanism. Although it is a research and development engine, initial results look very promising with the test engine achieving a 10% improvement in fuel consumption compared to stratified direct injection engines.

Ricardo, on the other hand, has been working with leading defence research contractors Qinetiq to produce lower cost lithium ion batteries for use on electric and hybrid vehicles. It has just completed a two year project to reduce the cost of lithium ion technology and make use of prototype battery cells developed by Qinetiq. These use an iron

Design Pointers

- British design and inventiveness remains second to none
- Foreign companies consult British design and R&D teams not only because of their inventiveness, but also their impartiality, meticulous attention to detail and integrity
- UK engineers are also particularly good at finding better solutions to problems and finding new applications for existing technology.
- The transfer of technology out of the defence and oil and gas sector is prolific in the UK and it is exploited globally

sulphide based chemistry which can be cycled more than 1000times without much loss of performance provided the battery is not run completely flat.

This means that the battery cells have to be carefully managed. Ricardo has devised a battery management system, which it says, is fully adaptable to a range of cell chemistries and battery architectures. The pack includes a number of innovations to improve performance and reduce cost.

Ricardo group technology director Neville Jackson says: "By combining lithium ion battery cell chemistry with our innovative battery management system, we have demonstrated that iron sulphide based cell chemistry is a viable energy storage solution for hybrid vehicles."

Mark Roberts, strategic market team director of energy and environment, at Qinetiq says: "Not only could this improve performance in existing hybrid electric vehicles through reduced cell size and weight, but also make all electric vehicles a more credible proposition by increasing range. And because iron sulphide battery cells are cheaper to produce than traditional cobalt based battery cells, lower production costs could make hybrid and all electric vehicles much more affordable in the future."

UK engineers are good at finding new markets for technology

Another area where the UK reigns supreme is doing consulting design work for the oil and gas sector, and to some extent, the nuclear sector. The reason people come to Britain is that the design work is competent and completely impartial. British designers do not favour products from any country; they look for best value wherever they can find it in the world.

A good example in the nuclear field is by Nuclear Engineering Services headquartered in Wolverhampton. It has undergone growth of 300% since 2003 and is anticipating further growth of 20% year in year. The company uses Pro/Engineer, AutoCAD, Autodesk Inventor, PTC's ProductView and Windchill PDM Link and a range of finite element packages in its design work, but what is particularly is the way all the design decisions are audited and how they ensure that everything is done by suitably qualified and experienced personnel. It is this kind of thoroughness and reputation for integrity that also attracts major oil and gas companies to come to UK institutions.

When expertise is built up in a particular sector, it can be made use of in what may not be immediately obvious ways. An example of a spinoff from the UK's offshore industry that has the potential to grow is a personal, recreational submarine.

The submersible has been designed and developed by former offshore engineer Robert Leeds. He says that his concept began in the 1980s when he was working in the Middle East inspecting offshore and harbour structures, and on returning to England in 1993, he formed a small company, Subeo, to develop a suitable, reliable, and not too expensive underwater craft.

The production version will seat three, one of whom is expected to be a qualified pilot of the vehicle. The sale price is to be £390,000, which is a lot less than other commercial submarines currently in production. And, Leeds says, he could easily engineer it to go down to 300m and fit it with manipulators if somebody wanted it for serious work purposes.

However, what this really demonstrates is the enormous inventiveness and ingenuity of British engineers and engineering. But, steps have to be taken to protect our intellectual property, since it is evidently the UK's greatest asset, and to ensure that young people have a smooth path into engineering career and are encouraged to follow it. However, overall, if the UK's future is in innovative engineering design - as many believe it is – then the UK has a pretty solid platform from which to launch.

www.jenton.co.uk
www.e2vtechnologies.com
www.argusdirect.com
www.lotuseng.com
www.ricardo.com
www.subeo.com

Ingenious sensor takes inspiration from a fly

A tiny parasitic fly has helped BAE Systems to build a cutting edge optical imaging system with a field of view six times bigger than the cameras it is designed to replace.

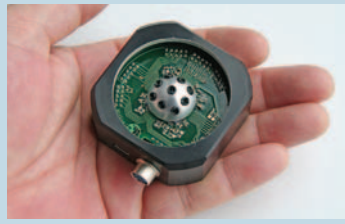
'BugEye' – about the size of a sugar cube – was developed by scientists at the company's Advanced Technology Centre (ATC). The project called for smaller, lighter cameras for missile tracking systems and wanted a lightweight device that could view 120° of sky to replace heavy, gimbal mounted equipment which can only cover 20° without being moved.

The ATC team spent six months studying insects' eyes to see if nature could provide a solution. They found one in a microscopic fly – the eye of the male xenos peckii has about 50 separate lenses and can see and process a very wide field of vision.

The individual images in each lens in the fly's eye are upside down, but the fly rearranges this in its brain. The ATC used computer software to perform a similar job. BugEye has nine lenses. The images from them are passed through a faceted, polished fibre optic faceplate, focused down onto one focal plane sensor, similar to that of a video camera, then stitched together and corrected by image processing software so that they are the right way up.

The result is a clear, wide angle panorama that can be viewed on a video screen. Further uses for the technology are being explored, including applying this process to night vision equipment for soldiers. It also has potential for use with CCTV cameras in public places and shops and if reduced in size, could be used for keyhole surgery.

www.baesystems.com



Nanofibres spun out in bulk

Tom Shelley reports on a process to produce exceptionally fine polymer fibres for a variety of purposes

Czech based manufacturer Elmarco is supplying machines that can mass produce nanoscale plastic fibres. The strands of materials, which are between 50 and 500nm in diameter, are being used for numerous commercial applications, but are showing potential for a host of industrial applications, including fuel cells, solar cells, and fibre reinforcement to produce super strong composites.

The technique, which has been given the name Nanospider, allows the production of very fine fibres at significantly lower cost compared with previous manufacturing methods. The technique uses electrostatic energy to produce streams of polymer from a rotating electrode partially immersed in a polymer dissolved in water.

Fibres used to be produced by pumping solutions through single needles or a spinnerette, with an electrostatic force being used to help to draw out the fibres. Although the Nanospider technique does require a higher voltage – 30 to 140kV versus 5 to 20kV – it can produce many more fibres at a time from solutions that often contain 15% polymer. And there is never a problem with small holes becoming clogged or blocked during the process.

The process can be adapted to a range of solutions, such as poly vinyl alcohol, polyethylene oxide and various biopolymers. It has already been used to spin chitosan – a biodegradable polymer used in various medical device products – and has also been suggested as a means of spinning synthetic spider silk, which has long been a desirable material to artificially reproduce.

Key account manager for Elmarco Peter Sedo says: "Its use of fibres in filters is now fairly common. You only need a very thin layer of fibres, typically around a micron thick, supported by existing media."

Elmarco has carried out some work with US company Clark Filter for the inclusion of fibres on its filters for environmental dust collection and various automotive air intake filters. It has also carried out work with HemCon Medical Technologies for its wound dressings. The nano fibres can also be very effective for thermal and noise insulation.

In addition, a number of applications which could benefit from using the technology are being investigated . Field tests of fibres in dye sensitised solar photovoltaic cells are underway. Sedo says: "Titanium dioxide is mixed into the polymer solution and fragments of fibres, which are then incorporated into the cells. Burning off the polymer leaves an exceptionally fine and open matrix of oxide particles."

Similar thinking is being applied to making better fuel cell membranes and advanced composite materials. Because there can be up to three spinning heads with independent chemical distribution systems in the current generation of pilot machines, it is possible to produce threads of up to three different polymers at the same time.

www.elmarco.com
www.clarkfilter.com
www.hemcon.com

Design Pointers

- Process produces a mass of polymer fibres 50 to 500nm in diameter, depending on process
- It works with PVA, PEO and biopolymers dissolved in water or PA6, PA6/12 and other synthetic polymers dissolved in solvents
- The technique is widely used in Europe, Japan and the US for high performance filters and wound dressings, but is fairly new to the UK

A clear future for plastic bonding

Tom Shelley reports on a fast way of joining plastics and synthetic fabrics, especially those that are transparent

Design Pointers

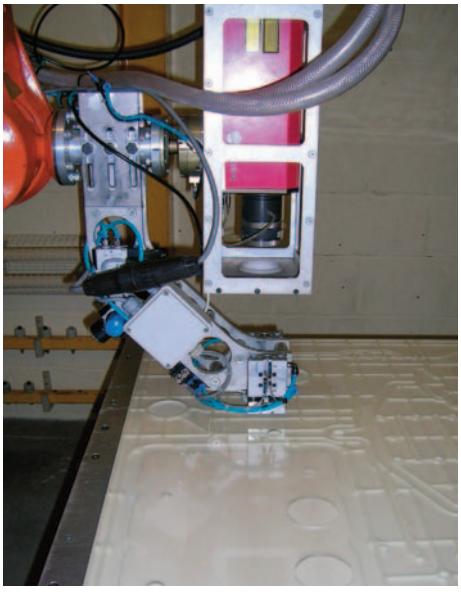
- The process allows the rapid joining of a wide range of transparent and lightly coloured plastics, without producing visible joints
- It produces sound joints, without vibrating or otherwise stressing the component parts, and can be used to 'stitch' synthetic polymer fabrics
- Many commercial applications have been found, but others continue to be added and the processes continue to be improved.

Transparent and lightly coloured plastics can be welded together by laser, with invisible joins, if a near infrared absorbing ink-like material is used at the interface.

The process was invented some ten years ago at TWI and subsequently licensed to a US defence firm. However, it is now being used by numerous other companies that make a variety of components.

Inventor Ian Jones says: "The infrared absorber is either coated on the plastic used for one side of the joint or built into one of the plastics, where it provides a means for localising the heat. The infrared absorbing layer only has to be 100nm thick to absorb 94% of the incident thermal energy."

However, the process and joining ink has since been sublicensed to various other companies, including Leeds based Barkston Plastics, which is the sole licensed distributor in the UK.



Barkston's marketing manager Jo Dell says: "Traditional joining methods work well for some clients, but not all. For example, adhesive bonding can degrade, requires long curing times and creates aesthetic problems. We also found that design improvements could be made by moving away from hot plate welding and heat treatments."

Laser welding allows precise control of manufacturing parameters, provides stronger hermetic seals compared to other joining methods, reduces the risk of mechanical and thermal stress, and avoids vibration. The process allows parts to be preassembled, enables high weld speeds and the making of three dimensional contour joints. It is suitable for mass production, small batch work and product development.

The technique also has the advantage of avoiding possible vibration damage caused by ultrasonic welding and the build up of welding beads: a problem associated with hot gas welding. And, Dell claims, the clear weld produces superior weld strengths and speed.

"Using laser welding," Dell says, "we are able to produce spot and seam welds in the micron range, even in hard to reach places. Sensitive components, previously impossible to weld with other processes, can be joined, enabling new product designs that were impossible or uneconomic beforehand.

"One example that we have manufactured is a new, improved oil reservoir as well as sensors, filters, tube connectors, micro-fluidic devices, oil tanks, infant incubators, isolators, bottles and containers, industrial batteries and micro fluidic 'lab chips'."

Dell also noted the process has been to join together dissimilar materials, both clear and coloured, including almost all thermoplastic materials.

Other applications that Jones mentions include electronic packaging, where components have to be hermetically sealed, and textiles that need to be stitched together by pulsing a laser on and off.

As well as waterproof clothing, the process allows the manufacture of automotive air bags from component parts, instead of their having to be made from more expensive, single pieces of woven fabric. It is also now, apparently, being used to make Italian designer furniture and ink containers for computer printers.

Jones says: "We are still doing research work, mainly for specific applications, and developing new welding procedures using the process."

www.twi.co.uk
www.clearweld.com
www.barkstonltd.co.uk

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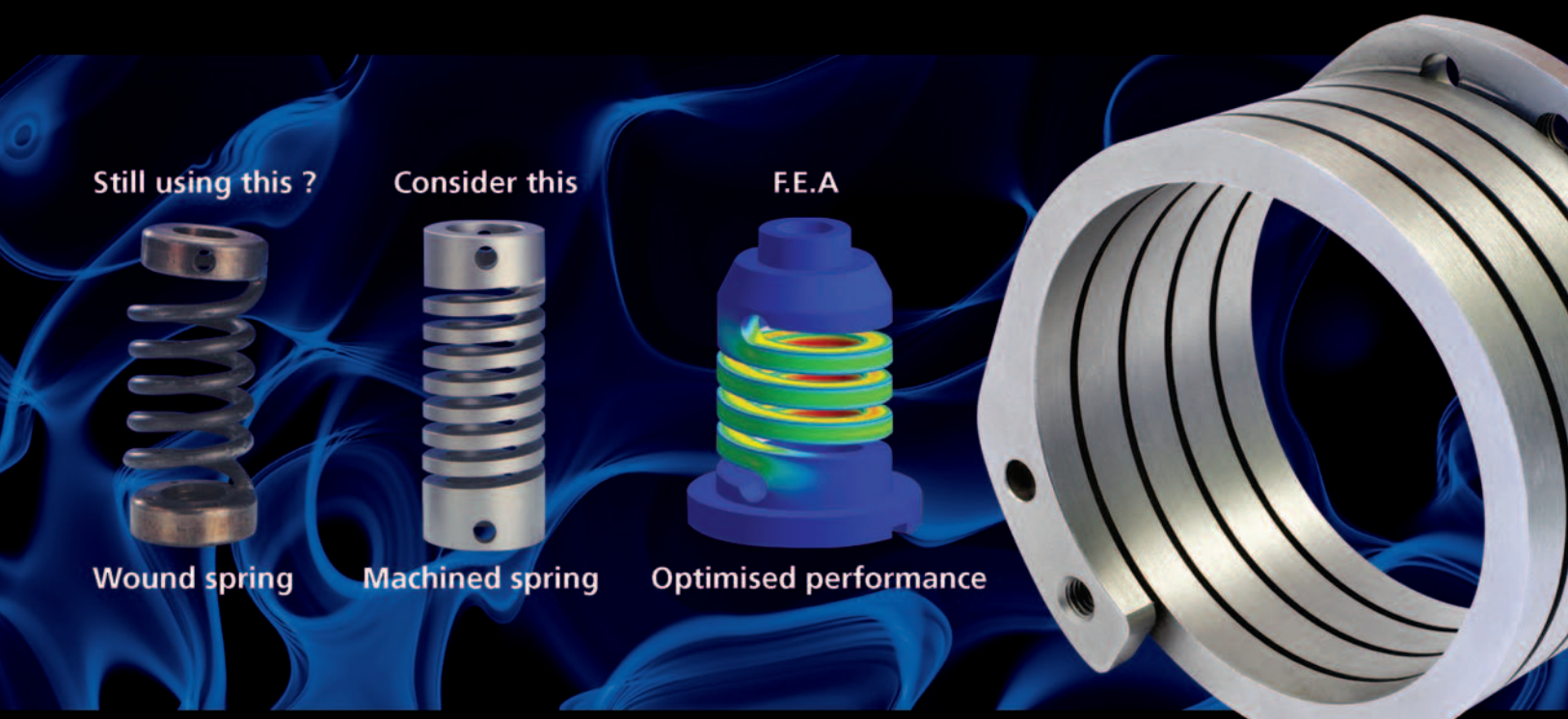

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Rendered images update in moments

Tom Shelley reports on a software development that will be of great benefit to all those who have to produce high quality photorealistic images of products

Substantially quicker rendering allows engineers to try more design variations in order to make sure their products always look right

Visual appearance has never been so important and is the key to success in the modern marketplace for almost all products.

Looking to address this issue, Cambridge based ArtVPS has developed software that greatly accelerates the production of high quality rendered images of products designed on CAD programs. Called Shaderlight 1.0, the package allows designers to change colours, textures and lighting virtually instantaneously.

The aim is to allow designers to investigate the look of products more fully and to not have to wait for rendering to be processed. This is a laborious process, which can sometimes take hours, only for the designer to realise the colour or texture may not work.

Shaderlight, which is aimed at vehicle design and consumer durables, can allow products to be placed in a suitable virtual background scene. This produces the best possible images in the least amount of time and should be useful for product review and revision, before commitment is made to prototypes or full scale production.

Shaderlight includes two major capabilities that have not been seen before in photorealistic rendering software.

The first is the creation of images based on Voronoi cells, allowing a first impression of how a scene will look before it is rendered fully, so it can be changed quite radically without loss of time before being fully refined. The second is the use of what the ArtVPS' chief technology officer Michael Lawson described as 'Intelligent pixels'.

He says: "These relate to the 3D world in terms of materials and lighting. If you change their properties, they update automatically."

He continued: "The development came about because rendering as a whole has been something of an arms race, but nobody asks the artists what they want. So we did.

"Even when the render has finished, we can still make changes."

A rendering of a BMW car in an outdoor setting can have its seat fabric changed instantly, and that takes into the account the fact that the relevant pixels were behind glass windows.

"This is possible because every pixel knows its relationship to every other 3D object. If an object is changed, so too are all its reflections," Lawson explains.

At the moment, the software is able to render models imported from Autodesk 3ds Max.

"We are also planning to work with other CAD programs, but we haven't finalised which ones just yet," says Lawson. "At present, it only makes use of computer CPUs. We have very firm plans to pursue graphics card processing units, but using non proprietary technologies."

One of the reasons for its speed is that Shaderlight uses as much RAM as is available to the system. This does mean that less RAM slows the rendering process, but Shaderlight is still considerably faster than the competition.

Automotive, consumer product design and architectural are the initial target markets, but the software will be appropriate to anyone engaged in serious product design. In its present version, it is available to download from the company's website for $895.

www.artvps.com
www.autodesk.com

Design Pointers

- Initial rendering is in Voronoi cells, so there is no need to wait for a full render if the first attempt at an image is clearly going to be unsatisfactory
- Because of the software's use of Intelligent pixels, colours, textures and lighting can be changed almost instantly, without the need to re-render
- The software presently only works with Autodesk 3ds Max, but it is planned to add the facility to work with models imported from other CAD packages

CFD moves into the design mainstream

Tom Shelley reports on how CFD analysis is becoming more generally available through its integration into mainstream CAD packages

BUB 7 undergoing wind tunnel tests. A slight change in the aerodynamics increased its speed by 8mph

Although the use of computational fluid dynamics (CFD) to optimise designs is not new, it has often been left to a specialist to carry out the analysis and interpret the results.

However, the trend now seems to be that more generalist engineers are making use of the analysis as it not only becomes available within mainstream CAD, but also more intuitive.

This approach is saving a lot of time, not only in the design of ordinary products, but also in pushing the limits of what is possible. Although the analysis does, perhaps, not give results as detailed as maybe obtained by specialist packages, it does act as a compass for generalist engineers to follow.

This approach has been particularly useful to the Bub Enterprise racing team, whose BUB 7 Streamliner recently set a new motorcycle land speed record of 367.382mph on the Bonneville Salt Flats in the US. While the team exceeded the previous record by just 8mph, it owes much of this performance gain to superior aerodynamics analysis. The vehicle was designed using SolidWorks, with analysis carried out using SolidWorks Simulation, including the use of the Flow Simulation software.

Bub Enterprise's chief executive Dennis Manning says: "The last thing we did before the run was to make an eighth of an inch change to the aerodynamics and that made all the difference."

The Flow Simulation software within SolidWorks has, in fact, been written by what is now Mentor Graphics' Mechanical Analysis Division, formerly known as Flomerics. Dr Erich Bürgel, general manager of Mentor's Mechanical Analysis Division, says: "It is not just available in SolidWorks, but also in Pro/Engineer and CATIA V5, with NX and Autodesk Inventor implementations under construction." Bub Enterprises also uses flow simulation software within SolidWorks, called FloEFD, to analyse its commercial motorcycle exhaust systems.

Dr Bürgel showed the software being applied to the design of a Fischer plastic ball valve. The analysis identified recirculation caused by a sharp edge adding a sharp pressure drop. The problem was eliminated with a fillet, which is something the design engineer would know to do.

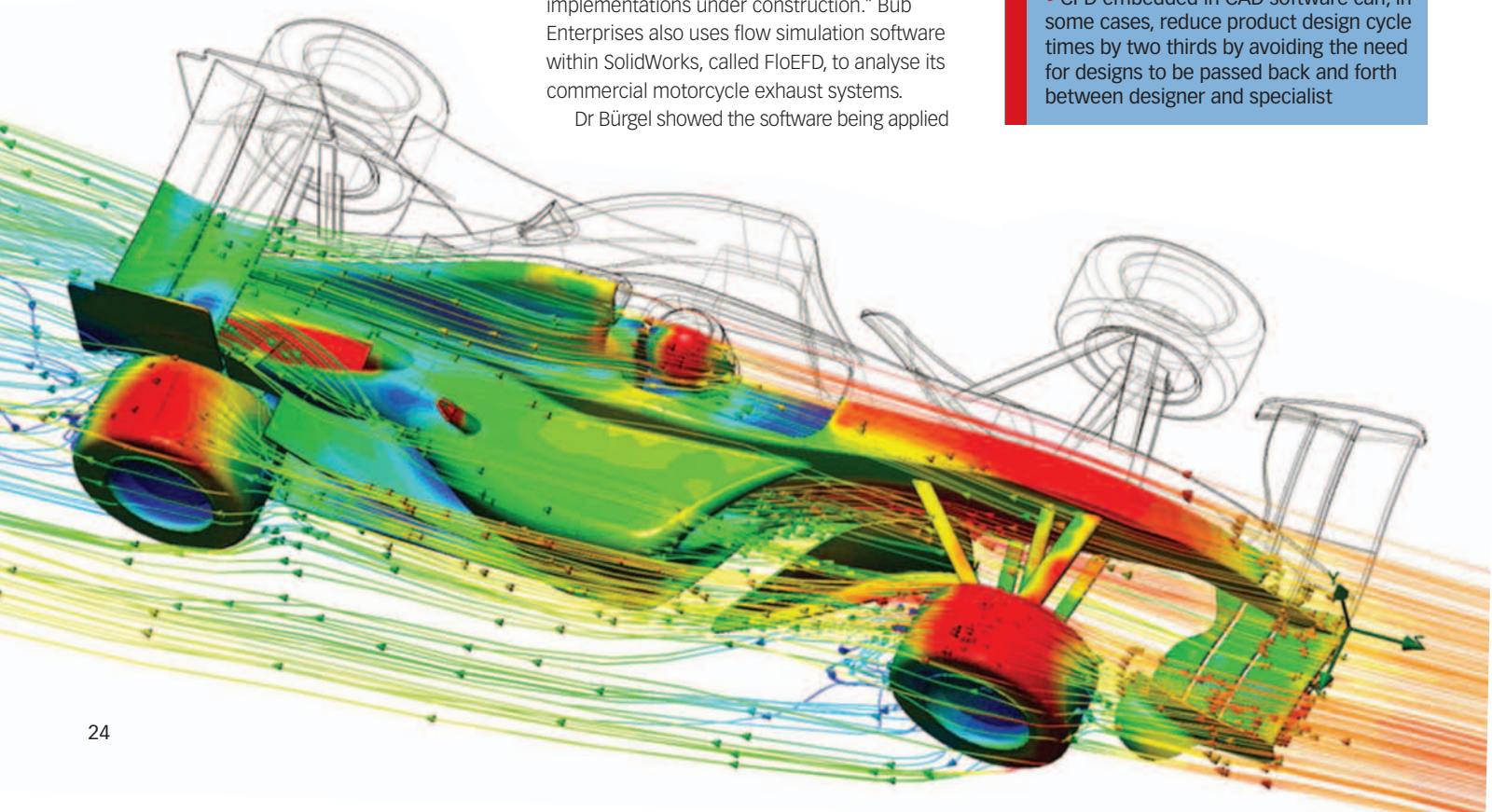
This is a typical example of how the approach can save time as it avoids having a model and design passed back and forth between the design engineer and CFD specialist.

"It still includes some approximations," says Dr. Bürgel. "However the big movement forward is that, ten years ago, it was really something for the specialist, whereas now it can be used by design engineers who are not specialists."

www.mentor.com/mechanical
http://seven-streamliner.com
www.solidworks.com

DESIGN POINTER

- CFD embedded in CAD software can, in some cases, reduce product design cycle times by two thirds by avoiding the need for designs to be passed back and forth between designer and specialist



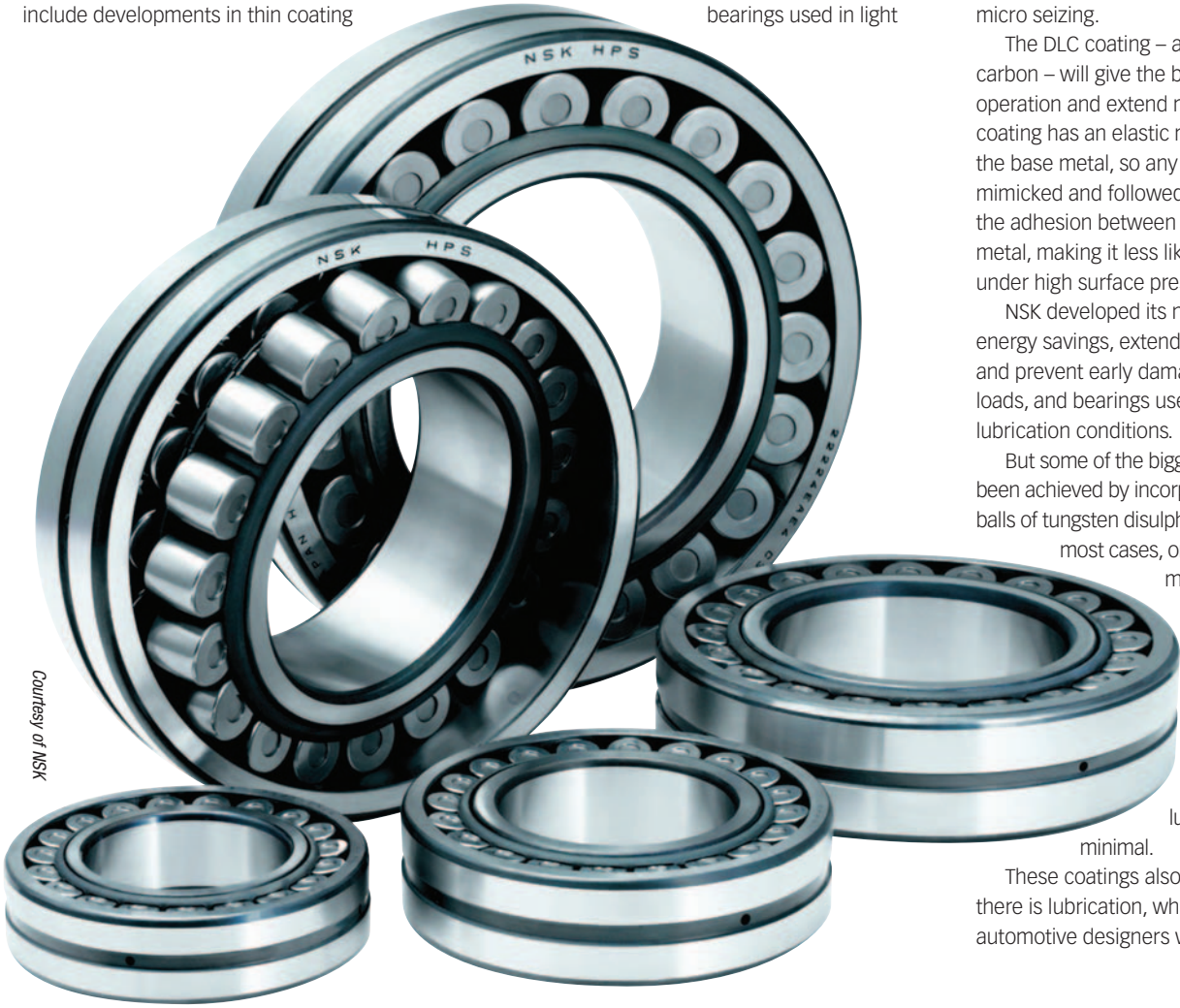
Reducing friction and wear

Tom Shelley reports on advances in coatings that reduce friction and enhance service life in both dry and lubricated conditions

Tribology is an often overlooked subject area and new technologies can often be misunderstood, due to their complex and 'difficult to get right' nature. Yet the science and technology behind interacting surfaces is vital to providing continual rotational and linear motion to a multitude of machines with minimum friction build up and wear.

And there are improvements continually coming through. Some the most recent include developments in thin coating technologies that significantly reduce the dry friction coefficient of interacting materials and improve wear life dramatically. These technologies can mostly laid down on a surface by using existing chemical vapour deposition and sputtering techniques.

The phenomenon of smearing – or micro-seizing – is caused by slippage between the raceway surface of the inner and outer rings and the roller surface. It often occurs in bearings used in light load areas inside papermaking machinery and areas with poor lubrication. If not addressed, smearing can lead to flaking and fracture, resulting in production lines being shut down.



Courtesy of NSK

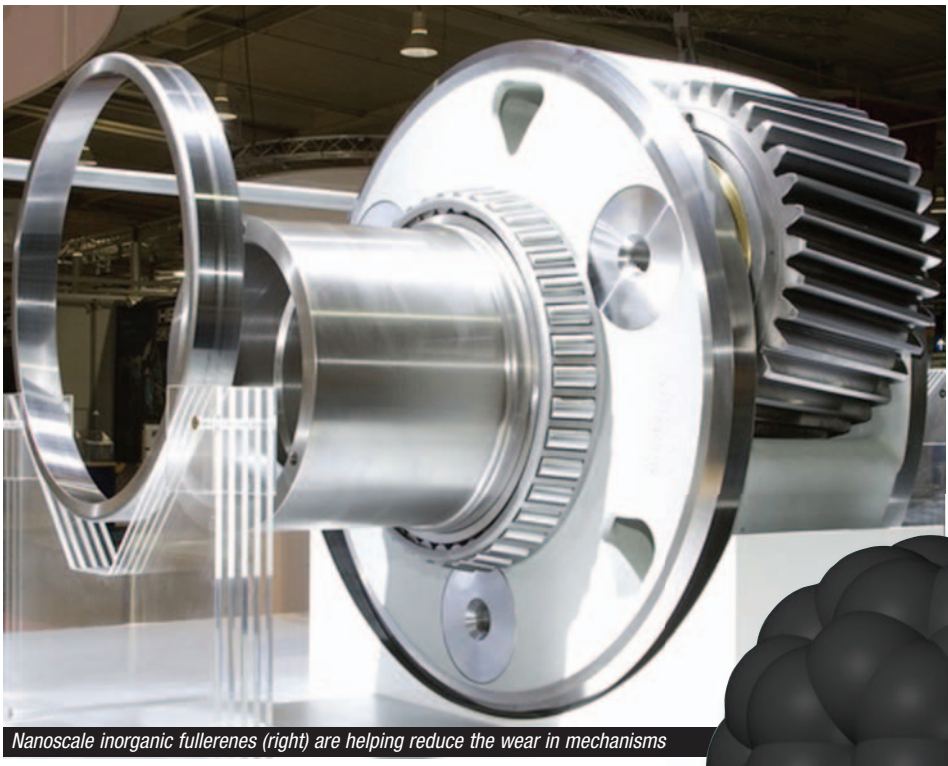
Bearing manufacturer NSK says it has been able to improved smearing resistance by applying a proprietary diamond like carbon (DLC) coating to its bearing rolling elements. It has recently produced spherical roller bearings for use in papermaking machinery that eliminate micro seizing.

The DLC coating – a hard film made mainly of carbon – will give the bearings more stable operation and extend maintenance intervals. The coating has an elastic modulus close to that of the base metal, so any deformation is closely mimicked and followed. SKF has also improved the adhesion between the coating and base metal, making it less likely to come off, even under high surface pressure.

NSK developed its new product to improve energy savings, extend maintenance intervals and prevent early damage to bearings with light loads, and bearings used in areas with poor lubrication conditions.

But some of the biggest improvements have been achieved by incorporating nanometre sized balls of tungsten disulphide. The coatings are, in most cases, only about one or two microns thick, yet this is enough to reduce the friction between unlubricated surfaces drastically. This is often essential when operating under extreme conditions, where lubrication maybe difficult or minimal.

These coatings also decrease wear where there is lubrication, which is useful for automotive designers working with camshafts



Courtesy of NSK

Nanoscale inorganic fullerenes (right) are helping reduce the wear in mechanisms

and spherical joints, as well as various sliding and rolling element bearings.

The downside is that, because stopping sliding surfaces from wearing each other out is extremely complicated, each potential use has to be examined separately in order to establish that it works effectively.

Although a coating may work in one application, it may not work in another. And while some hard coatings help improve wear resistance in one kind of application, they may not in others. For example, chromium nitride is very good at resisting fretting, but very poor when used on gears.

Professor Mark Gee, a fellow in surface engineering and tribology at NPL, says: "DLC and molybdenum disulphide (MOST) coatings, that incorporate titanium metal into a molybdenum disulphide matrix, are offering increasingly higher resistance to adhesive and abrasive wear. They usually have a load bearing limit in excess of 3GPa and a coefficient of friction ranging between 0.005 to 0.1, depending on load and operating conditions."

DLCs are already widely used to coat rubbing parts in the motorsport community; however, they can go wrong and suffer when moisture is present. However, Teer Coatings has developed a patented alternative, Graphit-iC, which has a graphitic microcrystalline structure that it claims performs much better with water based lubrication.

Prof Gee also says traditional hard cutting tool materials, such as tungsten carbide in a cobalt matrix, can also be used as bearing materials. "When this is done, pieces of tungsten carbide in the surface fragment are embedded in the matrix to produce a wear resistant surface," he says.

Another idea that has been around for sometime, but has never quite been developed, is to introduce very small spheres – made of a given material – into the metal matrix. But, US based ApNano is using the concept to produce commercially available lubricating coatings under the product name Nanolub.

It claims that multiple layers of tiny spherical particles lubricate surfaces as the particles roll over one another like miniature ball bearings, just on the nano scale. The coating is made up of particles of tungsten disulphide that are 20nm across. The spheres have been given the generic name of inorganic fullerenes.

NanoLub is now being added to various oils and greases and is also being used to impregnate parts and as a component of polymer and metal composite films and coatings. NanoMaterials and Israeli oil company Sonol have got together to incorporate the technology into a top up concentrate for enhancing engine oil performance.

The particles can also be incorporated into nickel coatings, where they reduce the dry coefficient of friction to between 0.05 and 0.1, as well as cobalt, aluminium and a wide range of polymers.

The idea of using nanoscale balls of material as an aid to lubrication and something that can be embedded into a metal surface has led to a European Union project called FOREMOST – Fullerene based Opportunities for Robust Engineering Making Optimised Surfaces for Tribology. The project is now nearing completion and has had high profile participation from EADS, Renault, Rolls Royce, Goodrich, Nanomaterials and IonBond.

The €18.9million project aims to substantially extend operational life, reduce maintenance requirements and reduce the environmental impact of a wide range of machines incorporating transmission trains, sliding bearings, spherical joints and roller bearings. It is hoped this project will produce a radical innovation in friction and wear protection concepts and insure that tribology continues to benefit mainstream industry and engineering.

www.teercoatings.co.uk
www.iom3.org.uk
www.ionbond.com
www.apnano.com
www.foremost-project.org/home.asp

Design Pointers

- Chemical and physically deposited coatings can greatly reduce friction and wear, even when only 1µm or 2µm thick
- Fullerene-like spherical particles, usually made of tungsten disulphide and around 20nm in diameter, have a dramatic effect on reducing friction and wear both as lubricant additives and in composite coatings

Big valve offers big opportunities

Tom Shelley reports on a novel valve that promises to make a heat engine energy storage system highly efficient

A 300mm diameter valve has been developed that opens and closes off air or gas flows at up to 12bar in around 2 to 2.5ms. It takes the form of a pneumatically operated slide valve that uncovers and covers a very large number of individual ports.

It forms a vital part of a novel heat engine which is being developed by Jonathan Howes, technical director of Isentropic, a technology company based just outside Cambridge.

A reservoir filled with gravel is heated to 500°C, while another gravel reservoir is cooled to -150°C. Reversing the engine allows the temperature difference to be converted in to mechanical energy.

Howes says: "I built my first Stirling engine when I was 15, but it's almost impossible to get close to its optimal theoretical efficiency because of the need to exchange a large amount of heat very rapidly."

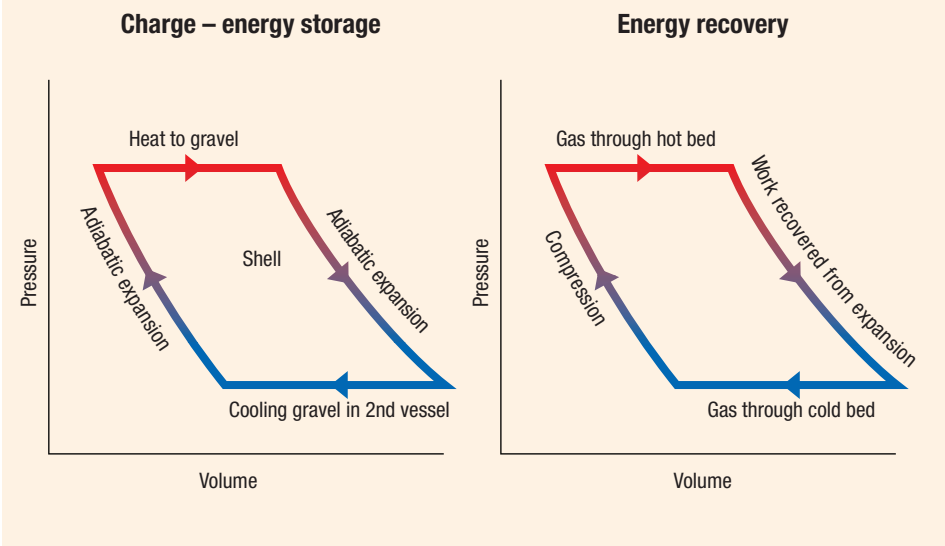
The engine has one cylinder, with a thermal barrier piston in the middle and special valves at the top and bottom. One end of the cylinder is used for compression and the other for expansion.

When energy is to be extracted from the hot and cold gravel beds, argon is passed through the cold bed where it undergoes isobaric cooling which reduces the volume of the gas. It is compressed to 12bar and then rapidly injected into the hot gravel bed. Here, it undergoes sudden heating, enabling it to perform work as it expands on the other side of the cylinder.

A crucial aspect of the machine is the valve, which has to open and close very quickly, produce very little pressure drop and minimise turbulence. There has been considerable commercial interest in using the valves for other purposes and it is likely that they will find themselves in industrial service before the heat engine. The other interesting innovation on the heat engine is its non contact piston seal. This is a new design and is also proving to be of commercial interest.

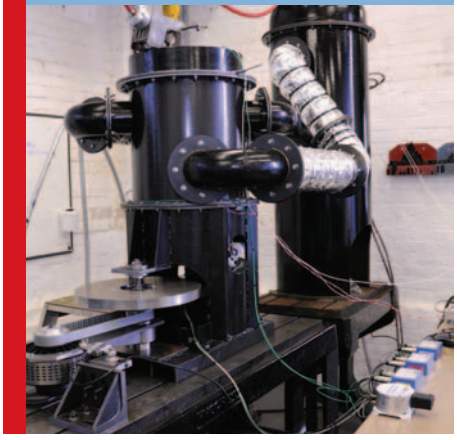
The main barrier for Howes and his team has been money. Although there has been a grant from the Carbon Trust and investment by Credit Suisse Securities Europe, a full scale demonstrator is expected to cost some £2million and a manufacturing facility would be around £25m.

But the biggest opportunity is likely to be the use of the valves to shut off air or gas flows very quickly. This has a host of applications, including emergency shut off valves in chemical, gas, heating and ventilation environments.



Design Pointers

- Novel reversible heat engine makes use of an equally novel slide valve that can repeatedly open and close a 200mm aperture, with minimal pressure drop and turbulence in 2ms to 2.5ms
- The heat engine is intended to store energy as heated and cooled gravel, with one container getting up to around 500°C and the other going down to -150°C
- The engine is still very much under development – the Mark 3 is just starting tests – but the valve and seals are now well proven and an order for a 2MW pioneer machine is said to be in the offing



Micro sensors take on big markets

Justin Cunningham investigates how an electromechanical sensor went from guiding munitions to car stabilisation systems

Although it has only been in business for little more than two years, Atlantic Inertial Systems (AIS) has already established itself as a global expert in micro electromechanical systems (MEMS). And much of its success is down to good engineering and business strategy. It has been able to keep the IP and 'clever' bits of the engineering process largely within the UK, whilst exploiting global markets.

Its inertial measurement units (IMU) were originally designed to be used as 'gun hardened' guidance systems that would be integrated within munitions and guide them to a target. The technology originated out of work conducted by BAE Systems which, in 2007, was sold off to US investment company JF Layman to form a separate company. JF Layman saw massive potential for the MEMS devices in a number of applications and set up AIS to service military markets. It also established Silicon Sensing as a joint venture with Japanese based Sumitomo Precision to take the devices to the automotive market.

"We have come from a background of fairly large company attitudes and mentalities," says Ian Scaysbrook, chief engineer of AIS. "And we are now getting used to being a small lean privately owned company."

The very different markets require very different approaches to engineering. The military market typically requires the delivery of high quality rugged products and needs a lot of support. The automotive market, on the other hand, requires high volume products at low cost – but quality is still important.

In the design of its IMUs and solid state gyros, AIS has taken advantage of off the shelf technology, but there is a limit to how much this can be exploited – especially for the high performing 'gun hardened' IMUs. Although MEMS devices do not currently offer as good performance as spinning wheel gyros, they are less expensive, a lot tougher and a lot smaller.

When fired on artillery rounds and devices can experience shock levels in excess of 20,000g – which a spinning wheel gyro would simply never survive. But the inherent ring-like structure of AIS' MEMS helps to spread the loads though its housing and makes the sensor inherently more resistant to sudden shock and vibrations.

"The old spinning mass gyros would not stand a chance," says Scaysbrook. "So, to get to that level of performance, we had to go back to the raw sensors and do some redesign work.

"We fired four last year and they all hit the target. Afterwards, we were amazed we could do it so well. We have now performed in excess of 60 firings and had a 100% success rate – no failures of the IMU at all, which is unprecedented. And their accuracy has improved as well."

And the markets and potential applications keep growing. Ruggedised gyros are used on the Ariane 5 space launcher, various helicopters, armoured vehicles and even in a soldier's boot – basically anything that needs to know where it is and which way it is pointing.

The automotive MEMS from Silicon Sensing are made from cheaper components and don't have the exceptionally high performance of military grade IMUs. The main use in the automotive industry is electronic stabilisation protection systems.

"The gyro essentially acts as a yaw rate sensor," says Scaysbrook. "So if a vehicle goes in to a skid, the sensor can detect the fact the car is rotating when the driver is telling it not to. This will then engage an engine control system that will turn on brakes and adjust engine power to the wheels accordingly to correct the skid."

The Silicon Sensing joint venture has sold more than 15million gyros to the automotive industry. Although price is significantly less than the military variants, the high throughput allows the business to be lucrative.

But it is also key to getting the precision for AIS's devices. "It allows us to cream off the best, most rugged and highest performing gyros," says Scaysbrook. "They are essentially the same gyros, but if we were not producing that rate of gyros for the automotive and commercial markets, we just would not be able to do that, it wouldn't be cost effective."

www.atlanticinertial.com
www.siliconsensing.com

Reuse, remanufacture, result

Your customers are becoming more aware of the benefits of reuse and remanufacture. Are you responding to their needs? By Andrew King.

Your business probably has a variety of different suppliers (with the associated administration and logistics costs). But what if you were offered a new supplier who provided nearly all the materials you need in just one delivery?

Much is made these days about material supply security. The combination of demand for raw materials from developing nations with regional political instability in areas of material supply, may well lead to increasing material insecurity. But what if this new supplier could also offer a better guarantee of availability than the others?

Your business also probably has a variety of different manufacturing operations to transform the raw materials you buy into the shapes you need (with the associated labour and energy costs). But what if this mystery new supplier provided most of these materials in their final shape?

Energy security

Just as material security is talked about, so is energy security. Although electricity can be generated from a variety of sources, long term costs remain uncertain. If your business runs energy intensive machinery, then you will already know what a few pennies on a unit of electricity can do to your production costs. But – you've guessed it – what if this mystery new supplier was offering better long term assurances on costs?

You say: but this so called mystery supplier is just another name for an all singing and all dancing subcontractor. It will still cost money, right? Wrong. Because our mystery new supplier is not a subcontractor.

Rather, it is your last customer. And, one day, this customer will want to part company with the product you sold them.

Now, it might simply be that your marketing department has convinced them that they are better off with your newest product. It might be that that the lease has ended or it might just be that your customer now considers the product 'beyond economic repair'. In all cases, they will soon part company with that product.

To many companies, this old product is called 'waste' – and definitely the customer's concern, not theirs. But some companies have long seen this product as a partial source for the next product they plan to sell. And so they arrange for it to be brought back to the factory. Sometimes, the product is dismantled, thoroughly cleaned and then rebuilt with a mixture of old and new parts. Other times, only some of the more valuable parts are taken and reused.

Historically, the business of reclaiming materials from customers has operated on a purely economic model. Customer discounts on new products, return deposit schemes – and even straight buy back deals – have all been used. The economics of reuse have still made a profit for the company.

But in the last decade, a new factor has

Xerox takes advantage of remanufacture

For many years, Xerox has reused its customers' old products. Fuser rolls have been returned for remanufacture because the precision manufactured aluminium drum is made from an expensive raw material that involves costly machining.

Entire photocopiers, such as the Docutech are also returned via a well planned logistics network at a central hub, then shipped to Xerox' factory in Ireland. Walking around the large factory, the only hint that this is a novel operation comes from the unusual shape of the Goods In pallets. When these old products arrive, they are dismantled with parts separated either for cleaning, further inspection or recycling.

Then, following a series of well planned assembly stages, remade products emerge. Often, the exact same assembly logic is followed from as in the original assembly sequence. And, because Xerox made a strategic decision to remanufacture these resources, it has also designed the products with a suitable modular arrangement to allow for upgrades. Thus,

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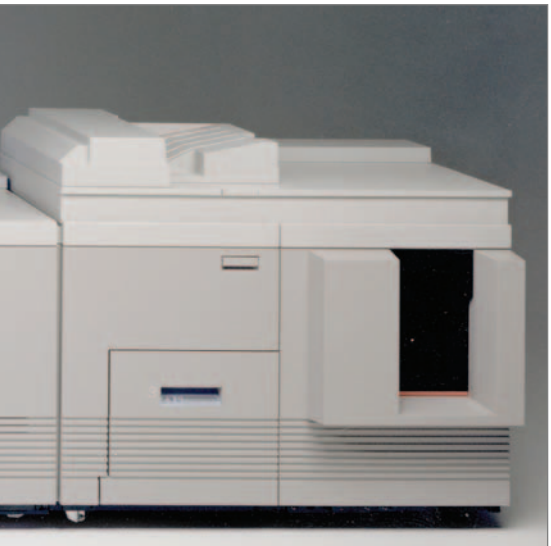
Help is available

If you would like help from the Centre for Remanufacturing and Reuse to evaluate opportunities in reuse, or would like to discuss issues of relevance to your sector or operations, contact CRR at: info@remanfacturing.org.uk, telephone: 01296 337165 or visit www.remanufacturing.org.uk

increased interest in this kind of business: the environment. And with the onset of take back laws (such as the Waste Electrical and Electronic Equipment Directive), many businesses are now mandated to bother about their customer's old product waste. A number of studies have shown that reusing old materials in their final shape (as opposed to crushing them by recycling) makes good environmental sense. And, provided upgrades are possible too, the benefits of new technology need not be lost either.



the product that emerges often combines the savings of reused materials and lower production costs with the benefits of newer functionality and better energy efficiency.

Xerox' customers are then offered a choice: a new photocopier at full price and full warranty, or a remanufactured photocopier at a discount price, but still with the full warranty. It is, perhaps, no surprise that a significant number of customers have chosen to save money, particularly when the offer comes from a company with a trusted brand, like Xerox.

Strategic solution

So why aren't more businesses looking to a more strategic solution to product take back? Why aren't they sourcing even just a small proportion of their future components directly from their customers? Well, the answer is that they are. Slowly but steadily, more companies are seeing the potential of this new type of closed loop business.

At first, they begin by designing in the capability for reuse through modular design and design for disassembly. Then they modify their logistics networks to enable a reverse element to be added. And they train and tool-up part of their workforce (sometimes protecting them from redundancy) to do the actual rework.

Do customers then come flocking to buy this type of greener product? No. But again, slowly yet steadily, they are becoming aware of the benefits. The economic discount is usually a 'no brainer' (Public Service organisations in particular need to reduce budgets in light of National debt). But the environmental argument is also beginning to make sense. With many organisations now mandated through legislation to 'do their bit', saving money and helping the environment through reuse is increasingly seen as a 'win-win' proposition.

Author profile:

Dr Andrew King is an associate of Oakdene Hollins, working largely for the Centre for Remanufacturing and Reuse on remote projects. He has worked closely with global manufacturers such as Xerox, ZF and Caterpillar to understand the manufacturing and life cycle impacts of products and components. As part of his work with CRR, Dr King has developed a reuse decision tool to assess the life cycle impacts of the reuse and remanufacture of componentised products.

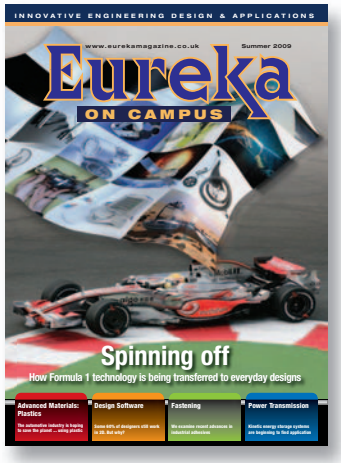
Get yourself an energy rucksack

The analogy of an 'energy rucksack' is helpful. As materials pass through a business from goods in to production, energy is invested into them in order to get them into their final shape. Whether it is the colossal energy needed in casting or the more moderate amounts needed for machining, this can be added to each component's theoretical 'energy rucksack'.

At the end of its life, the component could be recycled. However, all the energy invested in its rucksack would be lost during the material shredding, with new production energy (from new casting or machining) needed to make the replacement component. However, if the old component were simply to be reused, then its production energy would be saved. Quite often, that makes good environmental sense.

www.remanufacturing.org.uk

Inspired by innovation



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READER INTERVIEW

60 SECOND

Gary Livingstone
Managing Director
MiniTec

Q What is the history of the business?

A I used to work for Time & Precision Industries, which was a distributor for MiniTec. When Time & Precision went out of business in 1995, I saw an opportunity and basically bought the rights to distribute MiniTec products in the UK.

Q How has MiniTec fared since the economic downturn kicked in?

A Business has actually been quite good. We have managed to retain a pretty solid work flow and, in many cases, have actually improved output since last year. We have now got to the stage where we need to move to a new facility in order to meet the demand. It is a great position to be in, especially given the tough operating conditions the industrial sector has seen in the last 18 months.
The German company which manufactures the aluminium profiles is about to move to a purpose built factory, five times the size of its current building. MiniTec as a company is doing very well.

Q What is the secret behind your success?

A Our ability to seek out and find new applications and uses for MiniTec definitely puts us in a good position. We don't rely too much on any one sector, which has allowed us to keep in really good shape. An example of new uses is the Office Cube, which are put together using MiniTec aluminium profiles. This is basically a small flat pack office that can be set up in a warehouse, where you might have 50 of them side by side. Fully serviced, the approach is popular with small independent start ups and software developers.
We use aluminium for most applications, but also produce a profile in stainless steel. This allows us to address the food and pharmaceutical sectors, as well as other areas where aluminium is less suitable. But it is fully interchangeable with aluminium profiles.

Q What is the MiniTec product range?

A MiniTec is basically extruded aluminium profiles. These may seem quite simple, but a lot of thought and innovation has gone into getting them right and continually improving them.
A key feature is that while the profile is always the same, they can be made in various diameters, so they can be fastened together easily and put together to form almost any structure or shape. I have it in the office, at home for multiple of uses. It is really the engineer's Meccano and is used in workstations, by machine builders, as conveyors, and on airport baggage handling systems.

Q So what examples are there of innovation in your products?

A A lot of the success comes down to starting with profiles that are all interchangeable and which use the same standard fastener. The PowerLock fastener is unique: it needs no specific preparation, pre-machining or special tools. It uses a self tapping thread, is simple to fit, can be reused and, critically, saves time during assembly.
It has a small clip that can be inserted in the profile at any point – rather than just fed in at the T-bar from the ends – and it is spring loaded, so it stays in one place rather than sliding up and down if the bar if it is not flat. The fastener reduces cost, engineering and assembly time significantly and is standard.

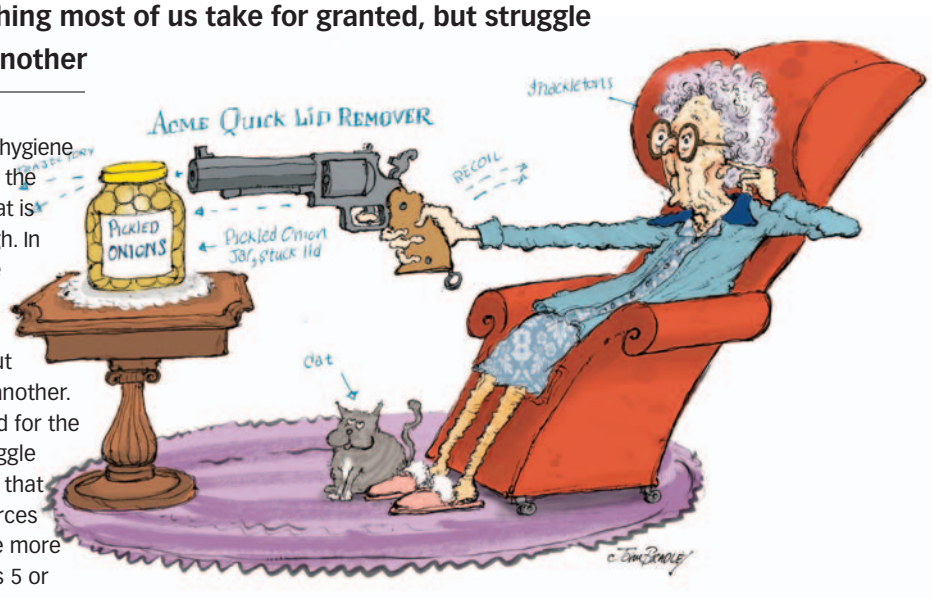
Q How crucial is innovation to your company and its business model?

A We constantly expect improvements and we constantly expect ideas. The only thing that remains the same is the aluminium profile, as the T-slot allows every single profile to join together.
We have to make sure we have like minded people and that is what it comes down to. We recently used small serrations on the PowerLock fastener to break through the anodising of the aluminium profile to make it conductive. The mindset of the company is to always try and save time and increase throughput. On an assembly, we know, we have been less than half the cost of competitive products, purely because of the speed and cost of the fasteners.
It is very important to have a new flow of ideas coming into the business and we regularly take on apprentices. Whoever joins has to spend three months on the shop floor. After that time, they need to come up with at least one time saving idea. That is the company's mindset – you have got to be thinking about saving time and making improvements.

Got an interesting project? To be considered as a future 60-second interview candidate contact: pfanning@findlay.co.uk

Lifting the lid

Opening a jar is something most of us take for granted, but struggle with at some time or another



Despite huge improvements to hygiene and food packaging technology, the knock on effect is packaging that is extremely difficult to get through. In particular, people often struggle to remove the lid of a jar.

Opening a jar is something most of us take for granted, but struggle with at sometime or another.

But the problem is amplified for the elderly and disabled, who struggle with the vacuum formed seals that fasten lids in place. And the forces needed to twist of some of the more stubborn lids can be as high as 5 or 6Nm. For many, this is beyond their capability.

The Challenge

Our challenge this month is to come up with a product that opens jars, which is small enough and cheap enough to be appealing to the mass market and simple enough to use that elderly and disabled people operate the device with ease.

Similar gadgets, such as mechanical can openers, have already come to market and they show there is a market for such devices. But there are currently few devices that solve the problem proficiently. Many are prohibitively large and expensive reducing their general appeal significantly. You should come up with a way of replicating what human hands do when they open a jar. The mechanism should grip the lid and jar and apply a steady twisting force until the lid is removed.

And, like the human hand, the mechanism needs to tighten its grip if it is about to slip. The device should be simple to use, not take up too much room and be aimed at the senior market and people that struggle opening jars, with possible appeal to the wider population as a gadget. It should also be low cost and that means a minimum number of parts. The solution uses a simple, well known – although slightly modified – mechanism which solves the problem elegantly. The answer will be revealed in the February issue of ***Eureka***. In the meantime, see if can come up with anything better.

The answer to last month's Coffee Time Challenge, how to design a better wheelchair, can be found in our Technology Briefs section on page 9

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Location: Europe (Non UK) Salary: £30000 to £50000 per annum

A Lead Mechanical Engineer is now required to join this very successful, standalone company part of a major energy group based near Innsbruck in Austria which develops and manufactures large gas engines.

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Degree qualified in Engineering or in a similar specialization, you will need a significant level of postgraduate experience with the mechanical development of reciprocating engines, particularly in relation to the key systems of valvetrain, cranktrain and major castings. You will need proven project management skills; experience in the definition, implementation and planning of validation tests based on standard quality processes (DFMEA, DFR, DFSS) for components/systems and engines. You must be comfortable in an international environment and have a willingness to travel.

For full details and to apply for this job go to www.EurekaJobs.co.uk and type in reference: 322686

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Location: Yorkshire Salary: Competitive

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They are looking for a strong communicator with the interpersonal skills to effectively liaise with customers, suppliers and classification societies. You must have the ability to comprehend and interpret International Standards and customer specifications whilst working accurately to time constraints. Knowledge of Microsoft Office 2003/2007 and Adobe Acrobat 9 is also required.

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Just weeks after winning the IChemE Award for Energy, Spirax Sarco was a close runner-up in the Industry category at the 2009 Carbon Trust Innovation Awards

The steam expert was recognised for its pioneering Flash Recovery Energy Management Equipment (FREME) engineered system.

Marc Eggermont, Director UK & ROI of Spirax Sarco commented: "Spirax Sarco is committed to producing energy saving solutions and services that can help reduce the carbon footprint of any steam system. We estimate that FREME has saved about 10,000 tonnes of CO2 to date in the UK, which will increase to a figure in the region of 100,000 tonnes over the next five years."

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Imaging

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New BOA Smart Vision System

STEMMER IMAGING can now offer the new BOA smart vision system from DALSA, launched on October 1st 2009 for End Users, Vision Integrators and OEMs. BOA has been introduced to complement Dalsa's existing 'Vision Appliance' (VA) range. Packaged complete with proven inbuilt software, BOA eliminates the need for programming and installing software due to configuration via a standard web browser interface.

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Optical Sensing

www.oceanoptics.eu

Ocean Optics Announces New OEM Engineering Team

In Optical OEM projects Ocean Optics is seen as an active partner for it's customers. To serve them even better, Ocean Optics, the industry leader in miniature photonics, has formed a dedicated OEM engineering group. This group provides expert support to optimize and expedite integrating optical components in systems of both new and established OEM customers. These services are extended to all OEM's whether they contract directly with Ocean Optics, or purchase through local distribution channels.

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Pressure Transmitters

www.sick.co.uk

SICK takes the pressure off with new PHT transmitter

SICK's new PHT hygienic pressure transmitter series offers comprehensive pressure detection for accurate process control and high reliability plant protection suitable for food and beverage, pharmaceutical and cosmetic manufacturing applications.

Launched as a flagship product of SICK's new Industrial Instrument Division, the PHT series includes absolute, gauge and compound pressure measurement. The high sanitary design features a flush-mounted 316L (1.4435) stainless steel diaphragm free of gaps and dead spaces.

The PHT series covers low pressure applications from 0 to 0.25 bar, such as hydrostatic levels in storage vessels, to 0 to 25 bar for fluid filling and pumping duties such as are common in the food, beverage, pharmaceutical and cosmetic industries.

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Safety Locks

www.fortressinterlocks.com

Fortress Adds the Slide Latch to its Safety Interlocking Range

The new eGard Slide Latch is a robust door locking device, for both hinged and sliding doors, that features an integrated tongue so it can be used in conjunction with key modules, safety switches and machine control functions. It is equipped with a self aligning actuator which works with the head bridge to realign the gate to increase robustness, allowing a misalignment tolerance of +/-7.5mm vertically and +/- 5mm horizontally. The Slide Latch handle has a built in lever to release the door lock and allows reliable actuator operation in combination with all door locking eGard configurations. The Slide Latch can easily be mounted onto current eGard configurations by simply mounting the head bridge on the existing head module.

@: sales@fortressinterlocks.com
✆: 01902 349 000

Sensors/Switches

www.appeng.co.uk

Pressure level temperature and flow

Applications Engineering Ltd holds a comprehensive range of pressure, vacuum, level and flow switches. We provide 'tailor made', custom designed products, accessories and associated product lines including the Jetcleaner hose and pipe cleaning system.

We offer a 30 day sale or return sample service on our standard products. That way, you only buy when you are satisfied that the product suits your application.

More often than not, we are able to get a product to you within 24 hours of you making your first enquiry.

@: info@appeng.co.uk
✆: 01825 764737

Self-locking Nylon Nuts

www.bulte.com

Bülte has added a series of plastic lock nuts:

The self-locking nuts are suitable for applications that require extra security as they eliminate backlash without sacrificing efficiency. This type of nut is more effective than standard hex nuts because it includes a no threaded part which closes around the thread creating a lock between the two threads.

Self-locking nuts are being used as a secure fastening nut for joining many kinds of parts. They are manufactured from natural Polyamide 6.6 that, when combined with steel screws, provides low drag torque and smooth operation throughout the life of the assembly (preferably not reusable). They also save weight over the conventional steel/nylon lock nuts.

@: sales@bulteplastics.co.uk
✆: 01789 263753

Test & Measurement

www.mecmesin.com

Mecmesin Turns On Screw Caps For Wine Quality

Mecmesin torque testers are providing an affordable means for wine producers to guarantee that screw cap wine closures retain a hermetic seal, thereby maintaining wine quality, whilst avoiding leakage and oxidation.

Torque testers, such as the Orbis 6N.m manually-operated torque unit, have long been used to measure release torque of closures, but are being increasingly employed by wineries and manufacturers of metal screw caps to ensure correct manufacture and application on the bottling line for the wine industry's requirements.

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www.prototypeprojects.com