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In this issue: Motors • Design Software • Fastening & Adhesives • Materials • Aerospace

From track to traffic

Can technology transfer
drive automotive evolution?





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Inspirational engineering



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

Once in a while, on the (very rare) idle moments when the *Eureka* editorial team is not frantically busy, we have discussions about terms that are overused in the press material we receive.

Of course, some commonly-used terms are technology trends – thus 'Cloud', '3D Printing' or 'Internet of Things' are cropping up ever more frequently. But the more irksome examples are the adjectives that are used to describe virtually everything. 'Gamechanger' (or variations thereof) would be one such, while 'unique' and 'state-of-the-art' would be others.

Another adjective that is used far too often in press releases is 'inspirational', which is applied liberally to everything from products to processes and which, as a result, has almost ceased to have meaning.

Almost, but not quite. Because sometimes you see or hear something in the engineering world that genuinely does inspire. A rare example of this phenomenon took place at SolidWorks World 2014, where Professor Hugh Herr took the stage to deliver a keynote address.

For those who have never heard of Professor Herr, he lost his legs to frostbite aged 17 when climbing Mount Washington and, profoundly dissatisfied with the prosthetic limbs available to him in 1982, proceeded to turn himself into a world-leading expert in prosthetic engineering and rehabilitative science.

To achieve this, Professor Herr first earned an undergraduate degree in physics at his local college, Millersville University, and a master's degree in mechanical engineering at MIT, followed by a PhD in biophysics from Harvard University. This is particularly remarkable since he had no prior interest in these subjects!

Professor Herr is now head of the Biomechatronics research group at the MIT Media Lab and is the holder (or co-holder) of more than 10 patents related to assistive devices, including those for a computer-controlled artificial knee, an active ankle-foot orthosis, and the world's first powered ankle-foot prosthesis (of which he is also a user, of course).

Next month's issue will feature more on Professor Herr, but in the meantime, I strongly advise anyone to look him up if they ever doubt that engineering can truly change lives and can be genuinely 'inspirational'.

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Mechanical KERS to rival electric hybrids

UK gearbox specialist Torotrak has bought mechanical energy recovery innovator Flybrid for £16million in a move that signals its intentions to compete against electrical hybrid systems.

Torotrak has long had an interest in KERS systems and the purchase of Flybrid will allow it to commercialise the Flybrid technology into 'an affordable hybrid system' to be called the Flybrid M-KERS.

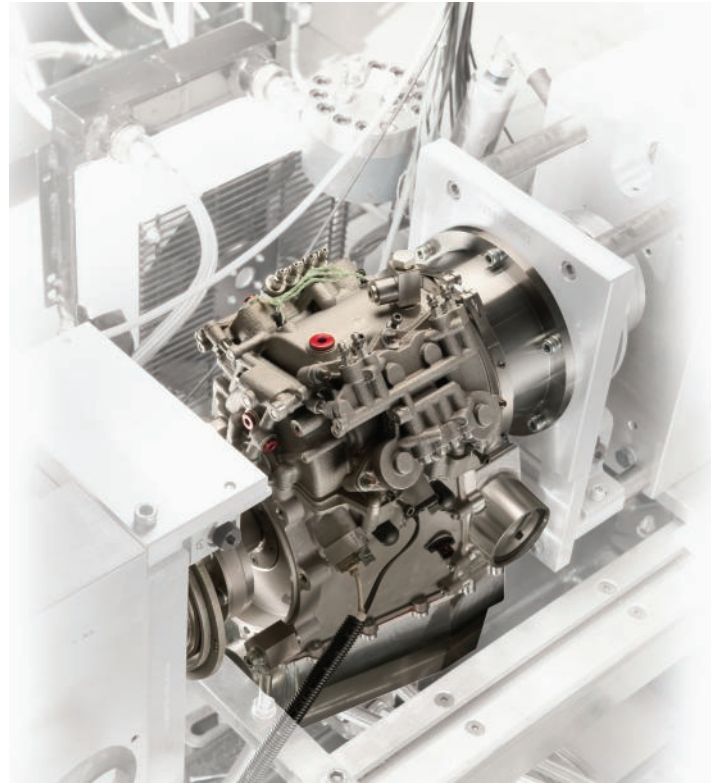
Independent research has identified Flybrid's mechanical flywheel approach to recover energy from vehicle braking to be more cost effective than the installation of numerous batteries and electric motors.

Jeremy Deering, chief executive of Torotrak, said: "The world can't wait for electric hybrid and plug-in CO2 reduction technologies to mature. It needs affordable, effective solutions that can be implemented now and we are better placed than anybody today to provide that fresh approach without the cost and complexity of rival technologies."

It means Torotrak can offer the automotive market a low cost, high performance hybrid system for high volume adoption in both passenger cars and commercial vehicles. The company hopes it will appeal to mass market cars such as a Ford Fiesta that have yet to take up electric hybridisation.

It complements Torotrak's existing V-Charge variable supercharging technology for engine downsizing, and its main drive transmission products. The M-KERS will be trialled this year and is expected to enter production in 2015.

www.torotrak.com



Airbus forms sustainable fuel Centre of Excellence in Malaysia

Airbus and its Malaysian partners have signed a Memorandum of Understanding (MoU) to promote the production of sustainable aviation jet fuel in the region. The

solution will be based on biomass production with the project seeking to determine the most suitable feedstock to produce aviation fuel.

Frédéric Eyche, new energies programme manager at Airbus said: "South-East Asia is already a wide and productive region in terms of biomass. The

creation of a Centre of Excellence in Malaysia is an opportunity to ensure that any selected biomass satisfies strict sustainability criteria.

"[This] MoU is part of our engagement to support traffic growth whilst reducing aviation's footprint on the environment."

The first assessment is expected to be completed by

December 2014.

Airbus already supports the certification and development of commercial quantities of sustainable alternative fuels for aviation through promoting regional projects worldwide. To date, Airbus has formed partnerships in Europe, America, Australia, Middle-East and China.

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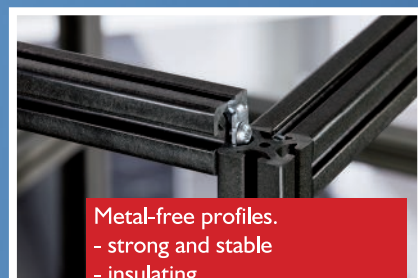
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Ford enlists MIT and Stanford for driverless car research

Hoping to combat some of the technical challenges surrounding autonomous vehicles, Ford has enlisted the help of two major US research institutions, Stanford University and the Massachusetts Institute of Technology (MIT).

The project will centre around Ford's automated Fusion Hybrid research vehicle, which relies on four LiDAR sensors to generate a real time 3D map of the environment.

MIT will be responsible for developing advanced algorithms that help predict where cars and pedestrians might be in the future. Stanford, meanwhile, has been tasked with creating sensors that can 'see' around obstacles.

"Our goal is to provide the vehicle with common sense," said Greg Stevens, Ford's global manager for driver assistance and active safety. "Drivers are good at using the cues around them to predict what will happen next, and they know that what you can't see is often as important as what you can see. Our goal in working with MIT and Stanford is to bring a similar type of intuition to the vehicle."

corporate.ford.com web.mit.edu



Record growth for UK aerospace industry

A surge in demand for commercial aircraft helped the UK aerospace industry achieve record growth last year.

According to trade organisation ADS Group, orders for commercial aircraft rose by 28% in 2013, increasing order backlog by 17%. In addition, ADS says aircraft deliveries jumped 7%, delivering a value of up to £20 billion in value to the UK.

ADS chief executive Paul Everitt said: "Global demand for new aircraft and engines is generating new demand and opportunity for the UK aerospace industry.

"The 7% increase in new aircraft deliveries and the 17% increase in the aircraft order book makes 2013 one of the most successful years on record.

"To maintain the UK's share of this fast growing market we must increase investment in technology, innovation and skills."

www.adsgroup.org.uk

Technique paves way for shatterproof glass

Taking inspiration from natural structures like seashells and teeth, researchers in Canada have been able to significantly increase the toughness of glass. A team led by Professor François Barthelat at Montreal's McGill University has created a technique that could stop glass from shattering when it hits the floor.

Researchers studied the weaker interfaces of natural materials like nacre, which can channel propagating cracks into toughening configurations. They then sought to imitate these features and implement them into glass, using a laser engraving technique. In doing so, the researchers were able to increase the toughness of glass slides by 200 times.

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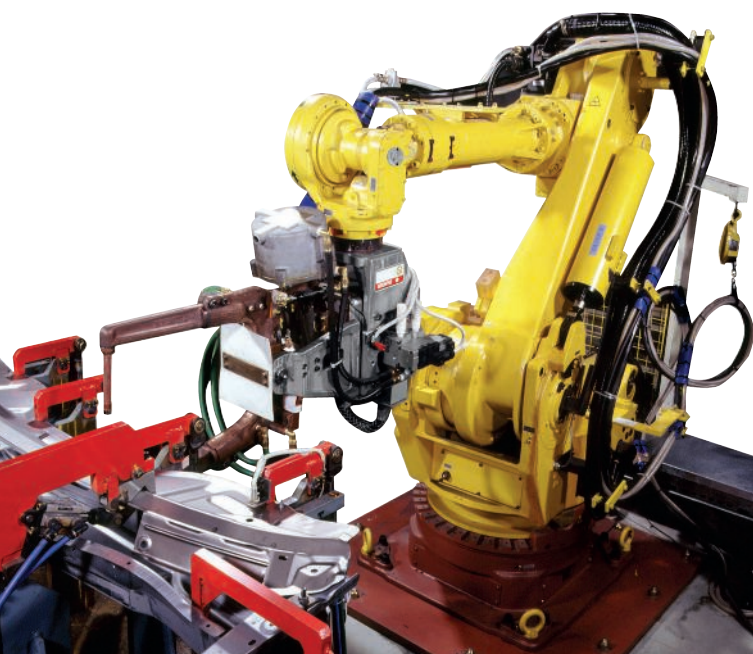
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Drax set to become UK's largest single 'renewable generator'

The UK's largest power station, Drax, is set to become the country's leading 'renewable generator' by augmenting coal with biomass.

Drax has invested heavily over the last few years in biomass conversion facilities that will allow three of its six generating units to burn biomass in place of coal. The first unit has been running successfully on biomass since the beginning of April, with the second planned to begin operating later this year and the third in 2016.

Drax says biomass is a low cost, low carbon and sustainable form of power that is an essential part of the future UK energy mix, which can be available when needed. Across its full life cycle biomass is expected to deliver carbon savings of around 80% relative to coal. It has been operating a robust and independently audited sustainability policy for over five years, with all biomass deemed to be sustainable, protecting biodiversity, preventing deforestation while delivering carbon savings.

Despite its claim, however, the coal-fired power station remains controversial for environmentalists, with the power station also reported as the UK's leading single CO2 emitter.

Dorothy Thompson CBE, chief executive of Drax, said: "Sustainable biomass has a critical role in the UK's electricity mix. It is the only renewable which can deliver low carbon electricity on demand, at the scale the grid needs and precisely when it's needed. It is also a low cost renewable which will help to manage the expense of the UK's transition to a low carbon economy."

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Solution to last month's Coffee Time Challenge

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The solution to last month's Coffee Time Challenge of how to devise a running shoe that prevents injury comes from the Fraunhofer Institute, which has developed a battery-powered concept shoe that relies on an RF module, GPS sensors, accelerometers and microelectronics to evaluate a jogger's running form and technique in real time.

The system captures biomechanical signals from the body and transmits them via Bluetooth to the jogger's smartphone app, which then evaluates the data and offers feedback to the runner on how they can improve performance.

"The app could recommend running more



slowly, for example, or rolling off the foot differently, suggest seeking a different running surface or stopping if necessary," explained researcher Andreas Heinig, from the Fraunhofer Institute for Photonic Microsystems IPMS.

For more detailed analysis, the data captured by the system can also be transferred to a dedicated website, so that

users can create a customised training programme with specific performance goals.

"Pulse-rate watches and chest straps record only vital signs like breathing and heart rate," Dr Heening continued. "In contrast, our running shoe medically evaluates and monitors training while jogging. It informs the runner for example of incorrect foot position, asymmetric loading, or warns of exhaustion or overload. There has never been a comparable device before.

The researchers are now working to make the system even smaller. The running shoe is expected to go on the market by early 2015.
www.fraunhofer.de



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PTC leverages service strategy with Internet of Things acquisition

PTC has announced the acquisition of Internet of Things (IoT) platform provider, ThingWorx, for an estimated \$112 million. It supports some changes to the direction of the 3D CAD and PLM software provider toward leveraging intelligence in products to enable better subsequent servicing of them.

ThingWorx is a platform that enables the design and integration of smart software on everyday 'things'. It complements the company's shift in to service lifecycle management (SLM) and puts it in a strong position to develop smart software leveraged products.

The concept behind the IoT is to integrate intelligence in to products that gather data on daily life and advise on everything from what you should buy from the shops based on what your fridge is telling you, to gathering data on performance for predictive maintenance. For example, a washing machine may send the manufacturer a report about an abnormal vibration, recommending the bearings are serviced.

PTC president and CEO Jim Heppelmann (right) said: "All aspects of our strategy to date have centred on helping manufacturing companies transform how they create and service smart, connected products. For



manufacturers, it is clear that improved service strategies and service delivery is the near-term 'killer app' for the Internet of Things and this opportunity has guided our strategy for some time."

A recent report from the McKinsey Global Institute says the IoT could be worth \$2.7 to \$6.2 trillion by 2025 and 80 to 100% of manufacturers could be using IoT applications by then.

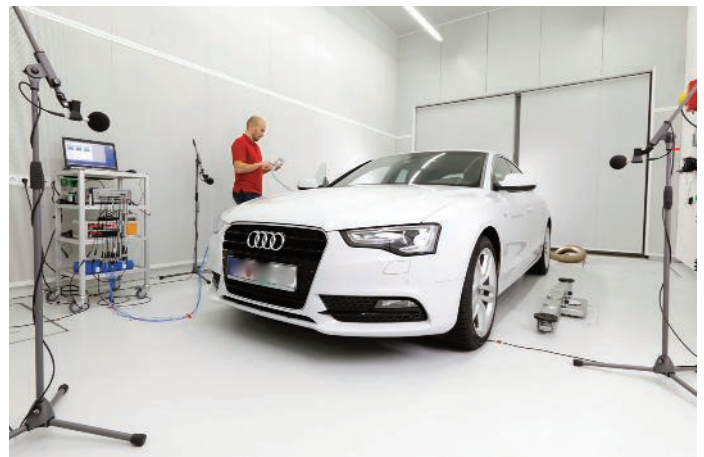
www.ptc.com

Bearing giant opens acoustic facility

Precision bearing manufacturer Schaeffler has opened an acoustic testing facility to investigate the origins of noise using the latest analytical methods. The company hopes to provide valuable clues as to where and how noise is generated and what can be done to eliminate it earlier in the design phase.

Typical tests carried out at the facility include the investigation of airborne sound and vibration behaviour in vehicle drive trains and chassis as well as assemblies using ball screw drives and roll stabilisers. The company also hopes to examine and improve the design of plain bearings and rolling bearings used in a variety of industrial and automotive applications.

The centre is equipped with a large acoustic vehicle test bay, a fatigue test room and an area with extensive mounting facilities. Other facilities include special spring-mounted test cuboids (pods) that move independently from the rest of the building. www.schaeffler.co.uk



Air Products adds to hydrogen infrastructure

Air Products has introduced the first of its SmartFuel hydrogen high pressure tube trailers capable of transporting large volumes of hydrogen at high pressure to its growing network of SmartFuel hydrogen fuelling stations. This trailer is the first of a fleet of new design, higher pressure hydrogen tube trailers due to be deployed in the coming months.

This state-of-the-art SmartFuel high pressure tube trailer features specialised composite cylinders for hydrogen storage that enable cost effective hydrogen from central production facilities to be delivered directly to the fuelling station at a pressure well above 350 bar; a significant enhancement on the existing 200 bar industrial hydrogen delivery models. This increased pressure removes the need for onsite compression for 350 bar vehicle refuelling and significantly reduces site compression for 700 bar vehicle refuelling. Station operators see this benefit translated into lower capital investment in the station hardware, as well as a marked reduction in station operating costs.

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Stratasys launches first multi-material, full-colour 3D printer

The world's first multi-material, full-colour 3D printer has been unveiled by Stratasys.

The Objet500 Connex3 features a triple-jetting technology that combines droplets of three base materials to produce parts combining rigid, flexible and transparent colour materials – all in a single print run.

Stratasys says the device will help designers and engineers cut the time it takes to get products to market. "As the first true multi-purpose 3D printer, we believe it is in a league of its own," noted Igal Zeitun, vice president of the company's product marketing and sales operations.

Elsewhere in the 3D printing space, auto

and motorcycle enthusiasts with a bit of CAD savvy may be excited to learn of the MarkForged Mark One.

Unveiled recently at SolidWorks World 2014 in San Diego, the desktop device is being offered as the first 3D printer capable of producing carbon fibre parts. The Mark One can print to a maximum size of 305 x 160 x 160 mm in carbon fibre, fibreglass, nylon and PLA.

The carbon fibre parts it produces are claimed to be 20 times stiffer and five times stronger than ABS, and have a higher strength-to-weight ratio than CNC-machined 6061-T6 aluminium.

www.stratasys.com



Prodrive develops new carbon manufacturing process

Prodrive Composites has developed a process for directly moulding fixings onto the back of high quality composite panels. The process also yields greater mechanical strength versus conventional assembly techniques.

The technique adds clips, inserts and threaded fasteners directly onto composite panels to reduce assembly costs and allows designers to more freely specify connections. The process has already been successfully applied by premium automotive car manufacturers.

Prodrive Composites' engineering manager, Gary White said: "One of the challenges of using carbon composite panels is the provision of fastenings for their attachment, which can lead to costly, intricate components. Conventional solutions involve creating a complex carbon shape to carry the fittings. By moulding onto the finished composite, we can match the convenience of an injection-moulded plastic part at a fraction of the cost, while providing the low weight, strength and superb display surface of carbon."

www.prodrive.com



Elika pump reduces noise by 15dBA

Marzocchi claims it has reduced noise and vibration levels on its latest Elika series of hydraulic pumps, the ELI2, by up to 15dBA. Key to the development is its patented helical gear profile that eliminates air encapsulation, a main cause of noise and vibrations. The profiles of the gear teeth also reduce pressure-oscillations during operation with the helical gear ensuring continuity of motion. The result is a smooth output and is virtually free from pulsation.

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From *track* to

Motorsport is the progenitor of so many key innovations in mainstream car design that one might assume that the mechanism whereby this process of 'trickle-down' technology takes place are well-established.

In this assumption, however, one would be mistaken. Motorsport technology transfers to the automotive industry less often and less effectively than many might think. Says Bernard Niclot, technical director of the FIA: "People don't really understand the link between motorsport and mainstream cars very well... but motorsport drove many of the powertrain developments at the beginning of the 20th Century – including gasoline engines – and will do so again."

One doesn't have to look hard to find more modern examples of motorsport driving automotive developments. Says Steve Sapsford, Ricardo's director for high-performance vehicles and motorsport: "F1 has pioneered energy recovery systems and that was down to the regulations around advanced battery packs and cell technology. It's driven e-machines and electric motor technologies in a way that not only other forms of motorsport, but mainstream automotive technology, can benefit from."

However, Lawrence Davies, deputy chief executive of the recently appointed Automotive Investment Organisation (UKTI), makes clear just how big the innovation gap between mainstream automotive companies and motorsport has been in the past. He says: "A few years ago, when I

was [director UK purchasing/logistics] at General Motors, we had virtually no links [with motorsport]. It was sad in many ways, but that was how it was. So I, for one, am delighted to see links between motorsport and automotive being developed."

And being developed they most definitely are. In July last year, the UK Government officially recognised the link between motorsport and automotive development, while the Technology Strategy Board introduced a specifically motorsport-based funding package.

Of course, the main focus for this development at the moment is in the area of energy efficiency, which is a Holy Grail for designers in mainstream automotive and motorsport alike. Steve Sapsford says: "We face a massive challenge in that we're trying to reduce costs and make things more road relevant, improve fuel efficiency and incorporate lots of new technology – all while making sure we don't give anyone an unfair advantage."

Nowhere is this made clearer than in the advent of Formula E racing, which brings together electric cars and racing and is due to have its first race in September. Says Davies: "Energy efficiency and low emissions are bringing motorsport and mainstream automotive back together."

Beyond the entertainment value of these races, there is an explicit and avowed intention on the part of the organisers to use the sport both to drive the technological development and to enhance the public image of



traffic

Bringing technology from motorsport to mainstream automotive is rarely a straightforward process. Paul Fanning asks if Formula E will prove any different.



"One of things that's exciting for me in Formula E is that in F1 we were always limited by the internal combustion engine... F1 now is just process innovation, but Formula E still has many big leaps to take"
Mark Preston

electric cars. As Steve Sapsford puts it: "We can drive the development of the technology we need in mainstream automotive much harder and faster if motorsport is leading the way."

This, of course, involves regulation, which is where Bernard Niclot and the FIA come in. He sees the fact that electric drive technology is still in its relative infancy as a huge opportunity for the sport in terms of its popularity and its capacity to deliver innovation. He says: "After 100 years of development, internal combustion engine-driven cars are highly optimised, but electric cars are different. We obviously want Formula E to

help the development of electric vehicle technologies. At the moment, though, it's like a small baby. You need to put it in the nursery first and let it grow and develop."

Mark Preston, team principal of the Super Aguri Formula E team, concurs about the excitement inherent to working in this new discipline, saying: "One of things that's exciting for me in Formula E is that in F1 we were always limited by the internal combustion engine. .. F1 now is just process innovation, but Formula E still has many big leaps to take such as hopefully getting to four-wheel drive."

Equally, it is hoped that the fact Formula E will take place on street circuits will attract a new and different audience to current motorsport. Says Preston: "I'm interested in the experience change because that's going to change the perceptions of what people want in road cars. This is urban racing and I believe that change in experience will create a new interest."

Steve Sapsford, however, is emphatic in his insistence that the role of the regulatory authorities will be vital in allowing the technology developed for Formula E to make its way into mainstream automotive. "Governing bodies will have a massive impact on how motorsport develops," he says. "If we can get that aligned with how mainstream automotive is developing as well, there is a massive amount of power and efficiency in that technology... As engineers, we're all developing to the





regulations – that is the rulebook. If that is aligned, it becomes easier to develop technology.”

Lord Drayson (left), whose Drayson Racing team will compete in the new Formula is evangelical about the transformational nature of Formula E and the role it will play going forward.

He says: “Increasingly, the advantages of electric powertrain – particularly in relation to air pollution – are becoming clear. Things are happening faster than even we expected and I believe electric is the future and that the development of it will accelerate.”

Bernard Niclot, however, is more circumspect. “What we do in the FIA is not to say that the future will be this or that, but instead to let the automotive market decide and filter out all the possibilities. We try to manage uncertainty because we don’t know what the winner will be – in fact we don’t even necessarily think there will be a winner. I think the future of automotive will be very diverse. There will be a portfolio of different technical solutions. We simply try to give manufacturers the opportunity to try the various alternatives – as long as they are competitive and energy efficient.”

Steve Sapsford agrees to some extent, saying: “Despite the fact that there’s lots of electrification, we are going to be living with the internal combustion engine for a long time to come.”

However, when it comes to questions of whether hydrogen is a viable alternative technology, there is no great enthusiasm. Thomas Laudenbach of Audi Motorsport, for instance, says: “Hydrogen is there, but at the moment it is too far away. It takes too much energy to gather hydrogen and burn it – to provide it and still provide a positive energy equation is just too far away.”

However, Mark Preston offers some more comfort to advocates of hydrogen, saying: “The power unit can still be hydrogen and the drivetrain electric – those technologies could work together.”

The extent to which electric racing has already advanced the technology is a theme that Lord Drayson is keen to emphasise. He says: “We didn’t know even if it was going to be possible to develop this car and doing so has already answered a lot of questions about what you can do with an electric drive. We can discover the real engineering challenges of this car and now we can actually solve them.”

The different nature of electric drive technology, he believes, also attracts new technologies and otherwise unfamiliar companies into the market. “Using electric drives brings in new technology,” he says. “Take Qualcomm for instance, its wireless technology allows wireless charging. They simply wouldn’t necessarily have entered motorsport but for the electric drive. What’s happening in electric drivetrain is transformational and that’s why you’re getting these IT companies getting interested because they see how steep the pace of technology is.”

Thomas Laudenbach reinforces this point, saying: “Motorsport can be a driver for technology because you develop solutions and apply them immediately. That is why Audi is interested in motorsport – because we can drive it.”

www.fia.com www.draysonracing.com www.audi.com
www.ricardo.com www.ukti.gov.uk www.superaguri.com

Bright Spark

At the heart of the FIA Formula E Championship is the stunning new fully-electric Formula E car – the Spark-Renault SRT_01E. Representing the future of motorsport, the ground-breaking new single-seater is capable of reaching 0-100kph in less than 3 seconds and has a limited top speed of 225kph. Yet, the car produces zero emissions.

Using the very latest technology, the SRT_01E aims to push the boundaries of what is currently achievable in electric motorsport, whilst ensuring a balance between cost-effectiveness and sustainability, in addition to coping with the demands of racing entirely on street circuits.

It has been built by new French company Spark Racing Technology, led by the renowned Frédéric Vasseur, together with a consortium of some of the leading companies in motorsport.

Italian firm Dallara, who boast more than 40 years’ motorsport experience, has constructed the monocoque chassis, aerodynamically designed to aid overtaking. Made from carbon fibre and aluminium, the chassis is both super lightweight and incredibly strong and fully complies with the 2014 FIA crash tests - the same used to regulate Formula One.

Providing the electric powertrain and electronics is McLaren Electronics Systems, the world leader in high-performance technology for motorsport. Meanwhile, Williams Advanced Engineering, part of the Williams group of companies that includes the world famous Williams F1 Team, will supply the batteries producing 200kw, the equivalent of 270bhp. This will be linked to a paddle shift sequential gearbox, supplied by Hewland, with fixed ratios to help reduce costs further.

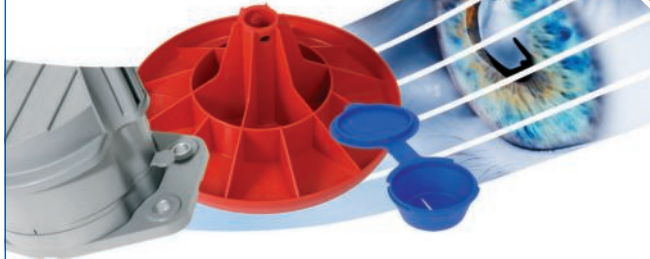
Overseeing all the systems integration will be the championship’s technical partner Renault, a leader of electric vehicles and an expert in motorsport thanks to its Renault Sport Technologies and Renault Sport F1 programmes. Specially designed 18-inch durable tyres will be supplied by Official Tyre Partner Michelin, with just one tread pattern available and three sets per driver per weekend in order to cap costs.

To ensure availability for the first season, all 10 teams will compete with identical SRT_01E cars. However, Formula E is very much an ‘open championship’, encouraging manufacturers and constructors to design and build their own cars to the technical specifications set out by the FIA.



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Passing it on

Neill Ricketts carried out apprenticeships and has since completed a degree from Salford University, and then an MBA from the University of Gloucestershire while Will Battrick completed an MEng from The University of Manchester Institute of Science and Technology. The two distinct approaches have given them insight in to the different methods of training future engineers. They now want to work with all levels, from school leavers to PhD students, to develop skills and interest in engineering.

"If we carry on growing at current rates we're going to need apprentices, graduates and research students," says Ricketts. "And the culture that got us through the first few years is an important part to what we do and we try to instil it in the people that join Versarien."

Trust your instinct

It's a risky business placing all of your eggs in one basket, but when the opportunity of a lifetime presented itself to two Gloucestershire based entrepreneurial engineers the temptation was too much to resist. Justin Cunningham finds out why?

While designing products might be a risk-averse activity, engineers that double as entrepreneurs sometimes have a different mindset. Since taking the leap from academic idea to commercialisation several years ago Versarien has won numerous accolades and awards, and secured contracts with several blue chip multinational companies. However, it has not all been plain sailing for the two engineers that founded the company.

"You have to understand that two years ago we were working out of a garage," says Neill Ricketts, co-founder of Versarien. "Since then, it feels like we have been on a roller coaster ride."

The journey started when Ricketts was divisional managing director of a group of high growth technology and engineering businesses including Total Carbide, a sintered tungsten carbide manufacturer. While scouting for new materials to complement its operations he came across a technology for producing micro-porous metals developed by the University of Liverpool. He instinctively knew it was an opportunity not to be missed.

"When made in copper the material is fantastic at heat exchange, sometimes 10 times more effective than other methods," says Ricketts. "And we can control that porosity very precisely. We have the ability to control the pore size, density, and even vary those properties throughout a structure. The material has a biomimetic morphology with a structure akin to coral or sponge."

One of Ricketts' first moves was to contact then ex-colleague Will Battrick to ask him to take a look. Like Ricketts, Battrick has a credited background in taking smart ideas and commercialising them. Similarly impressed, Battrick backed the material and sought to get involved. Excited by the prospect, Ricketts then approached the board of Total Carbide's parent company with expectations running high.

"But, they didn't want to know," he says. "I couldn't understand it, they just didn't like the material. The next move was to take it elsewhere so we approached another high profile UK engineering firm, but they gave us a similar response. So I had no option, I left the company. And then my wife hit the roof."

In a similar predicament, but seeing such potential, Battrick decided that it was his turn, "to have both of those conversations", and convince his girlfriend that his new position as Chief Technical Officer of a start-up company was a good idea.

"We both put our severance packages in to it and were not taking salaries," he says. "But, after several months of trying to get the business going we were running out of cash and literally had less than a month to make it work. At this point you start to doubt yourself and wonder, 'are we going to be able to do this?'"

Needing a break, the team decided it was time for a different approach and entered a Start-Up business competition to raise its profile.

"There was certain amount of eye rolling at the suggestion, given there were so many other things that needed to be done," says Ricketts, "but actually it proved fundamental to the development of the business. We literally got our first funding on the back of winning that competition."

Battrick agrees: "It's that third party validation. We can shout about it as much as we like and while we've got good careers and good track records that will only take you so far. So winning the competition allowed us to say, 'we are on to something here', and suddenly we started to have meaningful conversations with investors."

Since April 2012 the company has grown to over 50 employees and is now struggling to keep up with demand. Its main application is within

"We want to the guys able to get these advanced materials to market"

electronic and high performance computing systems where the porous copper acts as a highly efficient heat sink. The material is now being demonstrated for integration into systems everywhere from aircraft to cars and consumer electronics.

"They all suffer the same problem of needing greater heat dissipation," says Battrick. "Our issue now is being able to service these big markets."

The journey for Ricketts and Battrick had one final surprise in store when the Total Carbide business that Ricketts left to start Versarien was put up for sale. Knowing it was a good fit with Versarien, the pair brought the business in June 2013.

"Now the Total Carbide business, with Versarien, is worth twice as much as it was when I decided to leave," says Ricketts. "And we are now overrun with new business. But, it has not been easy and there were many long and sleepless nights."

While material innovations are an increasingly important area for driving the UK economy, it seems that large UK engineering firms still struggle to take on relatively risky internal start-up businesses. What is clear, however, is that engineers are increasingly coming to the fore and are prepared to take the initiative.

"We are essentially material developers and want to be seen as the guys that are doing a good job at actually getting advanced materials to market," says Battrick. "We are both passionate engineers but we are also entrepreneurs. Putting it all together and pushing it forward takes a lot of tenacity, confidence and belief."

www.versarien.com

Reinventing the wheel



With cycling numbers set to triple in the next decade, technology has an important part to play in getting people on their bike? Justin Cunningham finds out more.

The UK is embracing the push-bike as never before. London, for example, has seen the number of cyclists double in 10 years, with more than half a million trips now taken every day. And it is not just London, more than 60% of the world's population is expected to be living in cities by 2025, putting increasing pressure on transportation links.

It is hoped that the bike can provide some of the solution by taking some of the strain away from mass transport systems such as trains, tubes and buses by pursuing to move around using pedal power. But, while the benefits of using a bike to get around are clear, many are put off by longer distances and steep hills.

Bike design has gone hi-tech in recent years

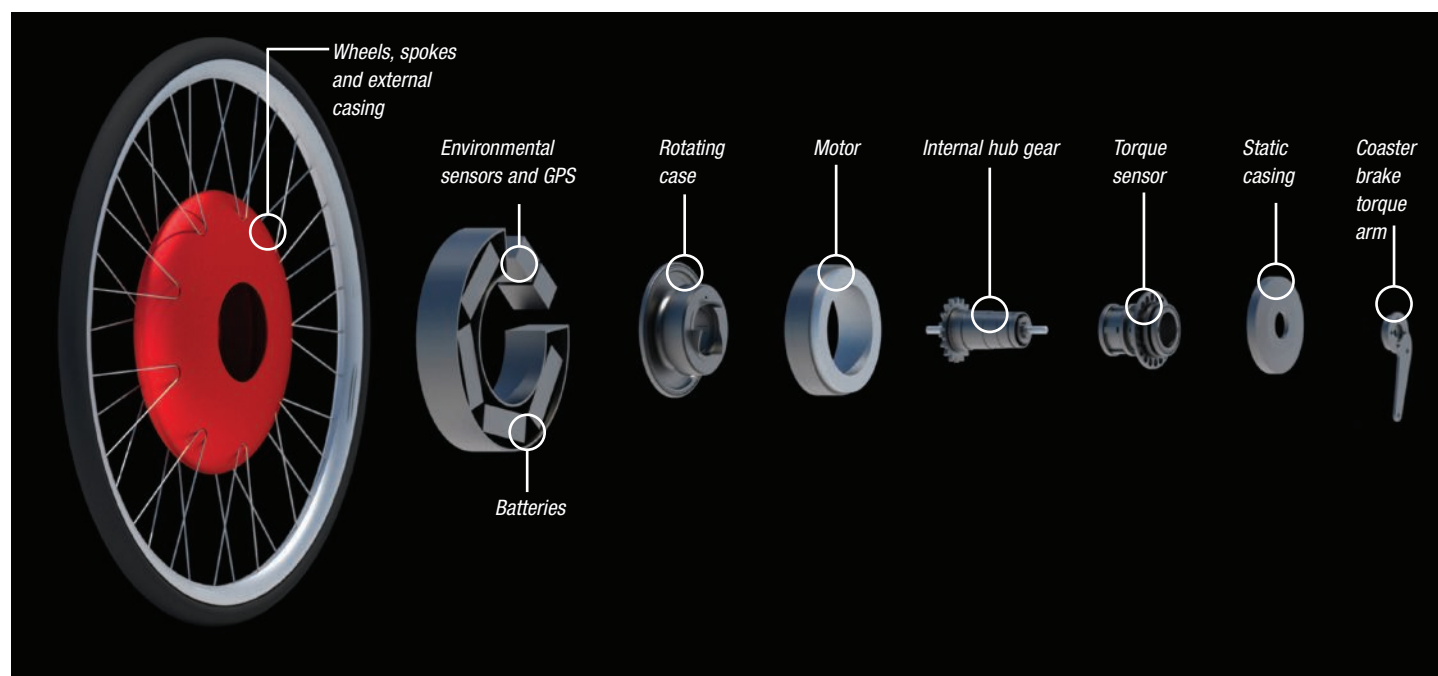
with increasing integration of technology such as lighter materials and near friction free bearings now commonplace. And, like the automotive industry, bike designers have been increasingly interested in integrating electric motors and hybridising them.

While many initial systems were bulky and required fairly significant implementation of a throttle control, batteries and motors, a development by the Massachusetts Institute of Technology's SENSEable City Lab in the US thinks it has come up with a far more elegant and practical concept.

"The Copenhagen Wheel is a self-contained unit," says Professor Carlo Ratti, director of SENSEable City Lab and co-inventor of the

Copenhagen Wheel. "It can be attached to any bike without needing additional electronics or wires, and it is fully controlled by your feet. When you pedal forward the motor supplements your torque, when you pedal backwards, to brake, the motor starts regenerating electric energy while reducing your speed at the same time."

The principle of the Copenhagen Wheel has now been spun out into the company, Superpedestrian. The wheel integrates batteries, gearing, a motor, sensors and control elements into a single hub unit that can supplement a cyclist's effort by providing three to ten times additional pedal power to the wheels. The aim is to assist cyclists, to enable them to cover greater distances and more easily tackle hills. The hope



is it will encourage people to take up cycling, and those already cycling to take on longer journeys.

"The Copenhagen Wheel is part of a more general trend of inserting intelligence into everyday objects to create smart, supporting infrastructure," says Professor Ratti.

The wheel uses a 250w or 350w brushless DC motor driven by from the 48v battery pack. The hub connects to smartphones via a Bluetooth connection that allows riders to log routes via a GPS connection, along with speed, and riders pedal power.

The Wheel is ridden like a normal bicycle with the motor smoothly phasing in and out automatically. The Wheel intuitively learns rider behaviour by analysing how hard he or she pedals against topography to determine how much support the rider may need. So on a steep hill the motor assistance will make the rider still feel like they are pedalling on a flat road. There

aren't, however, any additional throttles, wires, or buttons as the company is very keen to not take away from the pure simplicity of cycling.

The Wheel also features an intelligent locking system that locks the bike when the rider walks away and unlocks upon their return. The Wheel also features a smart security system where if someone rides away with it, the Wheel goes into a mode where the brake regenerates the maximum amount of power and sends the owner a text message with its location.

"Effectively, the Copenhagen Wheel puts your bike online at the centre of your personal Internet of Things," says Professor Ratti. "Over the past few years we have seen a kind of 'biking renaissance'. We could also call it a 'Biking 2.0' revolution, whereby cheap electronics allow us to augment bikes and convert them into a more flexible, on-demand system."

www.superpedestrian.com
web.mit.edu

Technical Specifications

Motor:	BLDC hub motor 250W / 350W
Size:	26" or 700c rim
Battery:	48Volt Lithium Ion
Connectivity:	Bluetooth 4.0
Battery Life:	1000 cycles
Smartphone:	iOS, Android
Charge Time:	4 hours
Compatibility:	Single-speed, multi-speed derailleur
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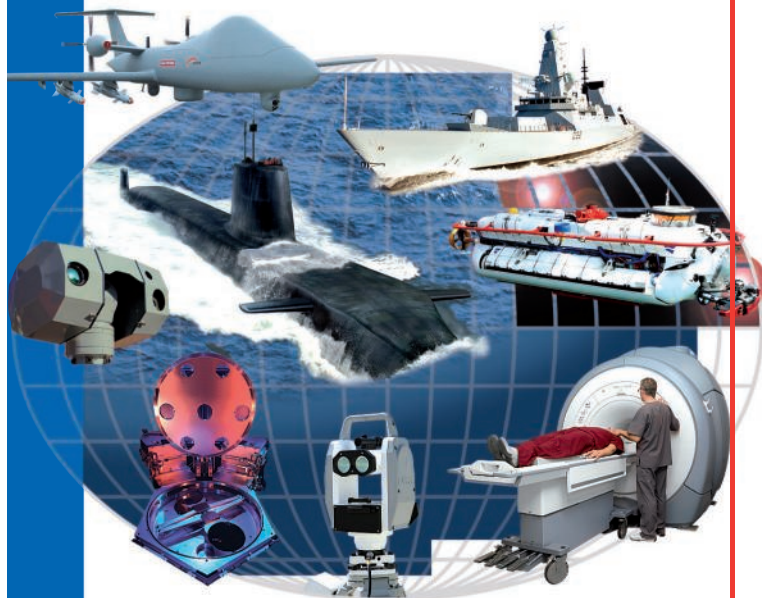


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A World of Motion CONTROL

Sensors bring brushless efficiency

A new sensor is able to offer greater efficiency in brushless DC motors with no need for chopper stabilisation. Paul Fanning reports.

Brushless DC motors need to operate more efficiently as energy and cost savings become a bigger concern. With this in mind, Honeywell Sensing and Control has developed a sensor technology for use with brushless DC (BLDC) motors that removes the need for chopper stabilisation, resulting in a product that has a faster response time, greater accuracy and minimal electrical noise without the need for additional filtering and the commensurate costs.

BLDC motors are growing in popularity due to their higher energy efficiency using electronic commutation versus mechanical commutation to control power distribution to the motor. Traditionally, though, most BLDC motor designers turn to chopper stabilisation to mitigate any sensitivity and stabilisation issues without thinking about the new advances that are available. Designers want the best – and this technology is claimed to be a more efficient and cost-effective solution without any ‘traditional’ manufacturing drawbacks.

At the heart of the technology is a quad Hall element and proprietary programming resulting in a highly sensitive and stable sensor tailored to meet the needs of designers using BLDC motors.

It means that OEMs get all the high sensitivity and stability requirements across a range of temperatures that are required in different sectors such as robotics, portable medical equipment and HVAC technologies and appliances where quieter and more efficient motor performance is of critical importance.

Initially designers may be cautious of using a sensor that does not have chopper stabilisation, but not only does the technology overcome chopper stabilisation drawbacks, it also brings additional performance advantages of faster response time, repeatability, improved jitter performance and no additional electric noise generation over a range of temperatures.

To prove the point, Honeywell tested the new non-chopper-stabilised sensors against a number of chopper-stabilised products – including those with claimed higher sensitivity.

The test involved mounting and centring samples as close to each other as possible so

that they all experienced the same environment on a circular target with 48 magnetic pole pairs used to trigger the product samples. All results were measured against a Top Dead Centre (TDC) trigger that had a very fast response time.

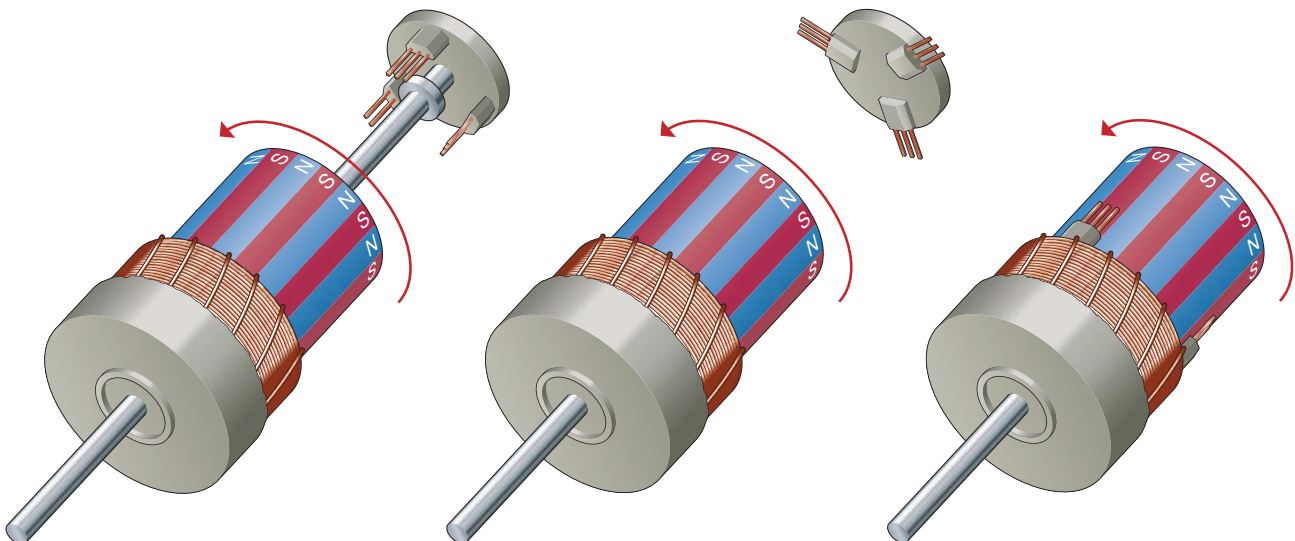
The results were impressive. In all cases the new technology delivered significantly better performance results in every area ranging from higher sensitivity and repeatability to faster response times.

Comparison testing results for reliability and response time showed that the non-chopper stabilised parts had a repeatable output with a response time that was between 10 µs to 20 µs faster than chopper-stabilised products, including the high-sensitivity samples.

Testing also showed that even if the repeatability issues could be overcome, the chopper-stabilised sensors still showed a slower response time, resulting in lower efficiency.

<http://sensing.honeywell.com>

In its whitepaper ‘How To Select Hall Effect Sensors for Brushless DC Motors’, Honeywell helps guide developers in selecting the correct bipolar latching Hall-effect sensor Integrated Circuit (IC) for electronic commutation in BLDC motors. These tiny ICs play a big role in motor efficiency, which can significantly affect the reliability and performance of many critical applications, including robotics, portable medical equipment and HVAC fans.



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SolidWorks builds Conceptual package

SolidWorks World 2014 in San Diego saw the further development of an announcement originally made at 2013's event. Paul Fanning reports.

Dassault Systèmes used this year's SolidWorks World to further develop a concept first announced at last year's event.

Heralded in Orlando, Florida last January, SolidWorks Mechanical Conceptual was originally supposed to become commercially available in autumn last year following beta testing. However, this deadline passed with no such appearance and this year it was announced that its actual release would take place on April 2nd this year.

Mechanical Conceptual is essentially a direct modelling option from SolidWorks intended to accelerate concept design for more innovation, better collaboration and faster time-to-market. Powered by Dassault Systèmes 3DEXperience platform, it removes the constraints of structured design programmes and instead offers a flexible, intuitive, powerful modelling environment that quickly captures, develops and communicates design ideas directly.

According to SolidWorks, mechanical

conceptual design consumes almost one-third of project time, with an average of six design iterations. With 98% of companies collaborating on conceptual design, the potential impact on companies' time-to-market and cost is clear, and transparent data management and communication are critical.

Dassault Systèmes was keen to make it clear, however that Mechanical Conceptual is a direct modelling package that is complementary to SolidWorks 3D CAD software rather than being in any sense designed to replace it. Indeed, it operates essentially as a paid for app within the SolidWorks package and is available for £2307 p.a.

Evolving a concept is where SolidWorks Mechanical Conceptual is really designed to speed up the design process. According to the company, it allows users to capture ideas and design iterations easily and with great flexibility directly in a digital model without pre-planning product structure. Equally, SolidWorks Mechanical

Conceptual's basis in the SolidWorks platform means that users will already be familiar with the tools and concepts, allowing them to focus on ideas rather than having to learn the software.

The single modelling environment, it is believed, merges the benefits of design history, parametrics, and direct editing so you can develop concepts the way you want – top down, bottom up, layout sketch, or master model. Meanwhile, direct editing easily transforms both native and imported geometry without limits, reducing remodelling time, while predictive, lifelike behaviour helps to confirm mechanical operation and shows how a model reacts in the real world so users can identify problems and resolve them while they design.

The software also combines the benefits of feature-based and history-free modelling for a highly flexible, interactive workflow, allowing users to eliminate wasted design time by never having to start over or drastically rework designs to make

SolidWorks Mechanical Conceptual is essentially designed to speed up the design process by allowing concepts to evolve more rapidly



an underlying change. It also helps to confirm mechanical operation during design and can alert users if design goals are violated. It also makes it possible to generate ideas quickly, try variations, and optimise mechanical operation.

Also announced at this year's SolidWorks World was the fact that Mechanical Conceptual will have a companion package called Industrial Conceptual, which, as its name suggests, is aimed at Industrial Designers.

Industrial Conceptual will also sit on the the 3DEXperience platform and is designed to help engineers and designers create complex geometry (3D concept models of stylised consumer products) as easily as machine design shapes. In terms of its release date, however, Dassault was not prepared to be any more specific than saying it would appear with the 3DEXperience platform "in the near future".

Of course, it would be impossible to have a new SolidWorks announcement without mentioning the Cloud and Collaboration. Thus, the company describes Mechanical Conceptual as bringing "natural collaboration" to the conceptual design process.

SolidWorks Mechanical Conceptual has social innovation capabilities built into its foundation. At any point, the designer can engage stakeholders by posting concepts to their private communities. Stakeholders are notified that there is a concept to review and can provide feedback using simple and familiar Web concepts. This type of participation will allow users to better engage with customers and differentiate themselves from the competition. After this, the designer is automatically notified and can continue to evolve the concept with this feedback.

Social innovation capabilities built into the foundations of Mechanical Conceptual are powered by Dassault Systèmes' 3DEXperiencePlatform. It automatically captures and retains concepts as they are designed and stores them on the cloud, with data continuously saved as you work. Data is always safe and up-to-date in one secure location where the design team can access the current design.

Users can also protect valuable ideas and quickly find and leverage previous concepts with full design intent and intelligence. Self-defined levels of access mean users can share, mark up, and discuss designs, as well as engaging better with customers.

www.SolidWorks.co.uk

Other News from SWW2014

SolidWorks Plastics Advanced

In Q4 2013, DS introduced SolidWorks Plastics Advanced, which lets customers analyse injection mold cooling systems and predict molded part warpage, ultimately allowing them to optimize their part and mold designs for manufacturability, maximum quality and lowest cost.

SolidWorks Inspection

SOLIDWORKS Inspection and SolidWorks Inspection Professional were announced to help companies create inspection drawings and reports within SolidWorks or using the standalone application.

These tools are for companies that need to create inspection documentation for first article inspection or as part of their quality assurance process and will be generally available in April 2014.

Collaborative Sharing

Collaborative Sharing powered by Dassault Systèmes 3DEXPERIENCE Platform for SOLIDWORKS, provides a structured, social, safe and connected environment for design teams and professionals who want to manage data on the cloud and collaborate without constraints.

Collaborative Sharing is included with the purchase of SolidWorks Mechanical Conceptual, providing every CAD user with all of these capabilities. Collaborative Sharing is also sold separately, for use by non-CAD users.

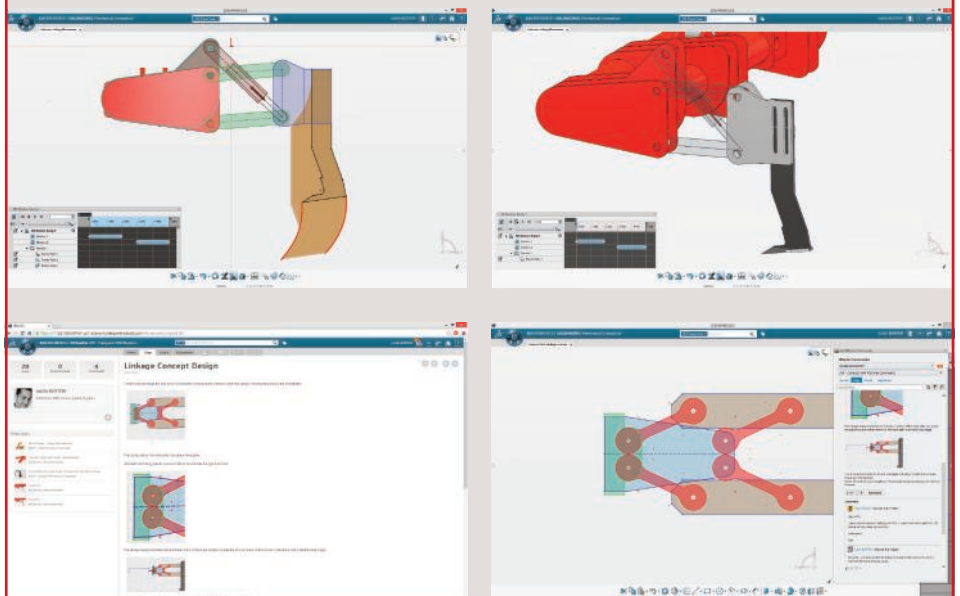
Simulia Product Design Simulation

SIMULIA Product Design Simulation is a structural analysis package that allows users to validate designs in SOLIDWORKS Mechanical Conceptual. Users can validate product (parts and assemblies) performance. It will be available in April 2014 along with SOLIDWORKS Mechanical Conceptual.

SolidWorks 2015 on the 3DEXperience Platform

The SolidWorks 2015 Portfolio will be integrated with the 3DEXperiencePlatform to allow the SolidWorks community to take advantage of all of the Collaborative Sharing capabilities. Collaborative Sharing for SolidWorks 2015 is a cloud-based, zero-overhead, easy to use, transparent data management and social solution which will provide basic data management and collaboration for existing SolidWorks users and set the stage for collaboration between SolidWorksMechanical Conceptual and SolidWorks 2015 users.

Collaborative Sharing for SolidWorks 2015 is expected to be available in November as part of the 3DEXperience Platform 2015x release.

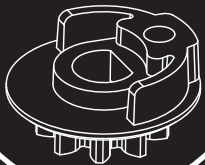


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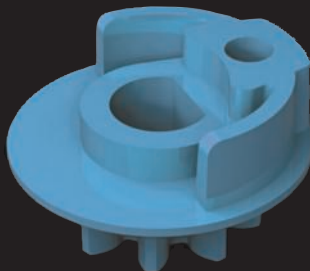


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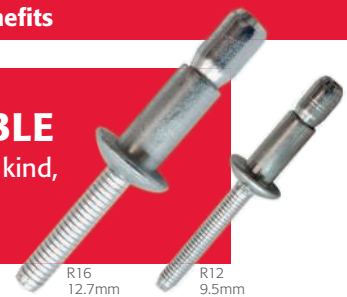
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Infrared welding gives seam strength

An infrared welding system offers high welding seam strength and absolutely no particles.

Paul Fanning reports

For some years now, infrared welding has been gaining significance as compared with hot gas welding and established processes such as hot plate welding and vibration welding. Now, a leading provider of infrared welding systems has developed this technology to series-ready status for a number of applications.

Contactless infrared welding of plastics has a number of advantages and is suitable for both small and large components.

Frimo offers the Highspeed, an infrared welding system specifically for small to medium-sized components. These can include everything from small air valves to various pipes, containers or engine compartment applications to interior components such as glove boxes.

A special drive system allows for movement speed, which has not been possible in infrared welding technology until now. In terms of critical changeover times, these comparably high speeds are becoming ever more necessary for energy-efficient and strong welding of high-performance plastics. For this reason, the Highspeed infrared welding system is equipped with linear motors. These motors are characterised by a high degree of availability, low maintenance, a high degree of repeat accuracy and low-noise operation. High precision is guaranteed through the retrieval of actual values from the route, allowing any slips of the drive train to be completely eliminated.

As the infrared emitters are only switched on during the plastic's brief heating time, the process allows for lower consumption of

resources and energy. The parameter and control options have been optimised to such an extent that it is possible to set the optimum movement and temperature values for the thermoplastic to be welded. This provides maximum strength of the welded joint, with a high degree of repeat accuracy.

Thanks to contactless heating of the plastic, infrared welding also meets increasing requirements for there to be no particles after the joining process, for example for air and oil ducting components. Many manufacturers of such components are imposing increasingly strict standards and regulations in this area. Infrared welding is also to be recommended for the welding of reinforced high-performance plastics, such as fibreglass reinforced polyamides, which are being used more and more as structural components in lightweight construction. The process offers extremely high

degrees of strength, which is of particular interest in safety-related areas, and also allows for 100% gas-tightness. Flexibility is catered for both in the use of the materials to be welded and in the design, i.e. it is even possible to weld complex 3D geometries.

The Frimo system portfolio for infrared welding currently includes six standard machines, from mini to maxi, for virtually any application. Like all Frimo JoinLine infrared welding systems, the Highspeed also allows for rapid and flexible tool changes, for example from the front or the back of the machine. The cartridge construction of the tools allows for completely flexible handling and, at the same time, ensures optimum protection of emitter blocks. Different sources of radiation are used in terms of tool technology. For the majority of applications, short-wave glass bulb emitters have proven to be suitable. These can be used either (most commonly) as a twin-tube emitters in the standard design or as an individually adapted contouring emitter.

Protective shadow plates are used to protect critical areas that are not be allowed to heat up, and can also be cooled. Depending on the requirements of the project, FRIMO now also use medium-wave infrared emitters, either as a glass emitter or as a metal foil emitter.

Frimo also offers a range of automated solutions using robots to increase availability and productivity, and the effort involved in handling components between machines is reduced.

Depending on the project and customer

The Highspeed is an infrared welding system specifically for small to medium-sized components



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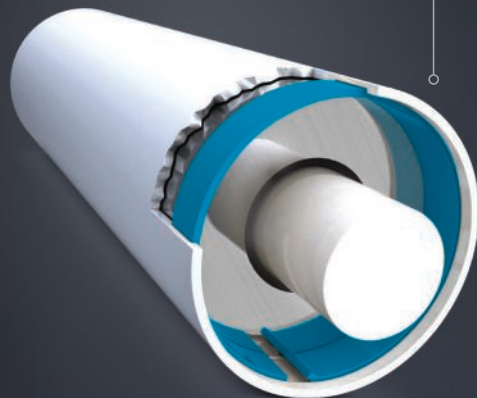
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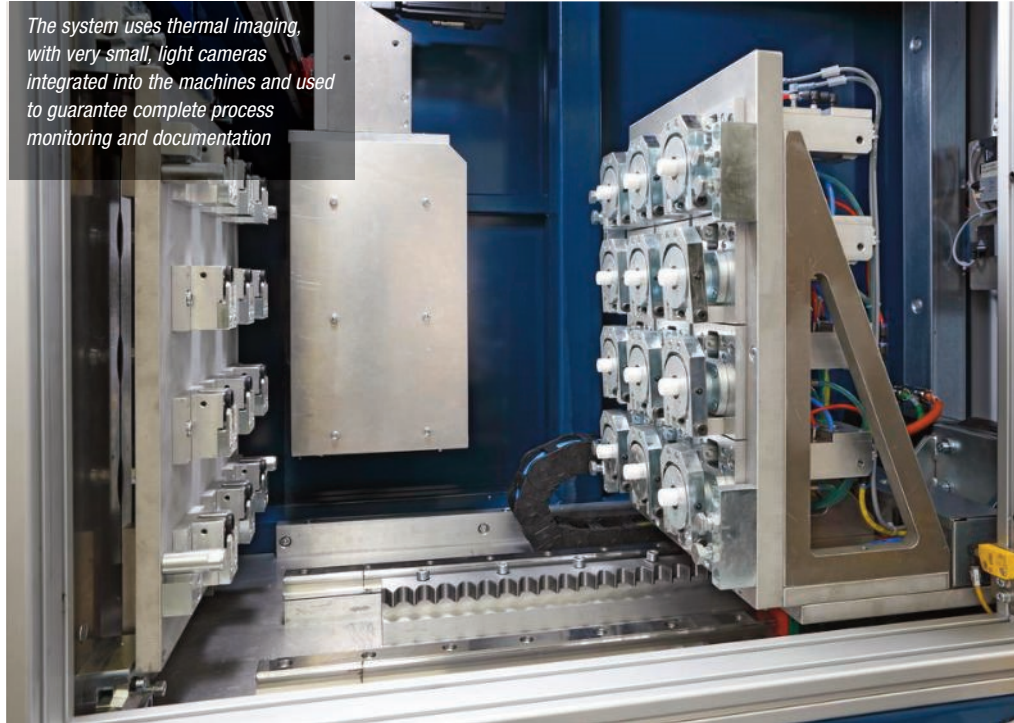
requirements, different production layouts and combination and/or special solutions can be realised here.

An important aspect, not just for quality assurance of safety-related components, is monitoring of the temperatures occurring on the surface of the joining partners. This system uses thermal imaging, with very small, light cameras integrated into the machines and used to guarantee complete process monitoring and documentation at all times. Data is transmitted to superordinate systems so that it can also be effectively used for remote maintenance.

The systems' control technology has been further perfected so that compensation of part tolerances within the infrared welding process is now possible for the first time. This is particularly advantageous in the case of infrared welding of gas and liquid-ducting systems. In this area of application alone, more than 30 infrared welding systems in a wide variety of designs are already in series use by various customers.

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Inserts for plastics in compact electronic assemblies

New micropem® thru-threaded brass inserts for plastics introduce ideal fastener solutions to attach components in compact electronic assemblies. These fasteners with threads as small as m1 install easily and permanently in a wide range of plastic materials from abs to polycarbonate. They promote secure and reliable attachment for devices ranging from hand-held consumer electronics to medical equipment,



among many others. A single mating screw completes the joining process.

The micropem inserts will install in either straight or tapered mounting holes and their symmetrical design saves time during production by

eliminating any need for insert orientation prior to installation.

Installation is achieved by pressing the insert into a mounting hole using either ultrasonic insertion equipment or a thermal press. When installed ultrasonically, the frictional heat caused by the vibration then melts the plastic surrounding the insert and, when the vibration ceases, the plastic solidifies to lock the insert into place. Use of a thermal press will melt the plastic surrounding the insert.

The micropem inserts are available in thread sizes m1 to m1.6 and in several lengths. They join a growing family of micropem fastener products and capabilities engineered to help enable smaller and lighter designs. www.pemnet.com

Balltec uses RotaBolts

Balltec, which develops high integrity mechanical connectors for use in particularly harsh environments, has fitted RotaBolt® measurement fasteners for the first time on a new offshore chain tensioner system.

The RotaBolts have been used on the main structural top yoke beam of the tensioner which has a load capacity of 1000 tonnes.

The bolted steel assembly weighs 20 tonnes and incorporates a self-contained power unit. It is described as being like an ROV, containing an autonomous electronic control module. The use of RotaBolts has significantly simplified the installation process and gives added assurance that the correct design load is being achieved across the critical bolted joint on the beam.

RotaBolt measurement technology is increasingly being used across a wide variety of applications to ensure structural integrity and dramatically reduce maintenance costs. Wherever bolted joints are subject to pressure containment, fatigue, vibration or structural slippage, operators are now choosing the measured approach of RotaBolt to achieve and maintain the correct tension across the joint.

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Engineering natural advantage

While bio-based plastics may have green credentials, that's not quite enough to win over many engineers. So, can the material offer any other advantages? Justin Cunningham finds out.

Plastic materials have had quite a lot of bad press in recent years for negative environmental impact, particularly by the mainstream press that are quick to use the plastic bag and The Great Pacific Garbage Patch as examples.

In fairness, plastic has had some positive impact by steadily replacing metal components. Perhaps the best examples here come from the automotive industry. Replacement of both structural and non-structural components has simplified production processes, reduced costs and critically reduced weight. And that has significantly improved fuel consumption and reduced tailpipe emissions.

However, plastic materials are on the whole derived from oil, which is by definition unnatural and finite. So, can a plastics company ever really begin taking sustainability seriously?

"Sustainability for DSM is extremely important," says Marnix van Gurp, director of research and technology at DSM Engineering Plastics Europe. "It is really in the core of our strategy and we want to focus all of our development on sustainability. The only way a company will last is to think about sustainability in the broader sense and we have to make that work. And in practical terms that is leading us to

make materials from renewable sources."

Sustainability is one of those buzzwords that everyone in industry seems to be using at the moment. Yet, despite its prolific use, it tends to be misunderstood and is commonly misused. However, for DSM the direction of its sustainable operations are clear and certainly seem to have credibility.

Although relatively early days, the company sees its future, long term, in producing bio-derived plastics and views sustainability to be about sustaining the company and keeping it competitive, as much as it does about sustaining the planet.

Like many of today's larger plastic manufacturers, it is perhaps less interested in what are commonly described as first-generation bioplastics such as corn-derived Polylactic Acid (PLA), and is instead developing what might be described as engineering bioplastics.

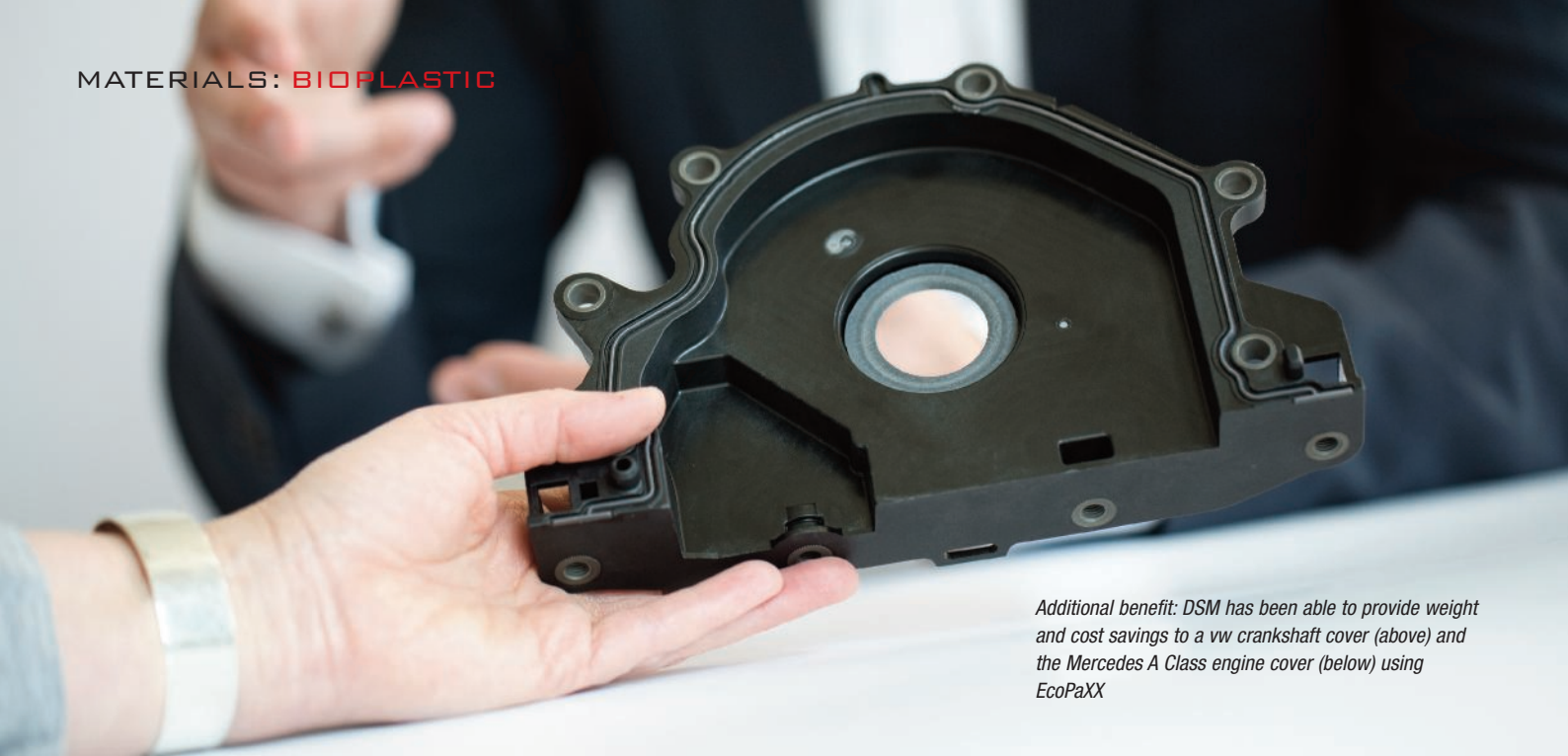
DSM has to date made very significant and positive steps towards achieving its goals by cleverly combining diamminobutane with a sebacic acid. In doing so it has made a PA 410 under the brand name EcoPaXX that's suitable for use within the automotive industry.

"This allows us to focus on speciality

applications in the automotive and other specialist industries," says van Gurp. "We need a material that is both strong and has a high melting point if it is to be used for under-the-bonnet applications. EcoPaXX is a polymer with a melting temperature similar to PA66, which is already well established in the automotive sector, so it is a good fit."

The sebacic acid used to make EcoPaXX comes from castor oil, which in turn is derived from the harvest of castor beans. The beans have a number of advantages in terms of how and where they can be grown. In countries like India they can be harvested several times a year and can be grown in poor soil not used to grow crops for human consumption. This potentially removes the beans' production from competing with food crops, a significant criticism of earlier moves toward biofuels and one DSM is mindful of not repeating with bioplastic production.

"The pace that it can be grown at means it has the potential to be a very efficient raw material, with very little environmental impact compared to other possible crops like rape seed oil or corn," says van Gurp. "It produces a very interesting polymer and we can achieve a bio-content of roughly 70% in the EcoPaXX."



Additional benefit: DSM has been able to provide weight and cost savings to a vw crankshaft cover (above) and the Mercedes A Class engine cover (below) using EcoPaXX

The move toward making it a suitable automotive plastic relied on DSM's ability to make the melting point of EcoPaXX sufficiently high to enable use within engine compartments. The team has so far been able to push the melting point to 250°C, more than adequate for under-the-bonnet applications.

Bioplastics do offer some unique advantages over oil-based ones. Far from simply just replacing oil-derived plastics, they are actually bringing additional advantageous properties to the fore.



"As sebacic acid is made up of relatively long monomers, it absorbs much less moisture than standard polyamides," says van Gurp. "This makes the material very hydrolytically stable, even more so than PA6 and PA66. So if you have really demanding cooling applications, for example, it's actually a very nice polymer to use."

And this is critical for bioplastics. The material must offer distinct advantages over oil-based plastics in terms of weight, cost and performance. The fact it is bio-based or has less embedded

carbon is not enough to convince many engineers and purchasing managers. With tough targets on tailpipe emissions set by the EU on automakers, the focus is on lightweighting and fuel economy, and not bio-based or environmentally friendly materials.

"We must sell the material on more than just the fact it's bio-based," says van Gurp. "The material is, however, becoming increasingly valued by the automotive industry because it has excellent properties, but not so much because it is made from renewable sources."

In addition, EcoPaXX has a very good surface finish, and while it may be used in the engine compartment the appearance of engine trim has become increasingly important over the last decade to signify quality. However, despite the potential, DSM is cautious of immediate roll-out.

"While we see it as a very versatile polymer, the big

volumes will not come currently because it is bio-based," says van Gurp. "But, going forward, it will become increasingly applied as engineers put more importance in moving away from oil-based polymers."

Sustainable Future

One of the greatest strengths, and weaknesses, of plastics generally is its longevity. There has been much criticism around the throwaway culture that has become part of modern society and the fact

that plastics do not simply disappear, but remain in state almost regardless of the environment is a problem. While plastic materials that biodegrade might be one solution, it has been argued that actually is far from an ideal, even if it might answer some of our litter problem.

"DSM certainly believes in bio-based material rather than biodegradable plastic materials," says van Gurp. "In the end, biodegradable materials are not sustainable, as they are designed to be thrown away."

DSM has made assessments of both the carbon footprint of oil and bio-based plastics as well as carrying out full life cycle analyses of both materials. Perhaps unsurprisingly, it has shown that at the point of sale EcoPaXX is virtually neutral (cradle to grave) compared to an equivalent oil-based plastic.

"We feel we have the responsibility of coming up with materials with a carbon neutral status" says van Gurp. "But, it is a matter of having these materials in the supply chain and allowing customers easy access to them, and that means they need to be accessible from a supply point of view, and an economic one."

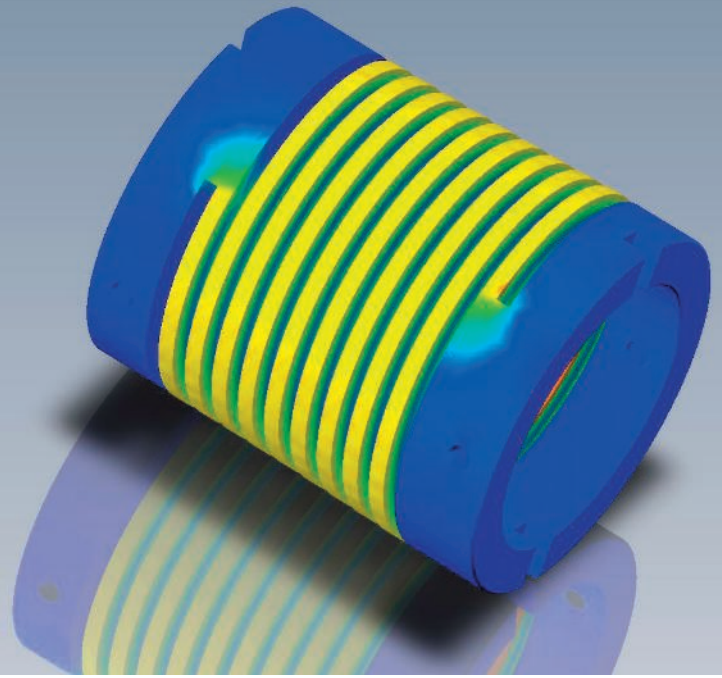
For the moment, however, EcoPaXX remains a speciality product that can be applied where required. And, currently it is not being marketed as a particularly sustainable product.

"A consumer will not buy a Mercedes because it contains EcoPaXX," says van Gurp. "Mercedes market the material as a part of its total sustainability portfolio, but the focus is still on fuel consumption. The volume and big growth will depend on the economic availability and will of course be influenced by future legislation."

www.dsm.com

Long life and precision with torsion springs

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Machined Torsion Springs from Abssac offer a range of advantages to end users. Being machined from a single piece of solid material, they can provide very precise linear deflection rates because they eliminate virtually all residual stresses.

In a traditional, wire-wound spring, the spring rate can change over time. Because of repetition, the elastic properties deteriorate, which of course means a massive headache for the end user, who is faced with the problem that no two wound springs are exactly the same in terms of performance.

Abssac's machined torsion springs, on the other hand, offer precision elasticity that a wire-wound spring cannot. To give some idea of the improvements possible, most wound torsion springs can achieve at best a linear deflection rate of around 15%, but the machined alternative can easily achieve 10% on rate and can be tuned to +/-2% for the more demanding applications.

This performance is due to a number of properties unique to machined springs, such as the fact that the coils react uniformly to give a linear rate. Equally, because each coil reacts to the same deflection, it is possible to determine how much the internal and external diameters will react.

This is far from all that these products have to offer, however. Because they are machined, it is possible to make these springs multi-start. i.e. Double-start or even triple-start springs with two or three intertwined spring elements are available in the single piece construction. The critical performance dimensions of the spring system can therefore be predicted, which ultimately alter the performance, degree of stiffness and accuracy required. Finite Element Analysis with specific node blocking is used to verify the feasibility and performance of the machined spring.

The machined nature of the springs also means that the application of a moment to the spring system is possible using a pure couple design. Some examples of this being double tangs (external internal and longitudinal), slot, splines (internal and external) and bolt circle configurations. It is also possible to resolve the moment by an integral torque restraint on the coil side.

The fact that these springs are machined from a single piece is also crucial because failures often occur in wound springs as integral features may need to be brazed, welded or attached in some other way

that can have a negative effect on the accuracy and precision of the spring.

In terms of the life expectancy of Abssac's machined torsion springs, the fact is that it is potentially infinite, providing it is used within the original design parameters. Clearly, the savings in terms of downtime and productivity offered by such longevity are potentially huge.

Available from 10mm diameter to 130mm diameter, Abssac's machined torsion springs have applications in a range of industries, including aerospace, oil and offshore exploration as well as surgical apparatus and prosthetics.

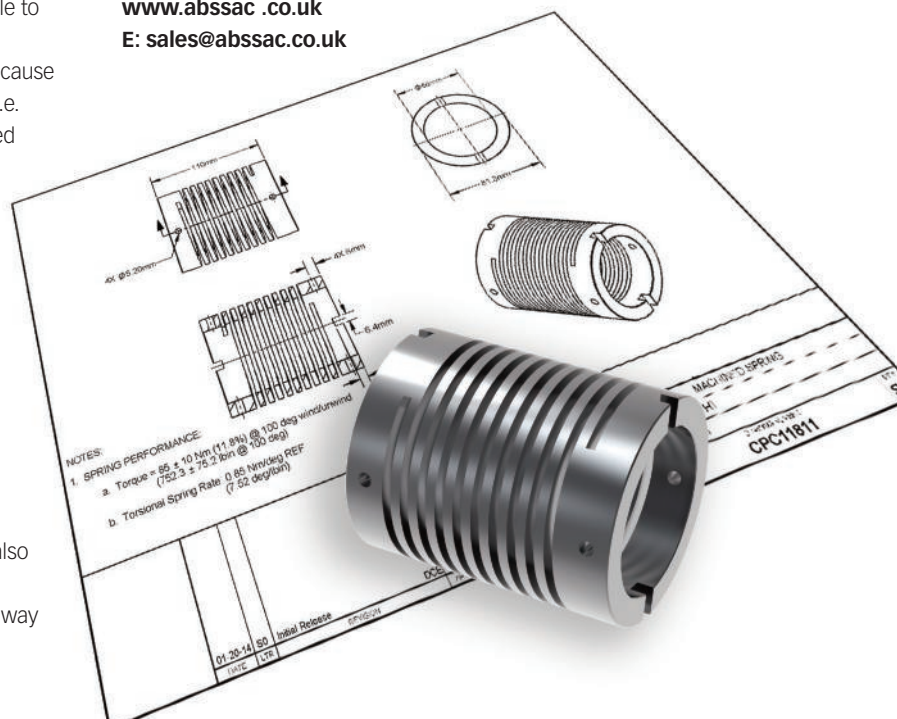
Because they are machined rather than wound, it is also possible to make these springs in a range of exotic materials that would otherwise not be feasible. These have included Inconel 750 and Inconel 718.

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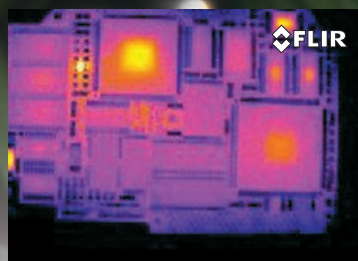
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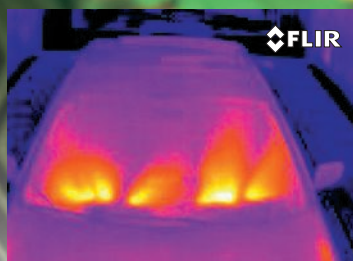
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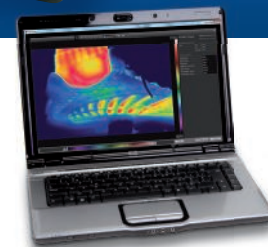
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Breaking the hypersonic barrier

While fuel efficiency and stealth dominating modern aircraft design, why is there renewed interest in flying at hypersonic speeds? Justin Cunningham finds out.

For many, the golden age of aviation was the 1950s and 1960s when the driver for aircraft was speed, with the rapid development of both jet engine technology and aerodynamic performance. It was an era that pushed the boundaries to such a degree that even today they represent many of the limitations.

One of the most iconic examples of aircraft from the era is the Lockheed Martin SR-71 Blackbird, which has come to symbolise the espionage that went on during the Cold War. Designed as a reconnaissance aircraft, crews could fly from New York to London in less than two hours and reach speeds in excess of Mach 3. It continues to hold the title of the fastest air-breathing manned aircraft ever flown.

By contrast, modern military aircraft seem to have accepted the speed limitation of the turbojet engine of around Mach 2. The extra effort, and expense, to go faster has these days been traded against stealth technology in a bid to continue to operate in airspace controlled by other countries, essentially to spy and gather intelligence.

However, there does seem to be some renaissance from serious aerospace companies outlining plans to again push the boundaries of speed. There has been renewed interest by military forces, particularly in the US, to build another very high speed spy plane to fill what it considers to be a coverage gap between surveillance satellites, subsonic manned aircraft, and unmanned aerial vehicles for intelligence, surveillance and reconnaissance (ISR) and strike missions.

Over reliance on satellite reconnaissance has spawned a growth in anti-satellite weapons, anti-access tactics, and counter-stealth technologies from opposition. In addition positioning satellites can day 24 hours or more with movements able to be predicted and sometimes even tracked by a savvy enemy. A high-speed aircraft, however, could penetrate protected airspace in a matter of hours anywhere in the world, and observe or strike a target before enemies could even detect its presence.

The US has historically felt most comfortable with technology that is a generation beyond its rivals. And by the mid-2020s it is believed that many countries will produce and export advanced aerial technologies that could effectively combat its current espionage tactic reliant on stealth and satellites. This is driving a rethink and the US Air Force is now seriously considering the further development of hypersonic aircraft to replace legacy systems

that could soon become outclassed.

Brad Leland, program manager for hypersonics at Lockheed Martin, says: "Speed is the next aviation advancement to counter emerging threats in the next several decades. The technology would be a game-changer in the theatre, similar to how stealth is changing the battlespace today."

One of the most interesting examples with perhaps the most potential again comes from Lockheed Martin's Skunk Works. It is proposing a next generation hypersonic spy plane that could fly at twice the speed of Blackbird. Given its reputation and the fact it built the SR-71 as well as arguably the most advanced aircraft of the modern day in the F-35 Joint Strike Fighter and F-22 Raptor, it should be taken pretty seriously.

Known simply by the designation SR-72, Lockheed Martin says its engineers are developing a hypersonic aircraft that could fly as fast as Mach 6 – that's London to New York



minutes – to take up tactical roles for reconnaissance and combat missions. However, it is unlikely to beat all of Blackbird's records as disappointingly, but perhaps obviously, the SR-72 is expected to be unmanned.

While the Blackbird was developed in the 1960s using a slide rule, paper and hand calculations, the SR-72 will be able to take advantage of the numerous cutting edge 3D CAD and simulation packages now available.

In addition, while Blackbird relied on the pilot skill and analogue controls, the new generation of hypersonic aircraft will be a product of the digital age and need millions of lines of code, thousands of sensors and powerful computers to keep it aloft.

The details of the SR-72 released so far focus a lot on the engine technology. The future aircraft will look to use an impressive and innovative concept on its proposed engine system.

Initial reports so far say the engine will run an engine setup called Combined Cycle Propulsion. In a similar way to the Blackbird, it would have the ability to augment its inlet nozzles to allow the engine to switch modes, from turbojet to ramjet.

Speculative reports look as if the SR-72 will use a flap at the leading edge of the air intake to direct the airflow between two separate channels for the turbine and ramjet engines. It is unclear,

however, if these will be completely separate engines, or just a single engine operating in different modes.

For several years Lockheed Martin Skunk Works has been working with Aerojet Rocketdyne to develop a method to integrate a turbojet engine with the experiential supersonic combustion ramjet (scramjet) engine still being developed. The operation of a scramjet is likened to trying to light a match in a hurricane and relies on supersonic air being mixed with fuel and combusted. If successful, however, it would power the aircraft from standstill to Mach 6.

Hypersonic speeds also place enormous thermal management issues on the engines and surrounding airframe. It created major problems when operating the Blackbird and led to perhaps its most infamous design flaw.

Due to thermal expansion, engineers could not get its fuel tanks to seal properly at ambient temperatures. On takeoff its widely acknowledged the aircraft leaked fairly considerable amounts of fuel over the runway.

The 85% titanium structure is needed to heat up and expand to properly seal the tanks. In practical terms, this means that, once airborne the aircraft had to carry out a series of sprint flights to warm the airframe to such a degree that it would expand and seal the tanks. Then the Blackbird would need to carry out air-to-air refuelling before actually beginning its mission.

During operations the airframe could reach over 300°C. Once landed, it required the pilots to sit in the cockpit for a cool down period to let the structure cool, and shrink, back to its rest state.

Any future aircraft travelling at twice the speed of Blackbird will be subject to even greater heat pressures, and will need to overcome these shortcomings and design flaws.

All of these factors support the widely-held belief that hypersonic flight is extremely expensive, technically near impossible, and will take decades to get right. However Lockheed disagrees and says future hypersonic aircraft do not have to be an expensive or a distant possibility. In fact it has been reported that Lockheed, 'have developed a way to work with an off-the-shelf fighter-class engine'.

The SR-72 is now following the US Air Force's hypersonic road map for developing a hypersonic strike weapon by 2020, and a penetrating ISR aircraft by 2030. At present an optionally-piloted scaled demonstrator is planned to be built as soon as 2018.

The demonstrator planned to be 18m long will be about the same size as the F-22 Raptor, and will be powered by one, full-scale engine capable of flying for several minutes at Mach 6. Flights of the demonstrator would be conducted starting in 2023 leading up to full scale testing and production in 2030. The SR-72 is to be similar a similar size to the SR-71 at about 30m long and is likely to have similar range.

The SR-72 will face significant political challenges in being accepted by the US Air Force, which may well opt for lower cost, and much slower stealth UAV to perform future ISR missions. However, the SR-72 would promise to be a game-changer should it be built, smashing boundaries and breaking records. Its development could well usher in a new golden age of aviation.

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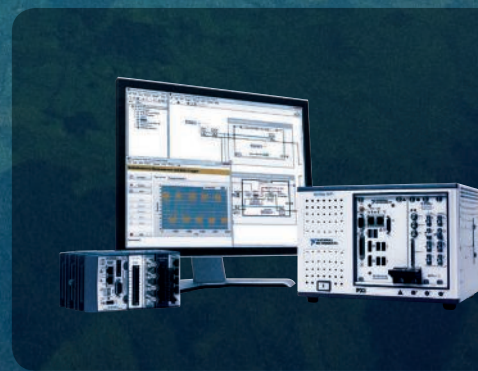
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Don't let leaks wipe out your patents

The Internet has changed the ease with which information can be published.

Here, Jonathan Jackson, Partner D Young & Co LLP, looks at the effects of this on patent protection.

The ease with which information can be disseminated globally over the internet also means it can be leaked easily. The leak may relate to a new product or unique feature and may often be provided by a single developer working for a manufacturer. Leaked information may only have been initially published on a single website, but within a couple of hours, can be disseminated across the world.

These leaks are not only potentially damaging from a commercial perspective, by giving away information about future products, but also potentially damaging from a patent perspective, as these leaks may constitute a public disclosure and thus prejudice any future European patent applications directed to the new product or unique feature within a product. In other words, the leak may make any subsequent patent application directed to that unique feature totally worthless. This is particularly damaging if the feature would make consumers choose one product over another, as the monopoly right provided by the patent is destroyed, leaving competitors free to incorporate this new feature.

As most of these disclosures occur on the Internet, we should first examine how the European Patent Office (EPO) deals with Internet disclosures.

The internet is constantly evolving, making it very difficult to determine with any degree of certainty what information was disclosed and when. These questions can be answered using Internet archiving tools such as The Wayback Machine, which automatically trawls the Internet and takes snapshots of webpages. But notwithstanding what can be shown to have been disclosed, the question to be answered is, "was this disclosure made available to the public?"

The leading case at the EPO is T1553/06. This

case has a test that determines whether a specific Internet disclosure was made available to the public: "If, before the filing or priority date of the patent or patent application, a document stored on the World Wide Web and accessible via a specific URL could be found with the help of a public web search engine by using one or more keywords all related to the essence of the content of that document and remained accessible at that URL for a period of time long enough for a member of the public, i.e. someone under no obligation to keep the content of the document secret, to have direct and unambiguous access to the document, then the document was made available to the public in the sense of Article 54(2) EPC 1973.

In many instances of leaks, the information is published on specific technology websites. Many of these rely on having a high position on search results. Therefore, these websites typically use very pertinent keywords and maintain their articles for many years. In many instances, therefore, it may be argued that the leaked disclosure on these technology websites is made available to the public and is therefore prejudicial to a later filed patent application.

Unfortunately, the European Patent Convention (EPC) does not provide a grace period for filing applications after disclosures. However, Article 55 of the EPC does allow that where there has been a disclosure due to an "evident abuse" in relation to the applicant, then such disclosure will not be seen as prejudicial to

the patent application as long as the European patent application is filed within six months of such disclosure. In other words, for a leaked disclosure not to be prejudicial to a European patent application, two criteria need to be met.

The European application must be filed within six months of such a disclosure.

Secondly, there also needs to be an "evident abuse" in relation to the applicant. Case law has developed in this area which suggests that the "abuse" requires actual intent to harm or actual knowledge that harm would or could be expected from a planned breach of confidence (see, for example, case T436/92).

In the event of a leak, it is important to identify when it occurred and to mitigate the damage. In order to identify when leaks do occur, it is possible to set up a Google alert. These provide email alerts when relevant content appears.

Once a leak has occurred, steps can be taken to mitigate the damage. If Europe is an important market, it is vital to file the European patent application within six months of the leaked disclosure. In order to argue that such disclosure was an "evident abuse" it is also important to show that any person who leaked the information had actual knowledge that harm could or would be expected as a result of the leak. As it is almost impossible to identify the source of a leak, it is desirable to show that all developers are regularly told about the damage that can be caused by leaks. Therefore, it is important to keep a record of not only what was leaked, but also to record what education developers have received showing that harm could or would be expected as a result of a leak.

It may be difficult to stop leaks, but when they do occur, it is important that your patent application is not washed away in any resulting flood.

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Eyes on the road

Can motorcyclists safely use multimedia devices while on the road? Maybe – if this challenge can be met.

Motorcyclists arguably need to keep their eyes on the road more than any other road user. The acceleration of modern bikes and inherent exposure to danger can make riders more venerable, especially if they become distracted.

Of course, motorcyclists have none of the creature comforts that many car users now take for granted. For example, while satnav on a motorcycle is possible, it is far from ideal and requires the rider to keep looking down at the screen to get the next direction. In addition speech directions are also often quite difficult, if not impossible, to hear.

Then there are hands-free kits to make and receive calls. While in most modern cars this all automated and voice activated, motorcycle kits are fiddly and do not integrate well with other gadgets and systems. The problems is that the workload of riders can be dominated by activating and keeping an eye on various gadgets, dials and systems, which means that eyes are elsewhere when they should be on the road ahead.

The Challenge

The challenge this month is therefore to come up with a way of allowing riders to access multimedia tools without taking their eyes off of the road ahead.

The challenge is really two-fold. The first issue is integration and getting a system that can take input data from the bike about

performance such as rev's and speed, as well as incorporating other technologies such as satnav, hands-free communication, rear-view camera, radio and even mp3s; all of which can be accessed hands-free.

While the key is integrating the many systems involved, hardwiring them all in place is far from ideal as it would both clutter the motorbike as well as provide various wires that

could be caught up to the rider's peril.

Furthermore such a system should not require riders to re-focus their eyes. Travelling at speed means that while it might only be a quick glance for the briefest of seconds, while taking eyes off the road and refocusing back and forth significant distance can be travelled compromising reaction times and braking distances as a consequence.

The solution we have in mind, while hi-tech, might seem rather obvious. However, it has taken some time to develop and get right. We'll outline it in the March issue of Eureka, but see if you can come up with something better.



The answer to last month's Coffee Time Challenge of how to prevent injury while jogging can be found in our Technology Briefs section on page 11.

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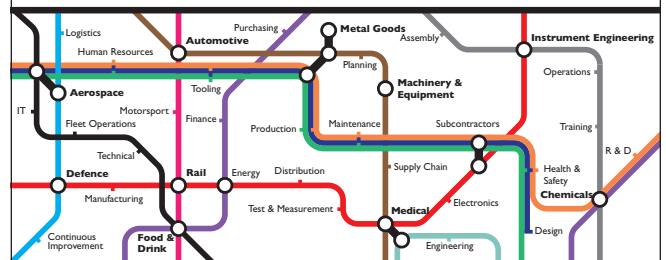


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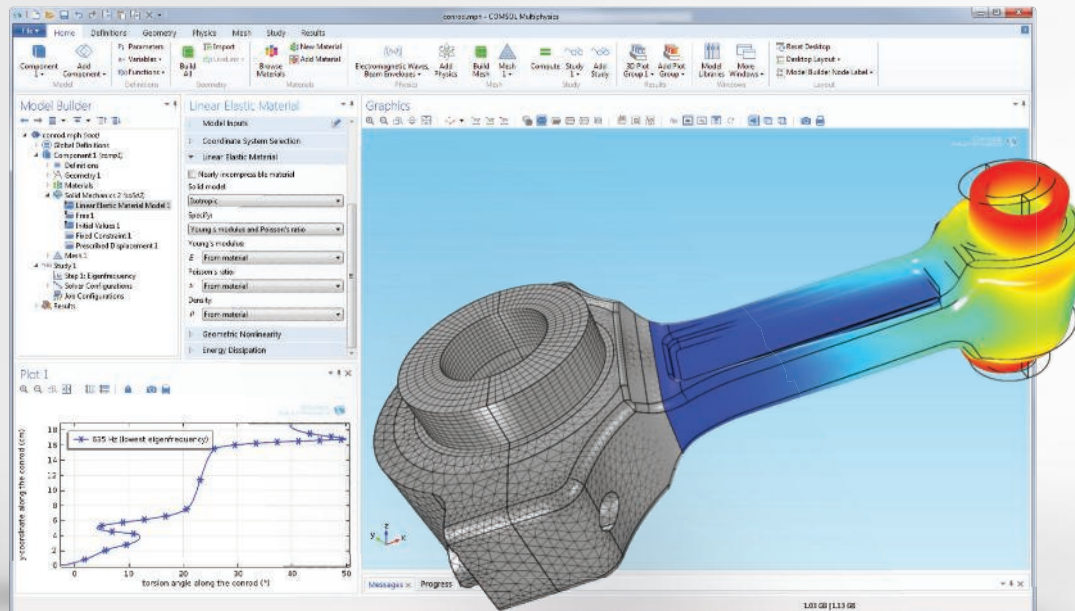
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