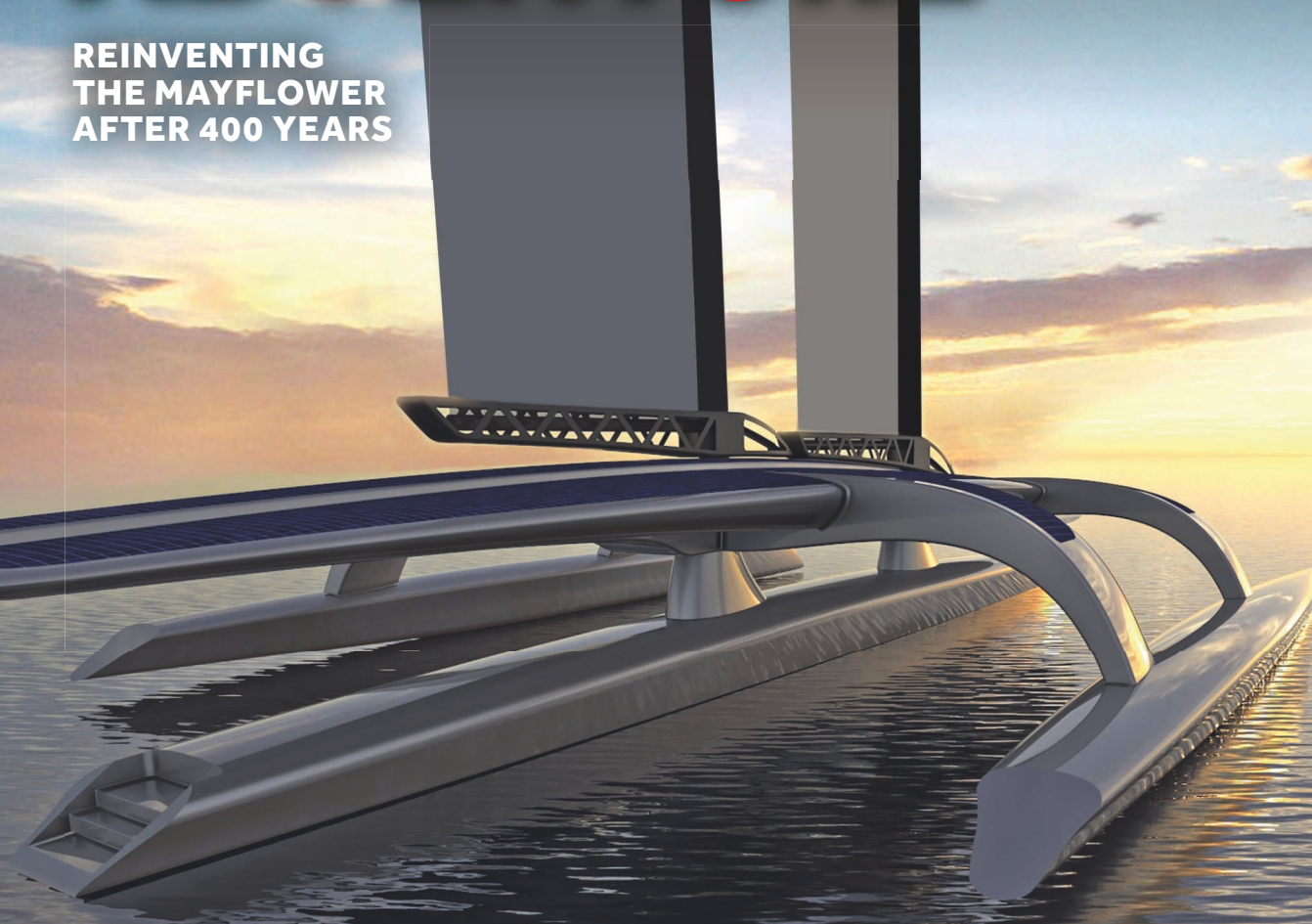


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THE MAYFLOWER
AFTER 400 YEARS



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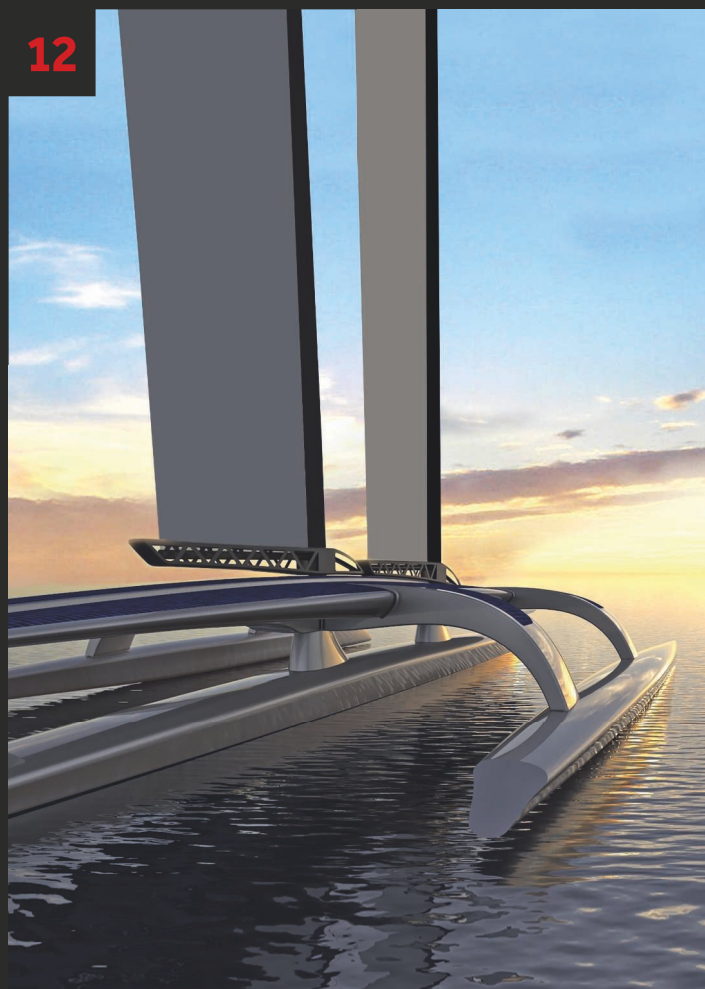
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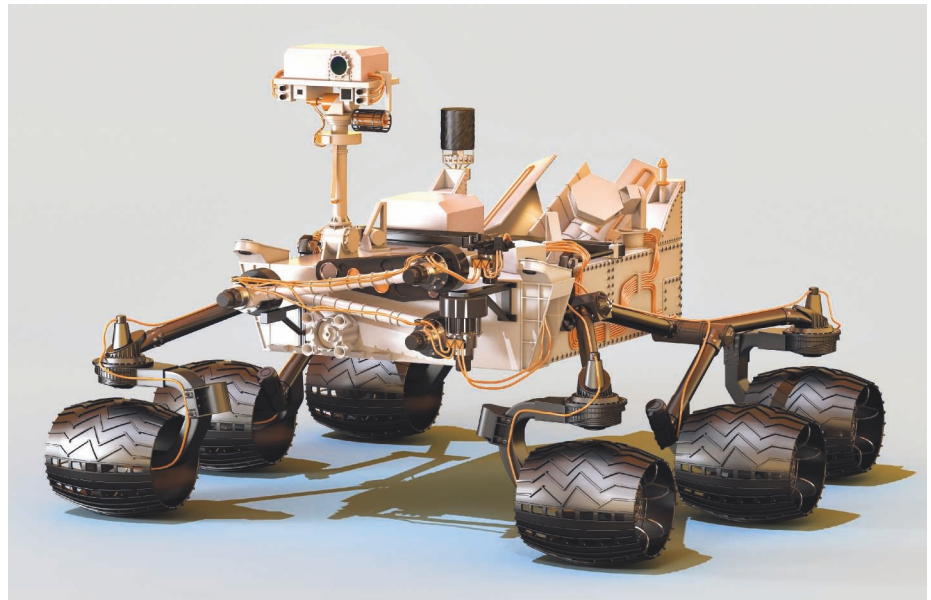
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CAD LEAVES GLASS HALF EMPTY



I HAVE SPENT quite a bit of time of late with the leading CAD suppliers and marvelled at their progress. The engineering power in the engine room of these packages is phenomenal. It is getting to the stage when concepts can be captured and turned into fully engineered products – the engineering designer offering a guiding hand through the process, rather than personally conducting the engineering due diligence.

We all know that not enough school students are going into engineering. This ever-evolving software can only be a good thing in this respect – students can use their imaginations to create projects while only having to dabble in the technicalities.

What concerns me, whilst appreciating that in the face of some excellent technology that this is a glass half empty argument, is that engineers will evolve whose potential is defined by the tools they use. At the moment, our engineers have to go through university or apprenticeships to learn about engineering and, hopefully, the engineering is understood. But, as time progresses, there is bound to be more emphasis on design, rather than engineering, as the software is doing the engineering for you. Fundamental engineering will then gradually become a forgotten art, which could be seen as unimportant if engineers are churning out

beautiful designs that are sound from an engineering perspective. But...

As someone put it to me recently, 'kids know how to stick a couple of Arduino's together and what that can do, but they don't understand what the electrons are doing'. And without that 'nuts and bolts' knowledge, can engineering progress? Will true invention become impossible because our design engineers are designers rather than engineers? Could a designer come up with Mars rover or a Dyson cleaner?

It is, perhaps, an unnecessarily negative outlook and while engineers are being trained properly it should not become an issue. But with CAD packages becoming so capable it may be that current theory-based engineering education is like teaching students to use a slide rule after the pocket calculator had been invented.

Any thoughts on the subject welcome!

Tim Fryer, Editor
tim.fryer@markallengroup.com

DYSON TO TACKLE UK ENGINEERING SHORTAGE

SIR JAMES DYSON has laid out plans to open the £15million Dyson Institute of Technology, teaching high quality engineering degrees alongside jobs at Dyson's Research and Development Campus in Malmesbury, Wiltshire. The inventor wants to double his company's engineering team by hiring 3000 engineers globally by 2020.

"The UK's skills shortage is holding Dyson back as we look to increase the amount of technology we develop and export from the UK," said Dyson. "The new degree course offers academic theory, a real-world job and salary, and access to experts in their field."

The four-year degree programme will combine academic learning, initially delivered by WMG University of Warwick, with hands-on experience developing Dyson products and working alongside Dyson's current engineering team of 3000.

Under new plans laid out by the Department of Education in a recent whitepaper, the Dyson Institute of Technology will apply for degree awarding powers, allowing it to become a new university.



Universities Minister Jo Johnson said: "The Dyson Institute of Technology will not only offer students the chance to study on cutting edge degree level programmes, it will also play a vital role in educating the next generation of much needed engineers."

Dyson also plans to invest £100m in external research

projects in the next four years – working with technology start-ups from Israel to Singapore to the US. The students will also have access to this global network of engineering expertise.

The application process is open now, with the first cohort of 25 students starting in September 2017.



PRODUCTS

Here is a selection of the latest products featured on the Eureka! website. Just enter the reference number in the search box for the full story

148364

Netfabb offers complete additive manufacturing solution

148356

Tamper-proof safety transponder

147962

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147958

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147802

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3D-printed tools enable cost-effective production of injection-moulded parts

147464

IoT developers kit

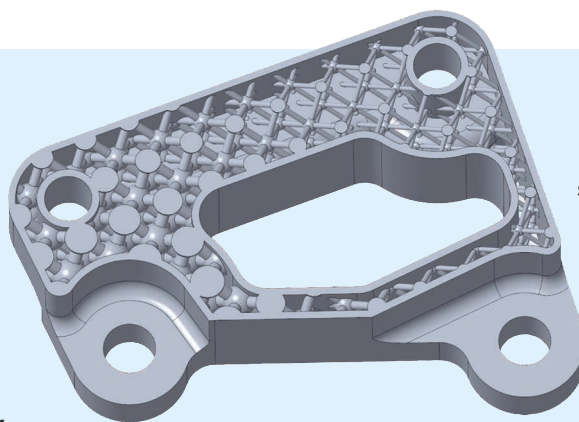
TECH BRIEF

Creo 4.0 design on IoT

PTC has announced the release of the latest version of its Creo 3D CAD software. Creo 4.0 is claimed to introduce new capabilities for IoT, additive manufacturing, augmented reality, and model based definition (MBD). Creo 4.0 is also claimed to enable smarter product design and greater productivity with an array of core modelling enhancements and new functionality.

With this latest release of Creo, PTC says, product designers can design smart, connected products and capitalise on new technologies, such as additive manufacturing and augmented reality.

"Realising the potential of the IoT is not just about



getting more product usage data, it means you can use, refine, and analyse that data to design better and smarter," explained Brian Thompson,

senior vice president, CAD segment, PTC. "Creo 4.0 enables designers to replace assumptions in the design process with real-world data to make better product design decisions and along with model-based definition helps give designers a more complete digital definition of a product."



Innovative female entrepreneurs

AS PART OF Innovate UK's infocus Women in Innovation competition, 15 of the UK's most innovative women have been honoured at a ceremony at London's Royal Society of Arts. The aim of the competition was to challenge the low numbers of women entrepreneurs in the UK. Each winner received £50,000 and a tailored business support package.

The proportion of UK women in entrepreneurial activity is around half the level of men. Innovate UK predict that boosting female entrepreneurship could deliver approximately £180billion to the UK economy.

Dr Ruth McKernan CBE and chief executive of Innovate UK said: "It is very clear that

harnessing the talent of women entrepreneurs could significantly enhance UK economic growth. I am delighted that we are taking action; supporting and funding female entrepreneurs to help them succeed and inspire other women to come forward, apply for funding and turn their ideas into successful businesses."

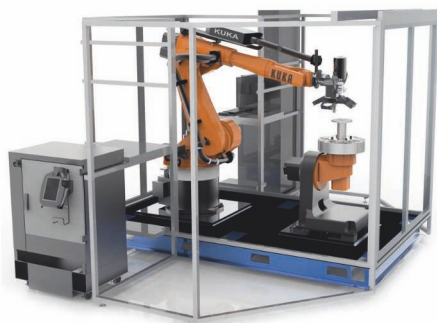
McKernan added: "From air quality monitors, to fully autonomous drone software, affordable solar power technology and a digital education portal which engages school children with the molecular world, the calibre of winners is an eye-opening view into the talent and vision of the UK's female entrepreneurs."

AM partners for production

Stratasys and Siemens have announced a partnership to integrate Siemens' Digital Factory solutions with Stratasys' additive manufacturing (AM) solutions.

The companies have been collaborating on multiple projects including the direct link from Siemens' NX software to Stratasys' GrabCAD Print platform, the Stratasys Robotic Composite 3D Demonstrator incorporating Siemens' PLM software, and its motion control and CNC automation technologies, to produce lightweight performance parts.

Arun Jain, VP of motion control, Siemens Digital Factory US, added: "Siemens' capability and commitment to the digital enterprise vision, along with its close collaboration with Stratasys, can help many industries realise shorter time-to-market, achieve flexibility in operations and improve efficiency in workflows through horizontal and vertical integration."



FAULHABER Drive Systems

The flyweight that packs a heavyweight punch

Brushless DC-Servomotors
3274 ... BP4 series.

In the fight for high performance with minimum weight, FAULHABER with the development of its series 3274 BP4 has put a new champion in the ring. The brushless DC servomotor, measuring 32 mm in diameter and 74 mm in length, has a huge continuous torque of 165 mNm. Furthermore, it weighs in at just under 320 g, which is half that of conventional motors with comparable power.



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WE CREATE MOTION

WATER RESTRICTIONS

DURING A RECENT refurbishment of the Allt na Lairige hydro-electric power station near Inverary in Scotland, the hydraulic control system was upgraded from the original low pressure system to a modern high pressure one. In-house designed multi-orifice restrictors were being used in the

hydraulic actuators which operate the main water inlet valves but, due to the increase in system pressure and the variation in temperature throughout the year which was affecting the viscosity of the oil, it was determined that the restrictors were not providing sufficient restriction.

The solution came from Lee Products who provided high Lohm rate restrictors from their 250 series axial visco jet range. Visco jets contain many internal stages to provide a very small restriction to flow but still keep the internal passageway sizes large enough to resist blockage by contamination.



CERAMIC 3D PRINTING TECHNOLOGY ON DISPLAY

Roland DG has unveiled an innovative ceramic 3D printer featuring jetting technologies that make it possible to create complex ceramic objects based on jetting binder material into alumina powder.

The goal is to explore the possibility of offering a small to mid-range 3D printer which supports materials capable of expanding the use of 3D printing technology for rapid manufacturing by SMEs.

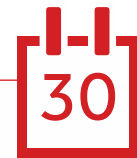
According to the company, the technology produces the fine detail needed for such items as valves, ceramic filter elements and heat insulators.



Metal option for SMEs

OR LASER has unveiled its **ORLAS CREATOR** direct metal AM platform and ecosystem, developed and designed for SMEs, which it plans to begin shipping in 2017. Until now, claims the company, SMEs have been priced out of the metal AM market with no commercially viable options available to them.

The **CREATOR** build platform features an innovative blade design that is said to ensure smooth operation and increased build speeds that produce parts up to 30% faster, with resolution comparable to higher spec machines on the market. For safe operation in smaller facilities, the **CREATOR** utilises a cartridge materials handling system.



EVENTS

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National Instruments hands-on taster
NIHQ, Newbury



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DRIVE INNOVATIVE DESIGN

WORKING ON BEHALF of ABB, IdeaHub is recruiting hardware and software innovators to take on the challenge of transforming the role of drives in industrial settings which may include improving the design, use and operation of drives or finding entirely new use cases for drives.

The IdeaHub is a cross sector, open innovation platform that connects designers with funding and support from global corporations. In 2015 they ran their first program for the ABB business unit Robotics, attracting over 150 applicants with 11 finalists selected for a pitch day in London with six ventures receiving an offer of support and collaboration. For 2016/17, they are partnering with the ABB business unit Drives and Controls to find solutions to



three core challenges to the next generation of drives and controls: Connectivity, simplicity and intelligence.

Morten Wierod, managing director of ABB's Drives and Controls business unit said: "We look forward to receiving ideas from innovators around the world.

Collaboration is the key in building emerging ecosystems around the Industrial Internet of Things."

The IdeaHub platform is open for applications until 31st January 2017. Successful applicants will get the chance to pitch their ideas directly to ABB at an IdeaHub event in April 2017.

Siemens Acquisition

Siemens has announced it will buy Mentor Graphics for \$4.5 billion to enhance its industrial software capabilities. This acquisition will extend Siemens' Digital Enterprise Software portfolio with Mentor's systems design, simulation and manufacturing solutions. "With Mentor, we're acquiring an established technology leader with a talented employee base that will allow us to supplement our world-class industrial software portfolio," Said Klaus Helmrich, member of the managing board of Siemens. "It will complement our strong offering in mechanics and software with design, test and simulation of electrical and electronic systems."

TECH BRIEF

Workstations go small

HP has unveiled the world's first mini workstation designed for users in CAD and other compute-intensive industries. The HP Z2 Mini Workstation is said to deliver breakthrough power and versatility, and at 2.3" high, is 90% smaller than a traditional business-class tower.

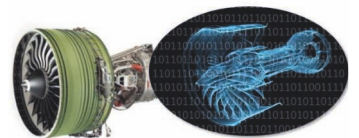
Building from the HP Z240 SFF, the HP Z2 Mini Workstation is claimed to be twice as powerful as any commercial mini PC on the market today and has the ability to support six displays out of the box. The HP Z2 Mini was designed for CAD users demanding smaller hardware without compromising acoustics and performance and mission-critical reliability.



ANSYS AND GE TO DRIVE DIGITAL TWIN

ANSYS AND GE have partnered to create model-based digital twin technology and disruptive commercial business models to deliver on the promise of the Industrial Internet of Things (IIoT).

This is no longer a theoretic concept as ANSYS and GE Global Research are already demonstrating actual implementation of digital twins, like the GuardEon Moulded Case Circuit Breaker, a low-voltage circuit breaker. By using ANSYS software, GE engineers are able to study and test complex physics at a level of detail that was impossible to achieve through physical testing. Eric Bantegnie, ANSYS vice president, said: "Pairing physics and analytics models via the digital



twin is essential to providing our customers with the 360 degree insights they need to create competitive advantage in a rapidly changing world."

Through this collaboration, ANSYS will work with GE Digital, GE Global Research and GE's industrial businesses to expand and integrate ANSYS' physics-based engineering simulation and embedded software development platform with GE's Predix platform to power digital twin solutions across a range of industries.

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FOLLOWING THE FOOTSTEPS... **AUTOMATICALLY!**

When celebrating the past, why not challenge the future? That is the forward looking stance being taken in Plymouth as the 400th anniversary of the Pilgrim Fathers voyage approaches. Tim Fryer reports

Depending on your view of how the American presidential race was run and resolved, and how this reflects on humankind's principal superpower, you may think the Pilgrim Fathers have got a lot to answer for. But if you accept that its politicians do not fairly reflect what is best in America, as is true in many other cases all around the globe after all, then the anniversary of the Pilgrim Fathers arrival is worthy of celebration.

In 2020 it will be 400 years since the Mayflower made its epic journey from Europe to America carrying 102 settlers, half of which wouldn't survive the first New England winter. The remainder are credited, symbolically at least, with populating

what has become the world's most influential nation and presumably these descendants will already be working on the fireworks display to end all fireworks displays to recognise the event.

On this side of the Atlantic, a team from Plymouth have come up with its own celebratory project, the Mayflower Autonomous Ship. Despite claims from Cornwall, Plymouth is generally regarded as the last stopping place in England before reaching America and so the city takes its Pilgrim Fathers responsibilities seriously.

When discussing how to commemorate, the notion of a replica

**In 2020
it will be 400 years
since the Mayflower
made its epic journey
from Europe to
America carrying
102 settlers**

was dismissed. There are several Mayflowers, most significantly perhaps the full scale version that was built in 1956 and sailed that year from Plymouth, Devon, to Plymouth, Massachusetts, where it normally resides as a museum and tourist attraction. It is currently undergoing a refurb in advance of the 2020 celebrations.

Instead, Brett Phaneuf, managing director at MSubs, suggested a more radical approach. Taking into account the Government's drive towards high value and specialised technologies, like robotics, Phaneuf suggested the building of a 21st Century Mayflower. Paddy Dowsett said: "What Brett



proposed was something that's captures the pioneering spirit of the original Pilgrim Fathers but actually it looks forward and acts as a totemic project for establishing the West Country as a cluster or hotspot for maritime autonomous development." Dowsett also works for MSubs and is project manager on the Mayflower Autonomous Ship project.

The idea of the project is to design, build and sail the world's first full-sized, fully autonomous unmanned ship across the Atlantic. It is not just intended as a celebration of the Mayflower's original journey, it is also testing technology that may enable further development of autonomous ships, and it will additionally function as a research vessel both during its trans-Atlantic jaunt and in its deployment thereafter.

Even before considering the technical issues, one major obstacle at the moment is that such a vessel may not be legal. "Interestingly, the high seas from a legislative perspective are actually quite complicated because they don't belong to anyone," explained Dowsett. "So in the simplest terms, once you've crossed a country's territorial limit [normally within 12 miles], whether that's in the air or the seas, the law of

FAST FACTS

LENGTH OVERALL || 32.5m

BEAM || 16.8m

DRAFT || 0.875 m
(1.78 m to tip of rudder)

SAIL AREA || 159 m²

HULL CONSTRUCTION ||
Composite
(Glass/Aramid/Foam)

DECK CONSTRUCTION ||
Composite (Carbon/Nomex)

**SPEED MAX ELECTRIC
MOTORING** || 12.5 knots

SPEED MAX SAILING ||
20 knots

**RANGE AT 5 KNOTS
ELECTRIC MOTORING** ||
Unlimited



that particular land applies. And so it's relatively easy to regulate. When you're on the high seas, it's really down to a series of United Nations conventions and some countries have embraced those conventions and put them into the law, some haven't."

Regarding autonomous ships, Dowsett added: "The regulatory framework is not yet geared up and particularly it wasn't when that decision was taken to support an autonomous vessel. Now interestingly, almost serendipitously, we think the regulations will change in about 2020 because autonomous vessels are coming, and they're coming quite rapidly over the next three to five years."

PROJECT PARTNERS

MSubs makes autonomous underwater vessels and is one of three principal partners, the other two being Plymouth University and Promare, and all three are

joint and equal financial contributors.

Plymouth University's renowned marine science department also provides research

"Controlling the sails is what makes it exciting, I don't think anyone else is doing that at the moment."

PADDY DOWSETT



students, testing facilities and expertise in terms of the scientific equipment that will be on board. Promare is a non-profit corporation and public charity that promotes marine research and exploration throughout the world.

Design is in the hands of Shuttleworth Design, the yacht designer. John and Orion Shuttleworth are the father and son team at the helm of this side of the project. Orion commented: "Our approach

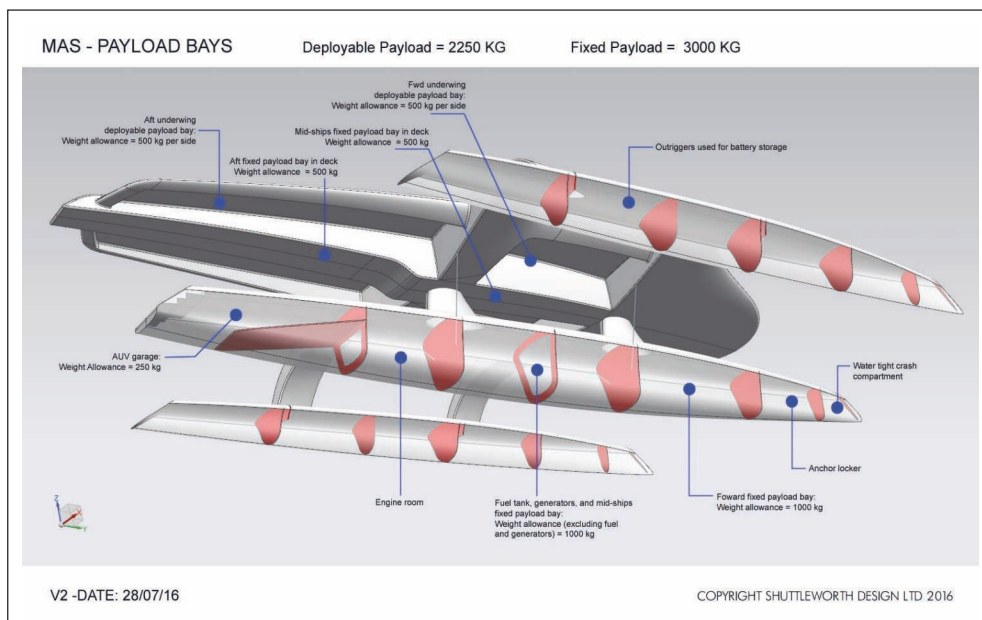
to developing the concept was to fully explore and take advantage of the opportunities that arise from not having to carry crew, and to create a vessel that is capable of using only renewable energy. Working within the limitations of renewable energy sources has given a clear direction to the developing form of the vessel."

Dowsett did add that it is likely that a small diesel engine will be included to motor the vessel at a rate of 5 knots to an area of sun or wind.

"A trimaran was chosen because it provides the most efficient hull form for low speed motoring," continued Shuttleworth. "The hull configuration developed from a requirement to reduce windage, while keeping the solar array sufficiently high above the water to reduce wave impact. Without the need for accommodation, the centre hull has been kept low to the water and the wings and deck are separated and raised above on struts. This allows waves to break through the vessel and significantly reduces roll induced by wave impact. The outer hulls are designed to skim the water reducing resistance by 8%.

"The two masted soft sail rig will enable a top speed of around 20 knots. Each sail is simply controlled by a single sheet, and can furl into the boom and allow multiple reefing configurations for varying wind speeds. Stowing the sails while motoring reduces windage and eliminates shadows cast over the solar cells on the deck, while allowing the masts to stay standing to carry navigation lights."

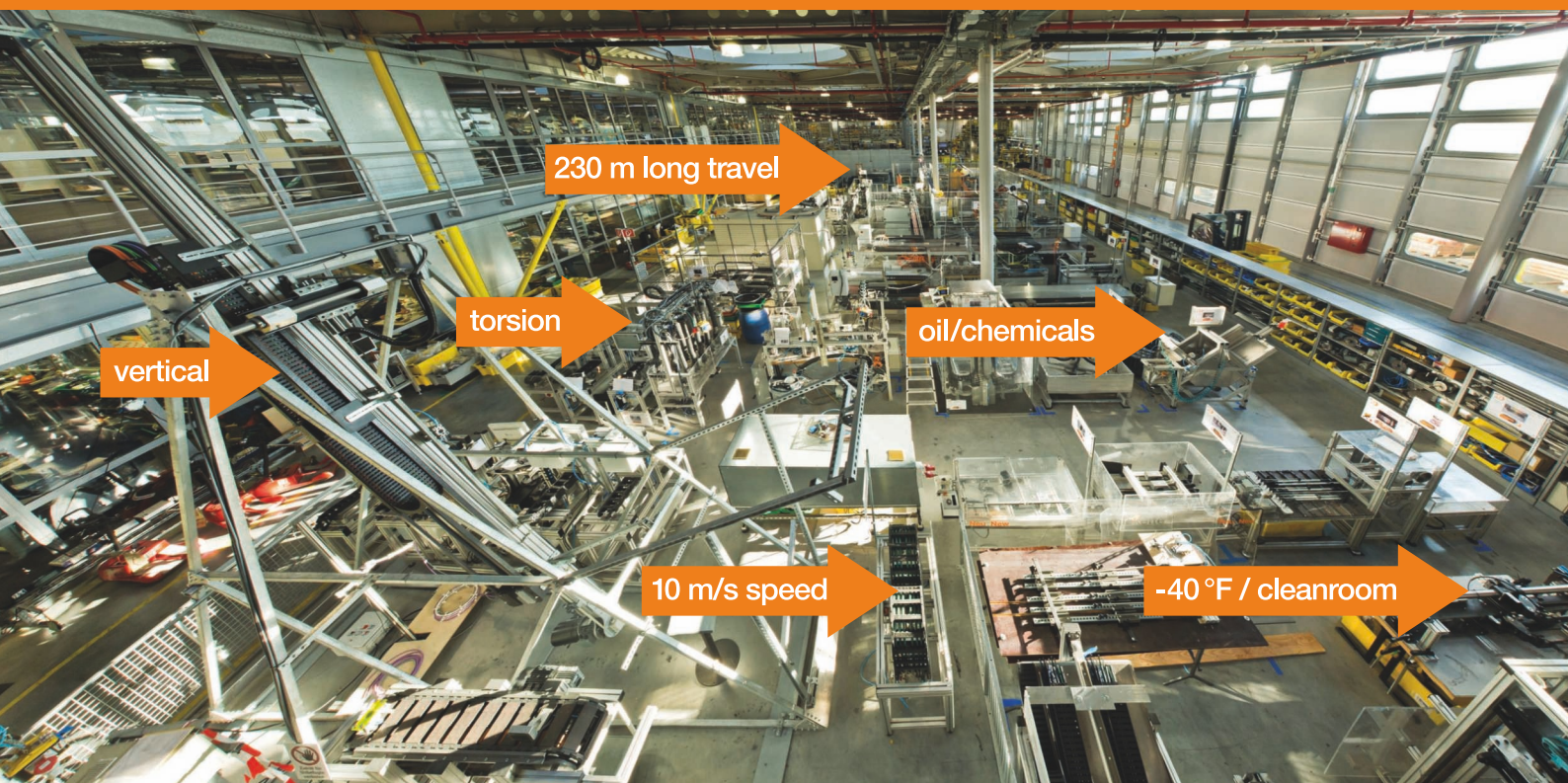
Dowsett believes the sailing rig is going to be the most challenging aspect. "Controlling the sails is what makes it exciting, I don't think anyone else is doing that at the moment. If it's a sailing vessel you're going to have to have winches to bring in the sails,



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depending on what angle you are to the wind, so our system needs to minimise the amount of moving parts associated with the sailing rig and then control the winches autonomously.”

With batteries filling the rig, another issue, and one that remains to be resolved, is whether or not to have the propeller shaft that these batteries drive permanently in the water. Under sail power this propeller provides unwanted drag, but it may be a necessary evil when the alternative is to have a mechanism to raise and lower as needed – it is potentially something to go wrong and if it did could leave the vessel stranded. The other consideration is that the batteries could be recharged when using sail power, either by reversing the direction of the propeller and allowing it to act as a generator, or by having a separate generation device.

“A number of yachting companies are incorporating these technologies now, but none of them are quite man enough for the vessel we’re looking to build,” commented Dowsett. “As

“A number of yachting companies are incorporating these technologies now, but none of them are quite man enough for the vessel we’re looking to build.”

PADDY DOWSETT

we build submarines, we have our own in-house experts on the batteries and power management and we’re doing some interesting calculations at the moment, working out the size of the propeller and what sort of power it would generate, versus the drag it causes and impact on the speed.”

This is the end of Phase Three of the design – a stage when MSubs and Shuttleworth are addressing these propulsion issues and also such aspects as how to make best use of the space available on the inner ship for such things as the navigation equipment and the payload of research devices.

The first model is now being built and tank testing should be conducted in the spring of 2017. Following that phase the consortium will take the design for

the full 32m, carbon fibre craft to a boat builder with a view to having the vessel ready for a year of trials in 2019, so she is fully prepared for being the star of the show in 2020.

To some extent Mayflower will be a demonstration vessel as Dowsett described: “The technology that will safely take the Mayflower from Plymouth to Massachusetts is the same as could be used for what we could call white van driver type tasks – supporting oil rigs, fish farms, offshore energy farms, applications that really do lend themselves to autonomous operations.”

However, Mayflower is designed as a climatic and oceanographic research vessel with cargo bays to launch and recover underwater autonomous vehicles and sensors. She’ll be fitted with sonar and the ability to tow such devices as plankton, sea temperature and salinity recorders.

“Once she’s crossed the Atlantic,” concluded Dowsett, “we are looking at sending her round the world, providing the Atlantic crossing goes well, and thereafter she’ll be available for charter. A lot of the exploration and climatic research is taking place in the polar regions, the inhospitable regions of the world. Of course, the great thing about autonomous vessels, is she can stay on station for three months, six months, depending on wind and solar conditions, without the need to replenish a crew, just send in the data. That is what she’s been designed to do after she’s taken part in the Mayflower 400.” **❶**

UNMANNED WARRIOR

MAST (Maritime Autonomy Surface Testbed) is an unmanned surface vessel (USV) system, developed by ASV Unmanned Marine Systems under Dstl (Defence Science and Technology Laboratory) funding and based on the 35ft-long Bladerunner 35 powerboat. The craft is capable of speeds of 60knots and can be operated with various levels of autonomy, from being helmed by a human operator to fully autonomous navigation.

The USV recently took part in the Royal Navy’s Unmanned Warrior event in October, during which it was used to autonomously track and intercept enemy boats and block their attempted attacks against larger ships.

The vehicle uses a combination of a 360° camera, Automatic Identification System, radar and GPS. By taking real-time measurements with these sensors and fusing them with chart information it can detect objects to avoid and plan a safe route through the water at high speeds while also complying with regulations governing collision avoidance at sea.



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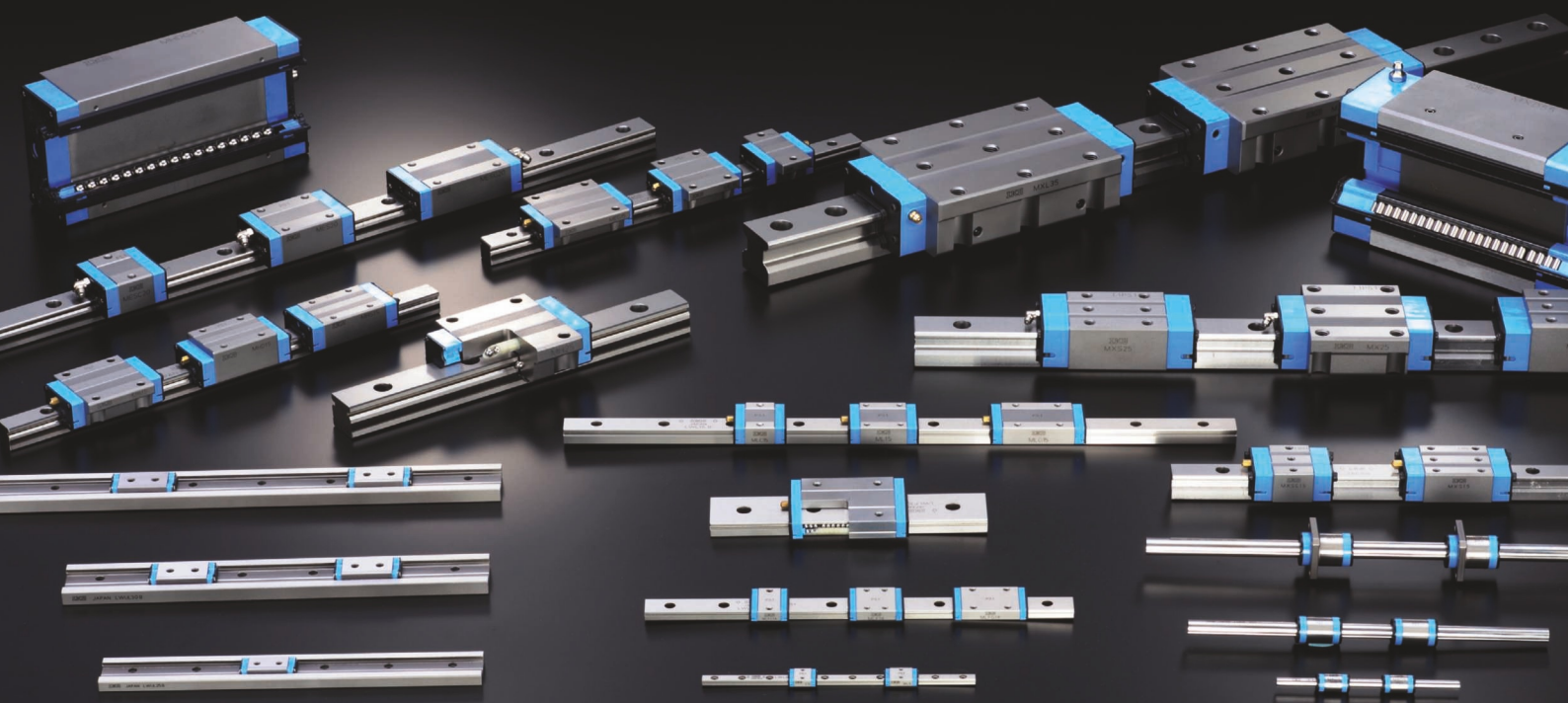


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SPEED



GOES TO THE BACK OF THE CLASS

In terms of objectives, breaking the world land speed record is only third on the list of priorities for the Bloodhound SSC team. Tim Fryer asked Mark Chapman, the project's chief engineer, to explain what could possibly be more important than speed?

Chapman stands beside the EJ200 ex-flight jet-engine, used in the test programme to develop the Eurofighter Typhoon. The engine will provide only part of the power when Bloodhound SSC makes its initial run in South Africa in the autumn of 2017 where it is hoped that the current record of 763mph will be exceeded by around 40mph. An upgrade then aims to take it over the 1000mph mark the following year.

The jet engine will take Bloodhound up to 600-650mph, but to reach record breaking speeds the driver, former RAF fighter pilot Andy Green, will have to fire a rocket when he is ambling along at just 300mph.

The rocket fundamentally uses the same technology as the Black Arrow that launched the Prospero satellite back in the 1970s, when the UK had its own space programme. And, it is the rocket that will be beefed up when the team vies for 1000mph in 2018. The rocket and its fuel tank, incidentally, sit just a few inches behind Green's head.

Green, observed Chapman drily, is on the design team. "Andy wouldn't do this if he wasn't confident in the skills that have been brought to bear on it. He doesn't just get in the car, right foot down, press the rocket, 800 miles an hour, job's a good'un – it's a learning experience. It's 100mph, 200mph, doing the rocket firing while the car's stationary,

doing a gradual increase of the speed, so it's only when he's actually trying to break the land speed record that he's going to be doing it in the correct sequence."

Over the next year the car will run about 30 times, starting from with tests in Newquay in the spring.

Surely, you'd think, this programme to reach top speed is the all-consuming objective of the team? Not so, according to Chapman, and in fact it is only third on the list. "The first thing for the car," said Chapman, "is to inspire a generation of children."

"When we fired the rocket in Newquay it was 186dB, the only things that will be louder are things like space rockets or the RAF taking off. If it's a normal day, it will be the loudest noise on Earth. And it's got a 60-foot flame. Our target audience is 8 to 12-year-old children, and that's what gets them excited."

VERY FAST FACTS

DESIGN SPEED || 1690KPH (1050MPH)

0-1000MPH || 55 SECS

WHEELS RPM || 10,000

LENGTH OF TRACK || 19KM

CURRENT RECORD || 1228KPH (763MPH)

Chapman thinks that adults will ask what they think are intelligent questions. Children, on the other hand, ask interesting ones. For example, while addressing a school assembly, someone asked, 'if it was vertical, how high would it could go?'

"I didn't know the answer," said Chapman, "so when it came to their physics class we sat down and worked it out using Newton's Laws. It was the first time they'd realised that equations were good for finding stuff out."

Second on Bloodhound's list of priorities is to share as much data as possible. Chapman claimed that the project was in an unusual position regarding sharing information.

"There is very little on this project that you can't ask questions about," he explained. "There's some great technology on the car that a lot of people don't have access to. The suppliers are involved in defence





projects or motoring projects, and they aren't allowed to share that information because they're controlled by non-disclosure agreements.

"For example, the last frame on the car was actually carbon fibre and it's covered in a ceramic coating from Zircotec, which is used on a lot of military applications. They are now able to actually showcase how good it is on the back of this."

Given the military grade jet engine, it is not surprising that much of the technology being applied is normally kept under wraps. The other obvious sector, Formula One, is equally sensitive to competitive issues.

"So we're kind of a melting pot of loads of different technologies and we can showcase them all," said Chapman. "We can share information with the media, with the public, with education. If you walked into McLaren you wouldn't be sat next to their latest car and you certainly

wouldn't be allowed to take photos of it and have a really good look. But we share everything."

And finally, down at number three, is the goal to break the land speed record. But what if Bloodhound SSC fails to get to 1000mph, or even 800mph – is the project a failure? Far from it claimed Chapman, as long as you succeed with the first two.


"We don't necessarily need a generation of land speed record holders, but we need a generation of children that aren't turned off by science. Hopefully we can help get them into the science and technology subjects. We need a population that's educated, which doesn't think science is rubbish and boring; a generation that can challenge politicians and economists over the next five, ten, 15 years and ask those difficult questions about where we need investment in the infrastructure. Do we need HS2 for example?



MARK CHAPMAN

Since graduating from The University of Bath in 1992 with a degree in Aeronautical Engineering, Chapman has worked on a wide range of projects from designing the rotor control actuators for the AB139 helicopter to a sewage works in Totnes.

He has largely been involved with aerospace projects including a couple of years in Seattle for Boeing with its Propulsion Systems Division and Rolls Royce in Bristol. Most recently he spent nearly four years as part of the design team on the Short Take Off and Vertical Landing (STOVL) system for the F-35 Lightning II, also known as the Joint Strike Fighter. Bloodhound is his first venture into what might be broadly called motorsport.

"Science is one of those subjects where it's kind of cool not to understand it. If you can't read or write, everyone goes 'that's wrong'. But with maths people go 'he's not good at maths'. Science and technology are key for this next generation. Everything is going to be technology-based. You'll see a population that is excited by science and can ask those challenging questions. So that's what we predict this is all about. It just happens that going really quickly in an exciting way and showcasing its advantages, is a great way of getting there." 

ARE ROBOTS GOING SOFT?

Using robotics systems has helped many patients relearn muscular movements or rebuild strength. But using 'soft' materials could improve outcomes further. Tim Fryer looked into the ongoing research

Currently we have
100N load
supporting 'muscle packs'
that are quite effective
and in series they end up
supporting up to
400 – 500N



Existing exoskeletons, one of the main applications of robotics in medicine, are made of expensive bulky, rigid materials that struggle to fit the individual. After all, if it is difficult enough to find a comfortable pair of shoes then something that requires contact across much larger areas of the body is going to present problems. But the materials used for exoskeletons, or robotic support structures, must be rigid and strong by definition, as they are supporting a body that is unable to support itself. Or do they?

Researchers at the Reconfigurable

Robotics Lab, EPFL in Lusanne are working on soft materials that could provide an alternative solution. Prof Jamie Paik, who is leading the research group, said of the existing, rigid exoskeleton solutions: "Such designs are effective in achieving high accuracy, high load, high speed applications, but at a cost of bulky parts and hard joints that inherently suffer from low conformability. Therefore, they rely on finely tuned control to achieve fluidity of motion.

"Another way of achieving this conformity while producing the mechanical support these systems

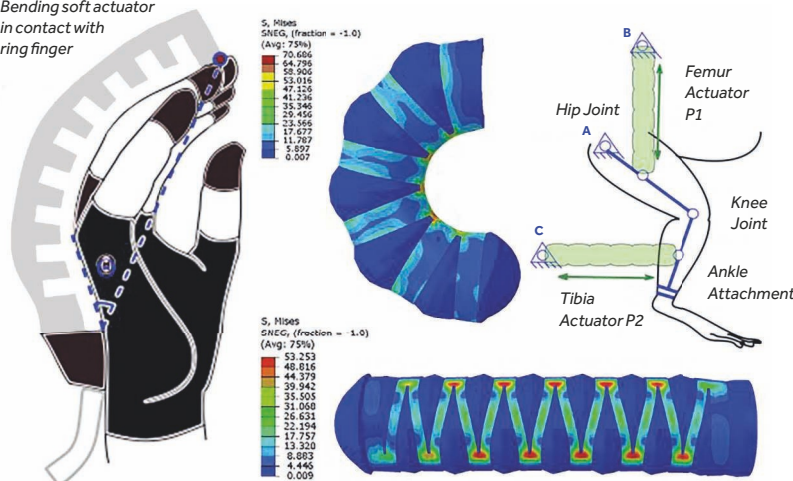
require, is in taking advantage of material properties. Silicone rubbers are inherently flexible and conforming. But if we can have a clever design and controllable pressure input with strategic control algorithm, we can make the system support impressive loads while not necessitating numerous control points. This is one of the driving reasons that we are searching for solutions within the soft robots paradigm."

The materials used are low-cost, compliant, off-the-shelf materials in order to make the robots manufacturable and scalable. Since soft robots are being designed to exhibit high flexibility and adequate mechanical strength, a variety of soft elastomeric materials have been tested and mechanically characterised in the lab before usage. Typically used materials include rubbers, foams and plastics.

Numerical simulations are then carried out for components with a view to design more efficient robots in terms of motion and force performance. Based on the numerical model predictions, only the most efficient designs are then fabricated and tested. The soft robots are fabricated from these materials using processes such as moulding, 3D printing and laser cutting.

Tailoring soft robot operation to support body movements.

Bending soft actuator in contact with ring finger





Above left: Dr Gunjan Agarwal, Matthew Robertson (researcher on the project) and Professor Jamie Paik.

Top right: These soft robots can bend in any direction.

Right: A belt designed to give upper body postural support – the movement of artificial muscles (or soft robots), the pink tubes in this case, can be precisely controlled to bend in any way a medical team wants.



The soft actuators developed at the RRL are pneumatic. Dr Gunjan Agarwal, a member of the research team, described the operation: "The actuators possess a hollow chamber inside a soft material core which serves as a corridor for the pressurised air supply. The air pressure is precisely controlled to ensure adequate inflation. The actuator core is made from a highly flexible elastomer material, to ensure a large range of motion."

To constrain excessive radial inflation, the actuators are reinforced with thin shell structures made from materials stiffer than the core material. Pre-defined patterns on the shell body govern the motion profile obtained with the actuator, such as bending, linear extension, compression, twisting or a complex combination. The shells are interchangeable between actuators, enabling multiple motion profiles with the same actuator.

Such systems are going to have limitations. "Soft pneumatic actuators


(SPAs) do not satisfy all the problems in actuation sources," said Prof Paik. "Currently we have 100N load supporting 'muscle packs' that are quite effective and in series they end up supporting up to 400 – 500N load. However, at larger loads the SPA starts getting bulky so a conventional system starts looking sleeker. There is a sweet spot where SPAs fit better than other types of actuator solutions in terms of size and control bandwidth."

Most of the work so far has been focused on designing and characterising the new SPAs. In terms of control, so far the team has used stored user movement data, or gyroscope readings from the wearers but are anticipating both the user and therapists will eventually control the movement and stiffness modulation of the actuators directly through different inputs, for example heart rate, fall detection via acceleration change, temperature, preprogrammed gait pattern, remote controlled via vision sensing, etc.

"Soft robots are easy to fabricate but challenging to control due to the unpredictable mechanical behaviour of the soft materials used at large levels of strain," said Dr Agarwal. "The complex mechanical behaviour of the soft materials employed and the intended robotic systems is accurately captured and described with the help of our numerical models. Since these models are not trivial to develop and require a significant investment of computational time and effort, we have made our modelling and design tool available open-source to the robotics community. Using our models and performance predictions, anybody wanting to develop a soft robot can quickly optimise their design to achieve the targeted operation space."

Dr Agarwal sees this as only the start of the long path for soft robots to walk down. "Some exciting developments in the recent past in context with soft robotics include the combination of expertise from diverse disciplines such as innovative 3D printing, mechanical engineering, and microfluidics to demonstrate autonomous, untethered, entirely soft robots," she claimed.

"These robots could pave the way for a new generation of completely soft, autonomous machines. Soft robotics could revolutionise how humans interact with machines. But researchers have struggled to build entirely compliant robots. Electric power and control systems - such as batteries and circuit boards - are rigid and until now soft-bodied robots have been either tethered to an off-board system or rigged with hard components. This is rapidly changing with the latest advances in design, manufacturing and control of soft robots, such as some of the techniques described here and that are implemented in our work."

Dr Agarwal concluded: "Recent advances in soft robotics have proved that this field has promising potential for application in biomedical rehabilitation and human assistance. However, the advances are still restricted to the laboratory. With the new advancements in the manufacturing and control of soft robots, large-scale industrial production of soft robots is inevitable and is set to revolutionise the perspective on robotics." 

"By tuning the air pressure input to the actuator, the motion and stiffness of the actuator can be precisely tuned for replicating the targeted muscular action."

PROFESSOR JAMIE PAIK

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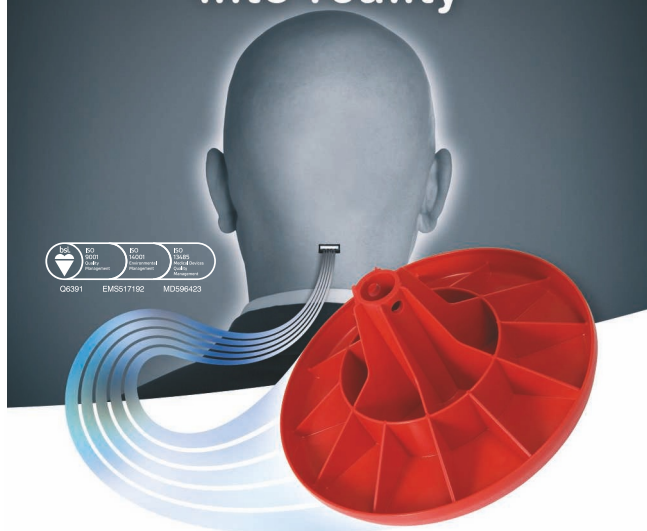


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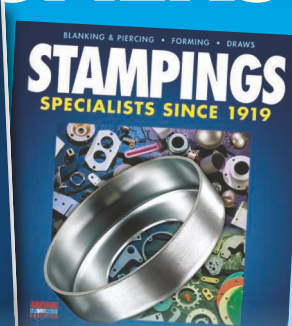
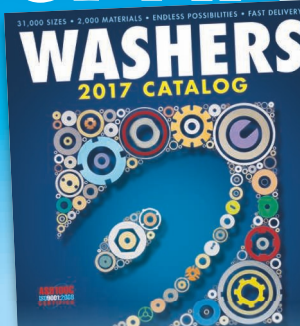
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BEST MATES IN INTERCONNECTED WORLD

In this year's annual update there are substantial changes in connection, electronics and visualisation, along with better tools for chamfer, fillet and holes. Tim Fryer takes a look at Solidworks 17.

My personal favourite is the Magnetic Mates," said David Falkingham, Solidworks manager for Northern Europe. "That for me is the highlight - just offering two components together and the system knowing how they should just fit. I've seen many a customer using Mates over the years and whilst I would say they've always been the best tool for doing assemblies in the industry, this makes it that much better. To see that Magnetic Mates is absolutely superb."

Magnetic mates, which allows easy drag and drop mating in large, complex assemblies, is just one of the new features in Solidworks 17, the version released last month. However, it is probably the Interconnect feature that will cause most interest as it opens the door to collaborative working across multiple CAD environments. It allows users to open proprietary 3D CAD data directly into Solidworks, including data from Creo, CATIA, SolidEdge, NX and Inventor, while retaining associativity to the original file. It theoretically allows seamless working with anyone and will allow

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*Above:
Andrew Harlan,
"We must fulfil a lot
of medical device
requirements, and
SOLIDWORKS has
been helpful for
leveraging cutting-
edge industrial
design to get our
work done faster
and our myoelectric
upper limb orthosis
to market."*

design changes to be incorporated much faster. "It means we can sit in a mixed environment of CAD systems and then just use anybody's data in our system," said Falkingham. "I think that's going to cause ripples through the industry. Previously you would need to do a data import, probably run something like Feature Works, which is fine if you want to do it the first time. But when the geometry then changes again in the originating system, you have to reimport it and some manual work to then change any of the designs that come off that. Now - it is seamless."

Interconnect is currently undergoing final tests before it is released in Service pack two in the coming months. All other headline features of Solidworks 17 are available immediately in the new release. These include Visualise, Solidworks PCB and the PCB Connector.

The last two of these recognise

the increasing interaction between electronics and mechanical engineers and were covered in the August issue of Eureka! Along with Visualise, a tool set for creating images, animations and interactive content, these packages were announced earlier in the year at Solidworks World.

Falkingham continued: "It is important now for us to demonstrate what we are doing for the future. Ten years back we just need to show what you've got now. The market has changed now and people want more of an understanding of what they're going to be doing in three to five years' time, not just in the next 12 months. Which is why you will see technology at SolidWorks World, that will then come out in subsequent releases."

Other new features in Solidworks 17 include new tools for Chamfer, Fillet, and Advanced Hole



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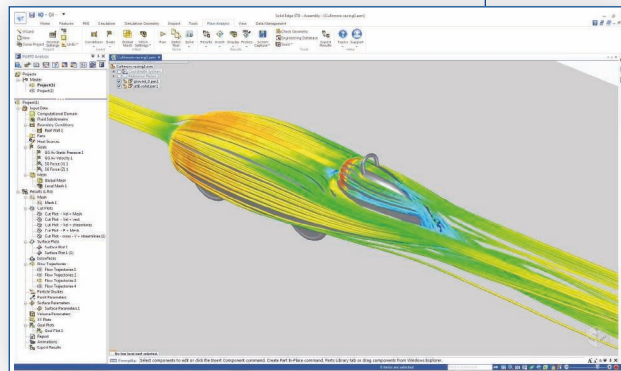
Mentor Graphics has worked with Siemens PLM to provide a fully embedded CFD solution, FloEFD, for Solid Edge CAD. Chris Watson, technical manager for the FloEFD products at Mentor Graphics, observed: "Solid Edge has an FEA solution which is based on Femap, but until now they didn't really have an embedded CFD solution."

"FloEFD for Solid Edge is a leap forward for our customers who need to do flow analysis on their engineering projects," said Dan Staples, vice president, Solid Edge product development, Siemens PLM Software. "This tool allows engineers to quickly run various 'what if' scenarios and optimise their design directly inside of the Solid Edge window."

It essentially offers the same functionality that FloEFD has offered other CAD packages, but until now CFD at this level has not been available within the Solid Edge. Now engineers can conduct analysis without having to leave the Solid Edge environment, removing the need for file transfers and translations, and therefore cutting the time (by an order of magnitude according to Mentor) involved doing CFD analysis.


Nor is FloEFD a 'CFD-light' solution. "We talk a lot in our positioning about trying to make it easier for people to use and more accessible to more engineers," continued Watson. "So sometimes with that messaging, people make assumptions that it is a pared down type of CFD. But it has a lot of high-end functionality. You can do things like hypersonic flow, combustion, compressible flows, non-Newtonian flows, so it is a fairly powerful CFD tool but our focus still nonetheless is on ease of use, on having mechanical engineers, design engineers, be able to do some CFD."

FloEFD is available as an add-in to ST9, the latest version of Solid Edge.



Specification. These create multiple variable chamfers in one operation; switch any pre-existing Chamfer to a Fillet and vice versa; capture and access previous hole definitions; and apply pre-saved specifications; and construct stepped holes faster with one operation. To help create complex 3D geometry there are new surfacing features such as wrap, drag and drop, emboss, deboss, or 3D Curve.

Further emphasis is placed on simulation, particularly the instant display and implementation of simulation results, and also in the design process with enhanced communication through Solidworks MBD (model based definition) and control of design data in Solidworks PDM.

These features become particularly important for engineers with a global footprint. For example, Andrew Harlan, principal mechanical engineer, Myomo, commented: "We must fulfil a lot of medical device requirements, and SOLIDWORKS has been helpful for leveraging cutting-edge industrial design to get our work done faster and our myoelectric upper limb orthosis to market. The ability to collaborate with industrial designers, consultants and manufacturers across different time zones simplifies the whole process." 

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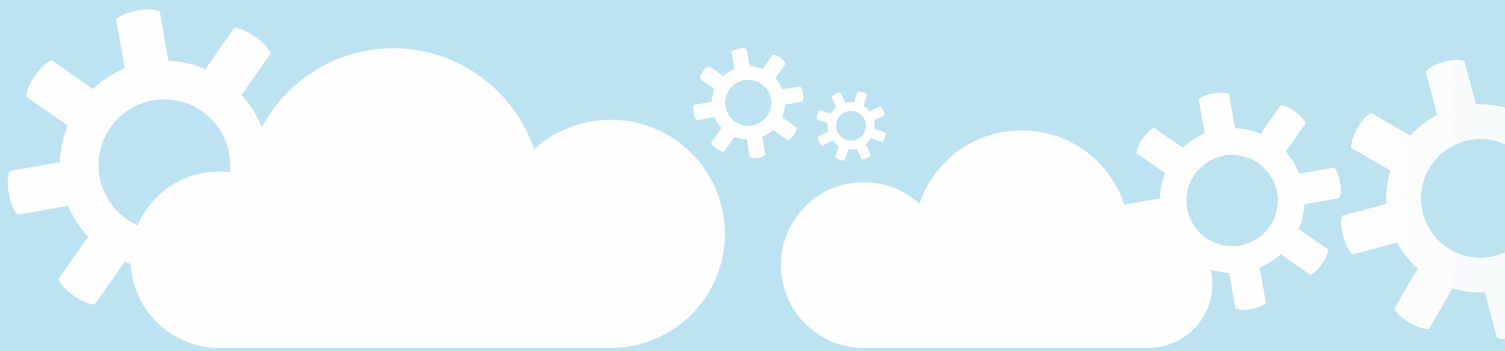
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FOCUS ON FUSION

Cloud-based CAD continues to progress with Autodesk's latest upgrades to its Fusion 360 package. Tim Fryer reports

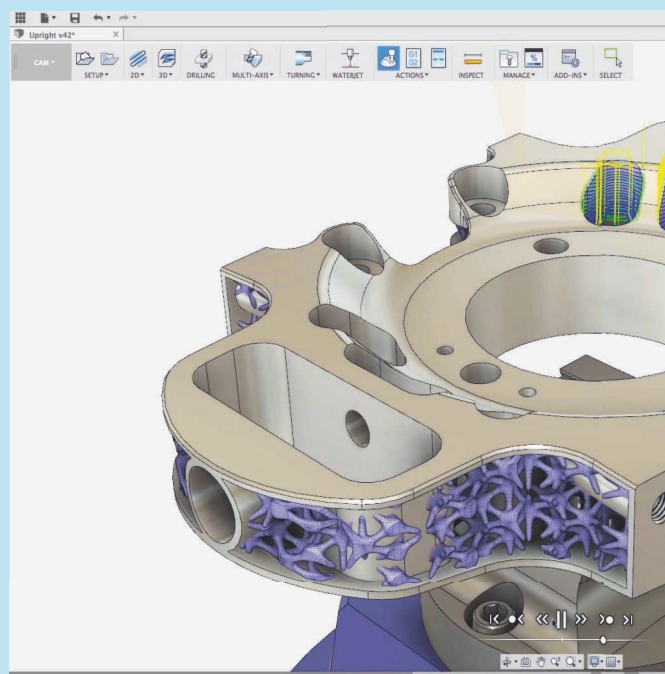
At the recent Autodesk University (AU16) users of the company's best known CAD brands, Inventor and AutoCAD, were assured that development of these products would continue. There are plenty of engineers using these packages that have no intention of changing unless they felt they were being left behind, and will therefore be thankful for this reassurance.

However, there was no doubt that the company's focus is on Fusion 360. It was launched only three years ago and covers the entire product development process in a single cloud-based platform. In performing functions such as CAD, CAM and CAE the company claim that engineers – from design through to manufacture and beyond - generally don't need to look outside the Fusion software suite to cover the full product lifecycle. And, for those to whom it is important, it

works equally well natively on Mac and PC.

AU16 talk was as much about what was going to happen in coming months, as it was about the product updates that had occurred just the week before at the beginning of November.

Principal features of this update concerned CAM capabilities and simulation. Prabakar Murugappan, senior director, Fusion 360 Products at Autodesk, commented: "With this update we have really pushed the boundaries. One is using the cloud to move more simulation capabilities into the Fusion ecosystem. We have bought in Nastran, whereas



Above: Generative design allows parallel design and optimisation.

Below: Engineers will have access to their models on any device

Pictures courtesy of Autodesk, Inc.

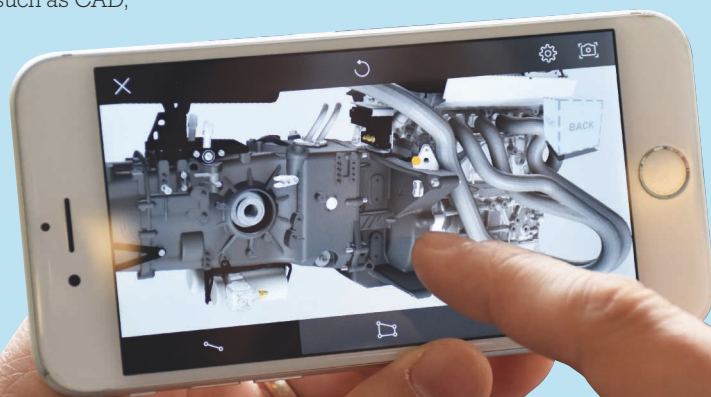
previously we were only supporting linear physics types and it is more important for us to know when something will break and bend."

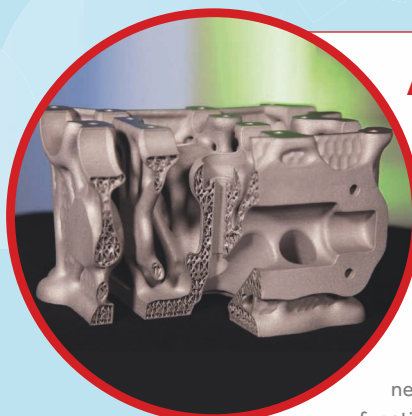
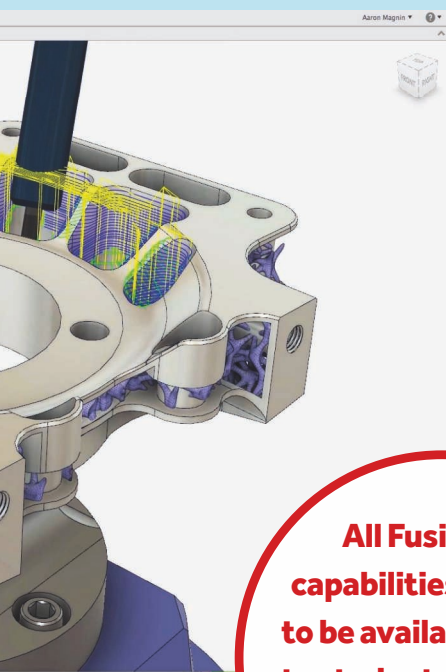
Nastran In-CAD software is a general-purpose finite element analysis (FEA) tool for engineers. It gives users access to advanced simulation, such as multiple load cases, structural buckling, and shape optimisation.

Steve Hooper, director of Manufacturing Strategy at Autodesk, believes that it is important to bring simulation into the workflow. "We are incorporating simulation as part of the design process, not an afterthought of just validating something," he said. "It's really just integrating with it and validating along the way."

It is Fusion's home in the cloud that makes this feasible for many.

Hooper explained: "The real power of being able to leverage the cloud for this is in terms of being





AM CONNECT

Also of interest at AU16 was news of enhancements to the Netfabb additive manufacturing solution. Although only released in September, it is already being beefed up with enhanced simulation capabilities,

new hybrid manufacturing functionality and collaborative multi-head 3D printing. Simulation for Netfabb

helps users to predict and adjust for deformation, allowing designers and manufacturing engineers to optimise designs and reduce the number of iterations required for reliable build results.

Additionally, Netfabb now includes solid modelling and near-net shape planning capabilities based on Autodesk PowerShape technology. This hybrid manufacturing functionality allows users to keep models in solid form and take advantage of solid modelling tools aligned to CAM workflows. It also allows manufacturers to keep sight of the original solid model and track the near-net shape as it is built to allow for the subtractive processes. With better visibility of the original model and the near-net shape, Netfabb connects workflow between build preparation and post-processing operations.

FUSION IN THE FUTURE

Much more is being promised for the early months of 2017. First up will be the sheet metal capabilities. While allowing engineers to 'flange, flatten and fold', it is also integrated with CAM so choices and impacts of using laser cutting, water jetting or machining can be determined at point of design rather than further down the line.

It doesn't quite extend to allowing the manufacturing processes to control what happens on the design side. Murugappan said: "We don't have that yet, but it's one of the things we are working on on the generative design side - picking your printer and material when you start your design."

Generative design gives engineers the ability to input design criteria such as desired criteria (weight, size, cost) and allow computer algorithms to generate design geometries that fit those constraints - and it is coming to Fusion 360 in stages. Shape optimisation was introduced in November's release with full topology optimisation to follow. Murugappan continued: "The other thing is we are working on is bringing in latticing. So using shape optimisation you have a shape, you can then impose latticing and it will then re-optimize. That is the thing about Fusion, everything is done in tandem."

Another feature that users can expect to see in the coming months will be the ability to integrate electronic designs (ECAD) seamlessly. Users will be able to select any type of PCB file and have it translated directly into their designs

All Fusion 360 capabilities continue to be available for free to students, teachers, schools, start-ups and hobbyists

able to queue up multiple different 'what-if' design scenarios, changing the way that people have accessibility to using this without having really expensive hardware solutions that may not be at their disposal."

The other main introduction involved the CAM features within Fusion. Existing capabilities included 2.5 axis, milling, three-axis milling, turning, water, laser and plasma, and these have now been extended by adding 3+2 milling, wrap, four-axis and a number of different five-axis strategies, contour and tilting capabilities.

The new CAM and simulation features are available in the Fusion 360 Ultimate subscription; pricing has yet to be confirmed in the UK for this new level, but a good guide is that in the US Ultimate costs \$1500 a year compared to the standard package subscription of \$300 (£276 or £36 a month in the UK).

via the cloud. Changes update automatically and cloud libraries will be available to populate boards with common 3D components.

Collaboration is one of Fusion's founding principles. Murugappan said: "We are trying to bring teams together. The next thing we are working on, branch and merge, allows teams to explore options in parallel and then bringing all ideas together and pick the best. What we have in Fusion today is an ability to see what people are working on, comment and mark-up, but not take a variation. Branch and merge allows teams to simply choose the path they all want to take. It's faster design exploration."

A final feature worth looking out for is the forthcoming arrival of modeling in the browser. Autodesk day that through mobile and browser functionality, there are no limitations to where, when, and on which device a product developer can access their design data and work on their projects. **!**

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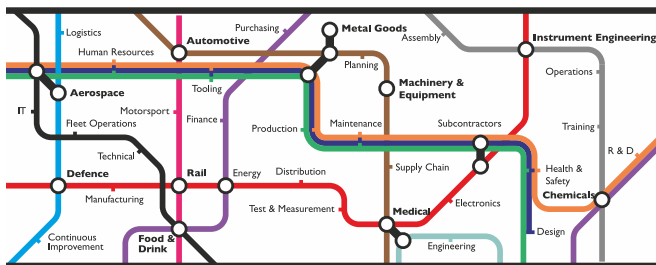
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TINKERING AND HAVING FUN

In October, when the trophies were being handed out, the youngest winner at the 2016 British Engineering Excellence Awards was Chris Bellamy, lead engineer at Jaguar Land Rover. We subjected our newly crowned Young Design Engineer of the Year to a Q&A.

When did you first realise that you had a talent for engineering?

I think my parents realised well before I did that I had 'the knack', with increasing concern for the things steadily being dismantled and created around our home - but I was just playing - an attitude which I continue to this day.

Once I got to university, I continued my tinkering and having fun; it's not till recently that I have looked back and realised that I was approaching things in a different way, and creating some innovative and exciting solutions - many of which failed - my upside down bridge concept was rather memorable!

I didn't fully realise what engineers actually did until my

third year of university, having spent the summer working with DMM Engineering, where I was involved in all stages of product development from concept invention through to production manufacturing.

Who inspires you?

I get inspired from anyone and everyone around me. Generally, those who inspire me are humble, determined, competent, passionate, proud, pragmatic, enthusiastic, charismatic people.

What is your biggest ambition?

I am very passionate about the sustainability of our planet. Unless companies and individuals can step up and develop radical solutions, which are appealing and adopted by



consumers, there will be disastrous consequences in the near future.

It is the perfect problem for the human condition - it requires short term sacrifice for long term gain - it requires group collaboration rather than individualistic benefit seeking - it requires understanding something which is invisible and too big to comprehend.

My biggest ambition is to find ways to create radically more sustainable solutions which consumers adopt out of choice not sacrifice.

What are you most proud of?

The three things that I am most proud of would be:

One, always speaking my mind - I have always stood up for my beliefs and principles, even when this goes



against convention, the easiest path or business profit. A bonus of this is that by always speaking my mind, my opinions are on the table, and it builds huge amounts of trust, I don't believe in cloak and dagger.

Two, being able to talk to and gain respect from everyone from the shop floor to the board room. I pride myself on being able to laugh with and gain the respect of shop floor workers, but then make an impact presenting to senior executives in equal measure.

Three, Inspiring People. I get a huge glowing warm feeling inside when I get notes or messages saying that I have inspired people to do something.

What tool (hardware or software) could you not do without in your everyday work?

A sketchbook, a pencil and a phone. The tried and tested oldies are the best. People are so eager to jump into email, CAD etc. these days, without thought and reflection first. Sketching is quick and simple but can answer so many questions, and is an art form that you can keep getting better at.

What has been your biggest challenge since joining Jaguar Land Rover?

Sadly, as I expect for most engineers, the biggest challenges are around co-ordinating and communicating with those around you to achieve the best result. The engineering can be brilliant, but if you don't have the engagement and agreement from the right people, decisions and processes, then your brilliant work will never see the light of day.

I have since taken a break from Jaguar Land Rover to explore the world while working remotely as an engineering consultant. This has been hugely enlightening - the engineering

"My biggest ambition is to find ways to create radically more sustainable solutions which consumers adopt out of choice not sacrifice."

content of the work is much higher, but the brutality of the buck stopping with you is really rewarding and revealing - it has taught me a huge amount. Trying to do all of this while living in a van has been even more entertaining.

What do you want to be doing in 10 years' time?

I've never found planning very successful. I prefer to be opportunistic. I never know what opportunities are going to arise each day, so I just grab as many as I can and run with them. If I had tried to plan where I am now 10 years ago, I would not have had a chance - I didn't even know what an engineer was!

More generally, I will be very happy if I can have inspired many more people; made radical improvements to the sustainability of our planet; and created a wild, winding and interesting story in the process.

Did you ever consider an alternative direction in your career?

My grandparents were doctors, farmers and teachers; my parents were doctors; my brother became a vet; so I always thought I would end up becoming a doctor or a vet. After discussing with a school teacher I changed my university application to engineering at the last minute, having heard about it through the Institute of Mechanical Engineers and the Arkwright Scholarships.

Above: Chris Bellamy, lead engineer at Jaguar Land Rover.



I nearly changed university courses after my second year, until I went on an industrial placement, and it finally clicked that engineering was amazing, could change the world, and pretty much do anything!

A lot of my university colleagues went into financial services or consulting after university, however I have always wanted to work on real tangible products that make a huge impact to people.

What university did you go to and what course did you take?

I went to the University of Cambridge, and following two years of general engineering, specialised in the Manufacturing Engineering Tripos.

How did you get into the graduate programme at Jaguar Land Rover?

After being rejected twice, I put in one last application on a whim and was accepted. I spent a summer corrosion testing cars, measuring rivets, testing new aluminiums and creating an innovation strategy, after which I was offered a position on their graduate scheme.

What do you do to chill out in your spare time?

I really struggle to sit still. I like to get into the great outdoors and use my body as much as possible in the company of great friends - I can't help being a bit competitive too. This includes taking part in Ironman triathlons, ultra marathons, rock climbing, windsurfing, yoga, skiing and any other way of moving outdoors. Best of all - I love replacing all those calories afterwards with delicious food.

I find that DIY works wonders if there are any particular frustrations which I need to work out, or need time to ponder and solve problems - I have an old house and a couple of very old rusty cars that provide ample opportunities for this. !

JUDGING CRITERIA

In deciding the winner of The Young Design Engineer of the Year Award, which is sponsored by RS Components, the judges took a range of factors into account, including: the knowledge which has been applied by the young engineer; the contribution made to projects; and the degree of innovation required. They also considered the nominee's personal qualities that promote the engineering profession. Having chosen this year's winner, the judges said: "Christopher has achieved a lot in a short career, recognising that it's not easy to make a mark in companies such as JLR at such a young age."



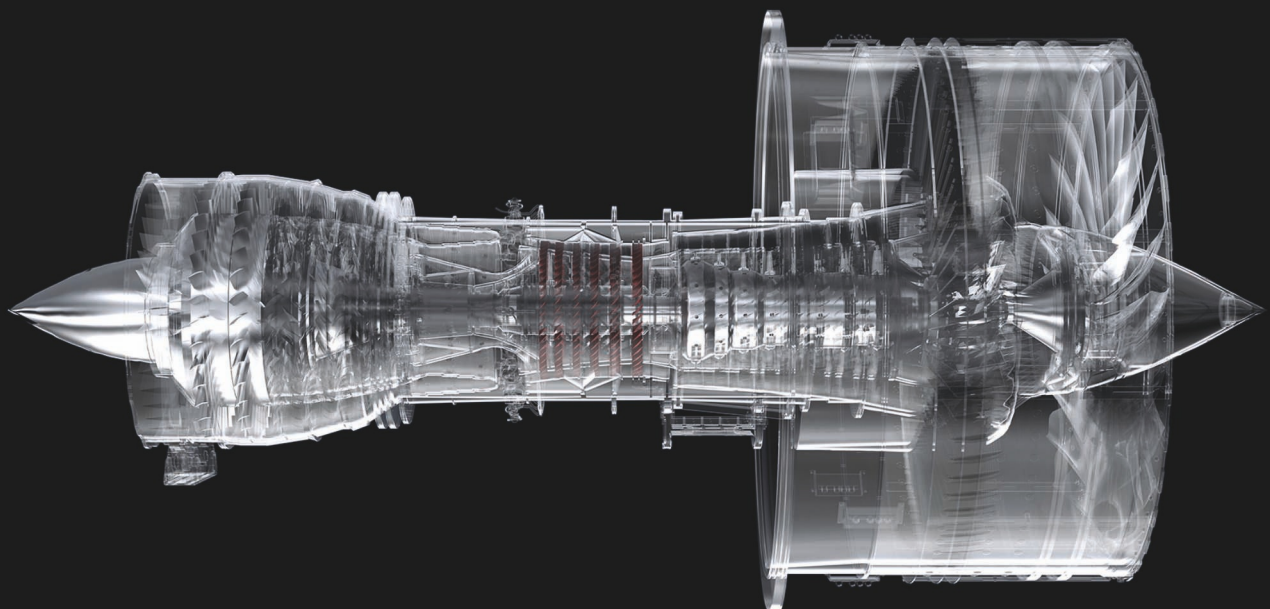
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SIMPLY INTEGRATING ADDED VALUE

Thanks to a variety of development platforms and widespread support, there is no stopping the expansion of the PROFINET equipment portfolio with integrated value-added functions. Mark Freeman discusses some of the latest developments.

PROFINET has now become standard for many users in a wide variety of industries, as reliable systems and innovative machines are only possible with powerful communication. Apart from the high speed and safety-related requirements, a growing number of additional functions are necessary to achieve the higher levels of productivity, quality and availability needed in global competition. On top of this, there is an ever-increasing demand for future-proof solutions so benefits can be gained today from possible future innovations.

System architects of PROFINET (PN) have consistently exploited the additional possibilities of Ethernet, as compared to fieldbus concepts. In this way, simply by switching from fieldbus systems to Ethernet, shorter cycle times for the IO data are achieved due to the 100Mb and full-duplex transmission. Using dynamic frame packing (DFP), a mechanism available in PROFINET, and automatic fragmentation of TCP/IP data, update rates of 31.25µs are possible with open TCP/IP communication. However, the update rate of 250µs available with PROFINET, combined with isochronous real-time communication (IRT) with a maximum jitter of 1µs, provides far greater speed than is actually needed for most applications. The usual cycle times of controllers, IO modules or drives are many times higher and, as a rule, the deterministic requirements are of more importance in this respect.



DEVICES WITH MORE THAN JUST IO COMMUNICATION

By integrating the PN protocol device designers can make new, built-in options, e.g. the partial shutdown of energy consumers during breaks in production, readily accessible to their customers. Without consistent standardisation, only manufacturer-specific solutions with their own program blocks are possible, which makes use unnecessarily complex.

PROFINET
has a first-class
starting point from
which to face the future
- especially in the field
of real-time
Ethernet

Engineering via PROFINET is easy. For example, all language and device versions of a device family can be described by means of a single general station description (GSD) file, and the most common faults are defined by means of the PN standard. This simplifies handling for the developer of the GSD and for the user during commissioning.

The properties of PROFINET, such as the simple addressing of devices with names and the integrated

topology view, directly facilitate engineering and commissioning.

This topology view not only serves as plant documentation, but – combined with the diagnostic messages – also offers reporting of faults with their precise location, allowing them to be resolved more quickly and easily. Access here is not only possible locally by means of PLC or engineering, but also via add-on tools or remote access. A wireless communication route is favoured, as this mobility enables commissioning engineers to position themselves and their engineering PC at a location that offers the best view of the machine.

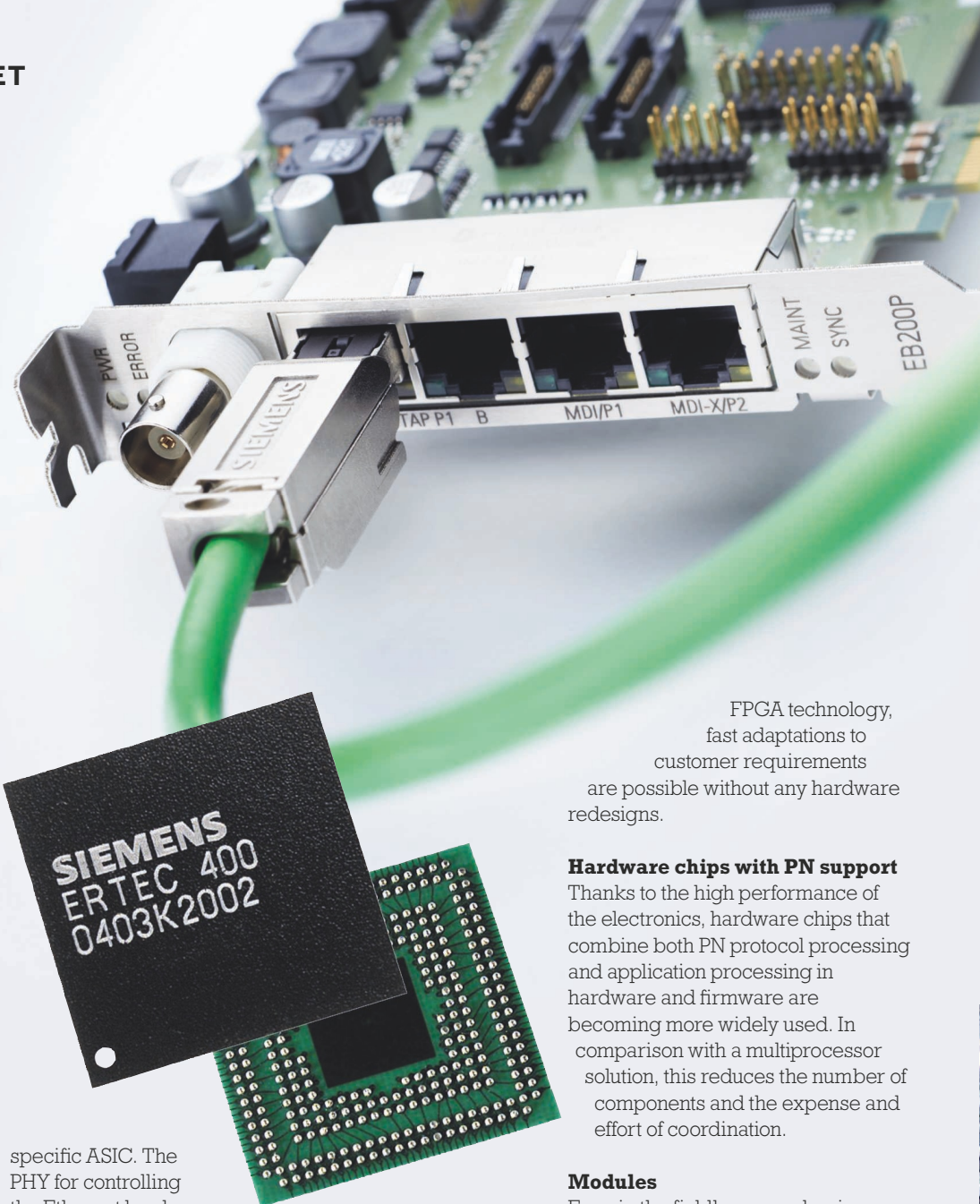
Devices that only require one channel of TCP/IP communication, such as cameras or IO devices with additional quality data, can easily be connected using wireless or cable communication. The function of generating quality data or additional associated values is increasingly spreading into the devices, as the rapid advances in performance of industrial electronics hardware and software enable corresponding devices to be developed at commercially competitive costs. Here are some of the options for different development platforms.

STANDARD ETHERNET CONTROLLERS

Through the integration of a PROFINET protocol stack, an existing industrial electronic system that already has an Ethernet controller 'on board' can be extended to include PN functions. No additional hardware is necessary. Although this does not enable any synchronised motion applications to be performed, it does allow the most widely used real-time requirements up to 1ms to be implemented. A simple example or 'playground' for such integration is a PN device or controller on a Raspberry Pi or BeagleBone Black.

PROFINET protocol ASICs

Many will be familiar with specific protocol ASICs from fieldbus technology e.g. SPC3 for PROFIBUS or SUPI for Interbus. The same solutions are, of course, also available for PROFINET integration. Protocol processing, including the optional IRT synchronisation, takes place on a



specific ASIC. The PHY for controlling the Ethernet hardware interface and two ports for the line integration are integrated.

FPGAs

Flexible PN integration with integrated pre-processing is available with FPGAs. Fully tested IP cores are available for the different requirements - including IRT communication - for integration into an overall device. Thanks to the

FPGA technology, fast adaptations to customer requirements are possible without any hardware redesigns.

Hardware chips with PN support

Thanks to the high performance of the electronics, hardware chips that combine both PN protocol processing and application processing in hardware and firmware are becoming more widely used. In comparison with a multiprocessor solution, this reduces the number of components and the expense and effort of coordination.

Modules

Even in the fieldbus era, plug-in modules which, like protocol ASICs, offer a defined application interface, proved their worth. No hardware development is necessary here if the interface is already available. To enable PC integration, however, the interface modules are also available for connectors that are optimised to smaller dimensions.

Gateways

Particularly where smaller quantities are concerned, gateways are used which convert other serial protocols to PROFINET.

Of course, these different platforms are used not only during development of a PN device, but also when integrating a PN controller into PLCs, PCs or other automation systems.

The possibilities of integration listed here require varying stages

Above: The Enhanced Real-time Ethernet Controller ASIC from Siemens is for use when developing network components and field devices needing demanding communication options.

PROFIBUS AND PROFINET

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- 27 Regional associations
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- 10 Test laboratories

of hardware/firmware integration and thus different proportions of in-house development by the device manufacturers. In this way, not only the time required for familiarisation and the utilisation level in the companies can be controlled, but also the device costs that depend on the quantities manufactured.

CHOICE MEANS OPTIMISATION

Selection of the right integration platform, and of the appropriate scope of functions of the respective PROFINET device to suit the customer, demands rather more consideration during development than if a communication architecture only permitted a few platforms or only restricted services.

However, this is the only way to create devices that are optimised in terms of both functionality and cost, which enable the manufacturer to integrate unique selling points that bring further benefits for the end user.

Technology providers naturally provide support for this selection on the basis of requirements and boundary conditions of a device manufacturer. For the integration of the PROFIdrive drive profile, source code is available on both the device and controller side, thanks to the work of the PROFIdrive community. This facilitates implementation in motion control devices, numerical controllers and robots. With its different application classes, PROFIdrive covers all applications, from simple rotary speed axes to interpolated isochronous mode multi-axis applications. The user benefits from the standardised application interface used by different manufacturers.

Unfortunately, some extended options of PROFINET are still not used by all device manufacturers, as they only want to offer functions used together with other types of communication. Further development is possible at any time, however, and is often only a matter of time.

However, the PI community can tackle more extensive innovations, such as those to be expected in the context of Industry 4.0, on the basis of the existing openness toward additional communication on the same cable, and the high level of standardisation of the data types. The 100% compliance with IEEE and thus with the Ethernet standard gives PROFINET a first-class starting point from which to face the future as, especially in the field of real-time Ethernet, many innovations are to be expected in the future from which PROFINET users will also benefit. The commitment of the many manufacturers and the market penetration of PROFINET are encouraging the continuous development of communication functions and thus the crucial added value of the devices for customers' plants and machines. **!**

The author is product manager – Distributed I/O and Failsafe Products at Siemens UK & Ireland

Left: An evaluation board is intended for hardware developers who want to use the ERTEC 200P for new products.

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RISK



With product lifecycles reducing all the time, having a strong obsolescence management system in place is essential. Tom Austin-Morgan spoke to the man who literally wrote the book on the subject.

A GAME OF

Above: Inverters have common problems and if they break down will need replacing to avoid downtime. This can become more difficult when an inverter becomes obsolete.

Far right: If something goes wrong with PLCs, commonly used in industrial systems, replacing parts can lead to long hold ups. If the components have gone obsolete, instead of a costly upgrade the plant manager may look to source the obsolete component.

Below: Jonathan Wilkins, co-author of the Book of Obsolescence Management.



We live in a highly connected age with rapid advancements in technology, automation and data capture. Industry is currently on the brink of the fourth industrial revolution, a time where smart factories will be run with minimal human intervention and there is more reliance on intelligent, connected devices to run industrial systems.

The upshot of this is that hardware and software now goes obsolete faster and faster, far before it has outlived its usefulness. This trend led to EU Automation's managing director, Mark Proctor, and director, Jonathan Wilkins to write the Book of Obsolescence Management (BoOM) to help manufacturing businesses formulate obsolescence management planning for their facilities.

Firstly, if this is a new concept to you, you aren't alone.

"It sounds like 'common sense' when you say it out loud, but there are a lot of people that we speak to that are not aware of it as a concept," said Wilkins. "Obsolescence happens every day, it's speeding up because of technical innovation, market changes, legislation changes and environmental policies. We really wanted to start

the conversation of obsolescence management, especially with the advent of Industry 4.0."

Wilkins says that design engineers, in particular, should think about obsolescence as early as possible in the design phase to maximise the lifespan of a system or product.

He continued: "The initial considerations of the development path are simple: What is the product and what is the function? Once the designer has established the basics they can move on to material choice, manufacturing method, production numbers, cost forecast, et cetera."

What is more difficult to assess and plan for is product lifespan, as designers cannot control all aspects of the component supply chain or what the end user wants from a product.

"Sometimes a better use of resources for a designer is to make a less durable piece of equipment," Wilkins explained. "For example, if you made a phone out of titanium it would never break, but it'd be incredibly expensive and in a few years it's functionality would seem ancient."

When trying to maintain machinery in a plant, it's best to have a continually monitored obsolescence management programme in place. In

THE SEVEN STEPS TO GOOD OBSOLESCENCE MANAGEMENT

1 INITIAL SYSTEM AUDIT

To effectively plan for the future you need to know what's going on here and now, so ask questions: How old is your machinery? How long has the machinery or parts been on the market? Are any current components already obsolete? Are software updates available?

2 KNOW YOUR RESOURCES

Once you know what's going on, have a look at your strengths. If a critical part breaks down, you need to be able to minimise downtime by calling on your resources.

3 GAME OF RISK

Looking after your most critical applications is where you should plan most. Draw up a risk assessment, analysing the likelihood of parts breaking down and the effect this could have. What is the component's average lifespan? What is the availability from suppliers? Can you risk it failing or is preventative maintenance the best option?

4 GO OBSOLETE SPOTTING

List all the obsolete parts in your system, these will be the hardest to replace. Have you had any 'last-time-buy' notices? It could be wise to stock up on these items for the future rather than face a costly system re-design.

5 WELL CONNECTED FRIENDS

What happens if the OEM stopped manufacturing a part a long time ago? Industrial automation parts suppliers are well-stocked or have the contacts to help you get obsolete replacements quickly.

6 CREATE A KNOWLEDGE BANK

By this point you will have created lots of invaluable notes, records and analytics to keep track of your obsolescence management strategy. Collate it all in an easily understandable format, it doesn't need to be a fancy system or bespoke software, a simple spreadsheet will do.

7 REVIEW, FIX AND UPDATE

Obsolescence management is a full-time job, keep up with your checks weekly or, preferably, daily to keep your database up to date. This will help you minimise, or at least prepare you for, any horrible surprises.



this instance, Wilkins says it's best to get to know your facility inside and out and create a knowledge bank of every component and piece of software. Check product codes and part numbers against the suppliers' websites to make sure there aren't obsolete parts already in your system. As for software, making sure you have the latest version can be as simple as pressing the update button when notifications come through. It is also worth checking software status in case notifications have stopped.

Make sure you are carrying these checks out at least weekly, preferably daily, so you have the most up to date information in your knowledge bank to be as well prepared as possible. "Your system is only as good as the information you're putting into it," Wilkins added.

If your system does include obsolete components, you can contact parts supply companies, such as EU Automation, who will be able to help you source replacement components. If you find you have received 'last-time-to-buy' notices from suppliers, it may be best to buy bulk loads of them to cover you for the foreseeable future and avoid having to undertake costly system re-designs.

The future of replacement parts may lie in 3D printing. Recently NASA carried out 3D printing on the International Space Station to explore the concept of on demand manufacturing. Daimler has also

announced that it is employing 3D printing to produce spare parts including spring caps, air and cable ducts, clamps, mountings and control elements. So, could this be a path the manufacturing industry could follow in future?

"In the industrial automation space we're not finding that people are coming up against the same issues as they are in automotive and aerospace," Wilkins answered. "The technology needs to become far more affordable before it rivals buying a new component or equipment."

"I think we're at the beginning of the journey. There's so much more that has to happen before we get to smart factories," he added. Right now it is still a lot cheaper to carry out audits, log data and be prepared via predictive maintenance than it is to wait for a part to fail and 3D print a replacement. It also reduces downtime.

For now, why not use the Book of Obsolescence Management as a tool to get you prepared for the journey ahead? **!**

Sometimes a better use of resources for a designer is to make a less durable piece of equipment.

SEARCHING FOR SWEET DREAMS



If life was accurately represented by soap operas, then the typical family would be torn apart on a regular basis by financial impropriety, infidelity, drunkenness and cruelty. And that's before the long lost children from a past life turn up. Fortunately, the majority of us lead less turbulent lives but even then very few live lives of constant and complete contentment.

If they do, they do not have a partner who snores. Snoring is the perennial bugbear. The destroyer of domestic bliss.

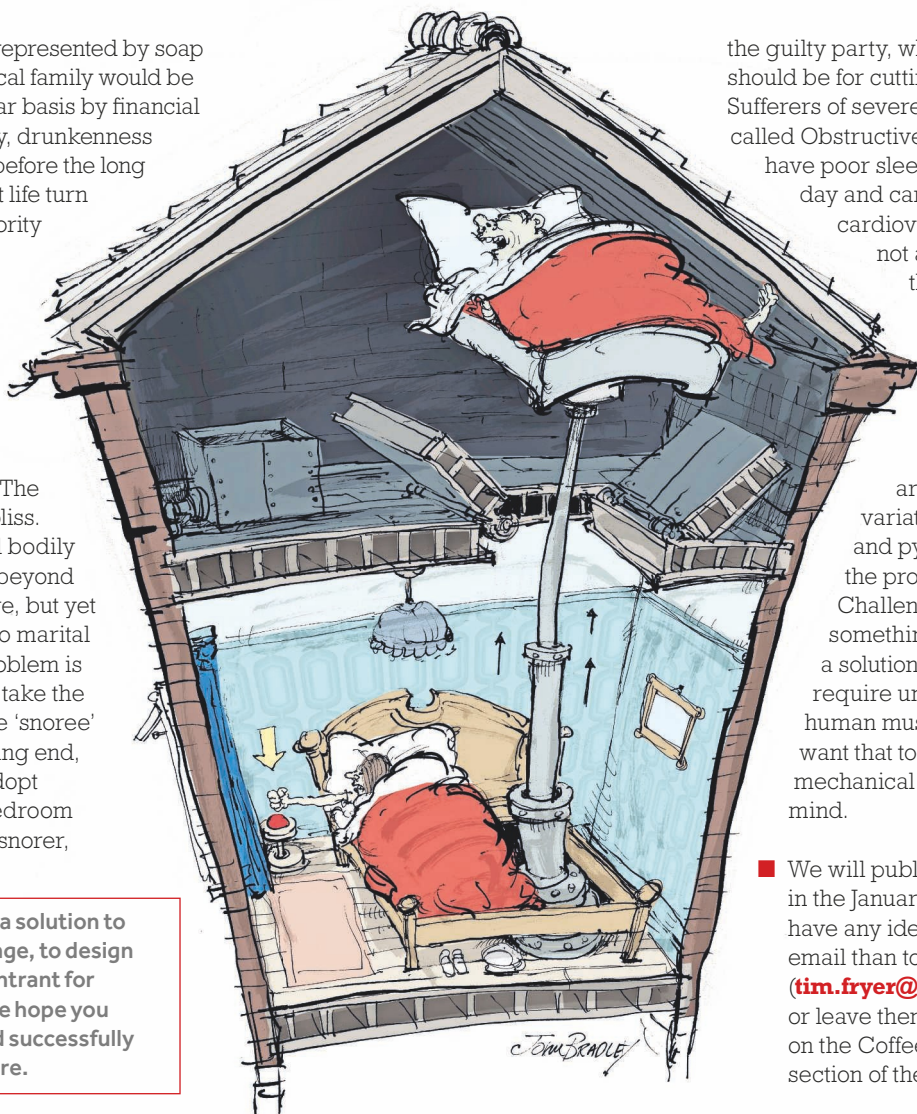
This simple physical bodily function should not be beyond the gift of man to resolve, but yet it remains an obstacle to marital relations. Part of the problem is deciding who needs to take the remedial action. Is it the 'snoree' – the one on the receiving end, the victim, who must adopt headphone or spare bedroom type actions? Or is the snorer,

the guilty party, whose responsibility it should be for cutting out noise at source? Sufferers of severe snoring, a condition called Obstructive Sleep Apnoea, typical have poor sleep, fatigue during the day and can have increased risk of cardiovascular events. So this is not a victimless crime even if the snorer sleeps alone!

We are taking the latter approach for this month's Coffee Time Challenge – the solution sits with the snorer. There are sprays, nose clips, variations on bed positions and pyjama design...but the problem persists. So the Challenge is to come up with something new. As ever we have a solution in mind. While it does require understanding of how human muscles work, we wouldn't want that to restrain you if any more mechanical innovations spring to mind.

■ We will publish our solution in the January issue. If you do have any ideas feel free to email than to the editor (tim.fryer@markallengroup.com) or leave them as a comment on the Coffee Time Challenge section of the website.

If you came up with a solution to last month's challenge, to design an all-conquering entrant for Robot Wars, then we hope you build your robot and successfully compete in the future.



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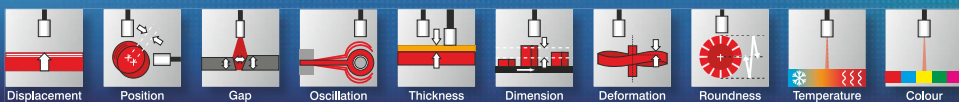
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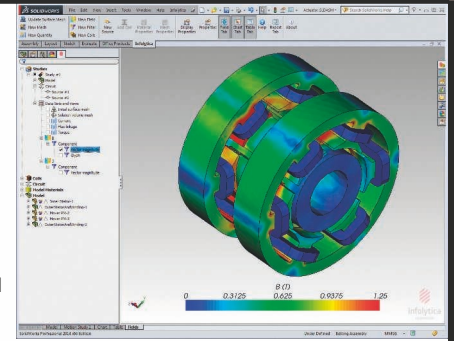
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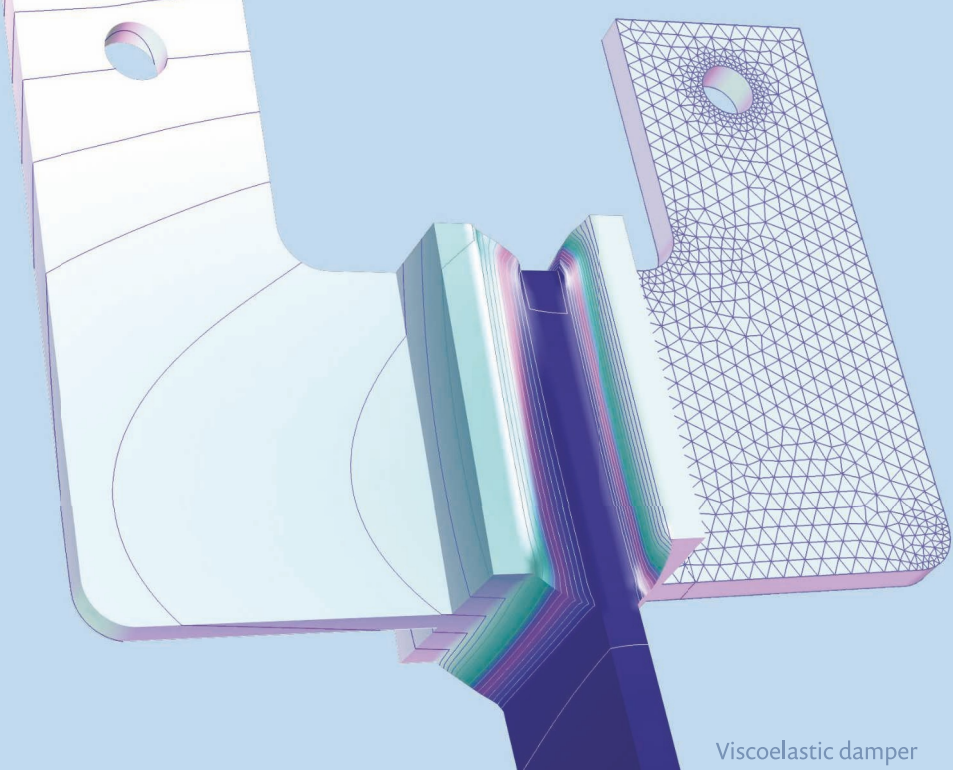
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