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12 COVER STORY
DESIGN IN REAL TIME
With tools like generative design software optimising part designs in real time, companies are taking this concept to a whole new level.

23 MEDICAL ROBOTICS
In a bid to improve surgical safety, a UK start-up has created what it claims is the world’s smallest surgical robot. It is affordable, can be deployed anywhere and could slash the cost of laparoscopic surgery.

27 FASTENING GROUNDING STUDS
How is it possible to create reliable ground or earth connections to vehicle body panels? It is a challenge the automotive industry has been grappling with for a long time.

31 SENSORS DETECTION
The prospect of robotic systems being able to differentiate between humans and other objects has taken a step forward with a new approach to thermal imaging.

34 POWER TRANSMISSION
ADDITIVE MANUFACTURING
Can designing fluid power components from first principles in order to make them using additive manufacturing pay dividends? One company is determined to find out.

37 DESIGN PLUS SKILLS
For the UK to become a global manufacturing powerhouse and driver of Industry 4.0, SMEs are going to need more government support, says Autodesk.

39 COFFEE TIME
CHALLENGE
SHOES YOU CAN’T LOSE
This month’s challenge is to come up with a high-tech way to keep your shoes in pairs, or at least make them easier to find.
Develop better products — faster.

An example of a simulation app in the COMSOL Server™ app library. App users can find an optimal heat sink design without having any knowledge of the underlying mathematical model.

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EDITOR’S COMMENT

INNOVATION NEEDS PROTECTION TO THRIVE

AS MODERN BRITISH innovators go, it is fair to say that Trevor Baylis CBE perhaps exemplified a certain archetype. With his invention of the wind-up radio, he perfectly represented the independent, self-motivating – perhaps idiosyncratic – inventor and rose to deserved fame as a result.

However, his recent death has also thrown into focus one of the most pressing issues facing those who innovate: the need to protect their inventions. The sad fact is that, towards the end of his life, Mr Baylis struggled with imitators, even going so far as to suggest that patent infringement be made an imprisonable offence. Certainly, he never saw the rewards that many felt his inspiration merited.

The problem, of course, is that protection of intellectual property (IP) remains to a large extent a rich man’s game. The sheer amount of money required to protect an invention is effectively prohibitive as far as the lone inventor with no corporate backing is concerned. The result is that IP cases can have an unfortunate tendency to go not to those with the best claim, but to those with the deepest pockets.

As well as celebrating his inventions, then, it is perhaps also fitting to regard as part of Mr Baylis’ legacy a salutary reminder of the difficulties that face innovators in trying to protect and capitalise on their ideas.

Paul Fanning, Editor

MISSION STATEMENT

DESIGN | INNOVATE | ENGINEER

Eurekaj connects design engineers with the UK’s industrial heartbeat by providing in-depth coverage on the very latest technology developments and industry trends; keeping you inspired, informed and innovative.

WEB EXCLUSIVE

INNOVATION NEEDS PROTECTION TO THRIVE

INNOVATION NEEDS PROTECTION TO THRIVE
The BEEAs are open for entries

SINCE THE BRITISH Engineering Excellence Awards were launched in 2009, the winning entries have ranged in size from chip designs to earthmoving vehicles. The Grand Prix – the best of the best – has gone to winners including: new imaging technology to improve outcomes for cancer patients; an engineer who designed a system to save water on a massive scale; a marine communications company; and in 2017, an LED manufacturing process that improves lighting efficiency. The BEEAs reward companies that have shown innovation in design within the last year and the design engineers who made those innovations possible.

If you have developed breakthrough technology, grown an innovative business or excelled in your specialist field, then why not enter the British Engineering Excellence Awards?

THE 2018 CATEGORIES
- Consultancy of the Year
- Design Engineer of the Year
- Design Team of the Year
- Engineering Ambassador of the Year
- Materials Application of the Year
- Aerospace Product of the Year
- Electronic Product of the Year
- Mechanical Product of the Year
- Small Company of the Year
- Start-up of the Year
- Young Design Engineer of the Year

For full category information and to obtain your free online entry form, visit www.beeas.co.uk. Deadline for submissions is 15th June 2018.

The winners will be announced at a gala lunch at etc.venues, County Hall, Southbank, Central London, on October 4th.

MEASUREMENT AND SYNCHRONISATION WITH COMPACTRIO

NI’S LATEST COMPACTRIO Controllers include NI-DAQmx and Time Sensitive Networking (TSN).

These controllers offer synchronised measurements across standard Ethernet networks to increase performance and help improve productivity in addition to flexibility. Engineers can use TSN to synchronise distributed systems across networks, eliminating the need for costly synchronisation cables.

The controllers feature sub-microsecond synchronisation with TSN over standard Ethernet for tightly synchronised, distributed measurements and control. They also include shorter time to measurement than previous CompactRIO Controllers, open and secure processing at the edge of the IIoT, high-performance data analysis and control with an industrial-grade processor and onboard FPGA. Reliable operation in harsh environments is also claimed, with a -40°C to 70°C operating temperature range, shock resistance up to 50g and vibration resistance up to 5g.

With the addition of NI-DAQmx, engineers can access I/O directly from ready-to-use functions. This intuitive driver coupled with the openness of the NI Linux Real-Time OS means users can continue to leverage the vast ecosystem of IP available for Linux, like SE-Linux.
OBITUARY

TREVOR BAYLIS
1937–2018

FOLLOWING STINTS AS a swimmer, national serviceman and swimming pool salesman, Trevor Baylis rose to fame following his invention of a wind-up radio that he was inspired to create after watching a documentary about the African AIDS crisis in 1991. By employing a strong spring, he invented a radio that could be powered for 15 minutes with a couple of turns of a crank, which he foresaw being used in the developing world for public health information broadcasts.

By the time of his death, Mr Baylis had more than 250 other inventions to his name, besides the radio for which he was most famous. These included electricity-generating shoes powered by piezo-electronic soles, and numerous devices for the disabled community.

Mr Baylis was a familiar face to readers of Eureka!, appearing in its pages many times over the years, including in an interview in 2003 by then Technology Editor Tom Shelley. He also campaigned extensively to encourage young inventors and on patent protection – even going so far as to suggest copyright infringement be made a criminal offence.

Baylis received an Order of the British Empire award in 1997 for his services to intellectual property and was awarded a C.B.E. in 2015. He died of natural causes on 5th March at his home on Eel Pie Island, London.

British steel wins major contract

AFTER ENHANCING ITS manufacturing capabilities with a £1 million enhancement of its Scunthorpe Rail and Section Mill so it could manufacture this longer-length rail, British Steel has secured a major German rail contract.

The deal will see the company deliver around 20,000 tonnes of 120 m rail a year to Deutsche Bahn, Europe’s largest purchaser of rail.

Peter Smith, British Steel managing director rail, said:

“Deutsche Bahn is by far the biggest purchaser of rail in Europe. Having a stake in the German market is strategically important to us and we hope to build a strong and lasting relationship with them.”

The initial contract is for 21 months from March and will see the rails delivered to Germany through the Channel Tunnel.

SEARCHING FOR CLEAN, ABUNDANT ENERGY

AN OXFORD-BASED COMPANY is investing £3.6 million to build a pulsed power machine to attempt to generate low-cost, sustainable energy from fusion.

The device, labelled Machine 3, is being constructed by First Light Fusion and the company says it is on track to be commissioned by the end of 2018. Once complete, it will be able to discharging up to 200,000V and more than 14 million Amps within two microseconds.

Machine 3 will be used to fire a high-velocity projectile, creating a shockwave to collapse a cavity containing plasma inside a ‘target’ which creates energy. The ultimate aim is to achieve ‘gain’, whereby the amount of energy created outstrips that used to spark the reaction.

This approach was inspired by the only example of inertial confinement found on Earth – the pistol shrimp, which clicks its claws to produce a shockwave that stuns its prey. The only other naturally occurring inertial confinement phenomenon is a supernova.

“We are confident that we will reach our present goal of demonstrating fusion,” said Nicholas Hawker, founder and CEO of FLF.
Funding support trebles

A RECORD NUMBER of prestigious engineering scholarships and bursaries have been awarded to some of the UK’s most passionate engineering students and apprentices by the Institution of Engineering and Technology (IET).

Responding to the engineering skills shortage, the IET and its funding partners offered nearly three times the number of Engineering Horizons Bursaries this year. The bursaries were awarded to 53 students and 22 apprentices, with one third going to women. They provide students with £1,000 per year of study on engineering degree or apprenticeship programmes, for up to four years.

IET president, Nick Winser, said: “I hope that the support we are providing through these scholarships and bursaries will enable all these students and apprentices to complete their studies and lead them onto long and rewarding careers in engineering.”

UNLOCKING THE SPACE ERA FOR THE UK

THE SPACE INDUSTRY Bill will enable the first ever commercial space launch from UK soil, creating the potential for hundreds of highly-skilled jobs and bringing in billions of pounds for the economy.

The passing of the Bill means British businesses will soon be able to compete in the commercial space race using UK spaceports, a market worth an estimated £10 billion over the next decade.

This will not only ensure Britain can launch small satellites and scientific experiments from its own soil, but is also able to take advantage of future developments like hypersonic flight and high-speed, point-to-point transport.

The UK is already a global hub for satellite manufacturing, operation and application development. Access to space will allow companies to deploy satellites as well, making the UK a one-stop shop for satellites services and the best place in Europe to start and grow a space business.

“The Space Industry Bill guarantees the sky is not the limit for future generations of engineers, entrepreneurs and scientists,” said Dr Graham Turnock, chief executive of the UK Space Agency. “We will set out how we plan to accelerate the development of the first commercial launch services from the UK and realise the full potential of this legislation over the coming months.”

BUSINESS NEWS

RP TECHNOLOGIES INVESTS £250,000

Prototyping, tooling and injection moulding company, RP Technologies has invested £250,000 in two additional Hurco CNC machining centres, a custom-built hot plate welding machine, a mould simulation analysis software package and additional members of staff.

NEW ORDERS WORTH £50 MILLION

AVID Technology has begun shipping its high-performance EVO Electric Motors. The North East automotive cleantech firm has secured over £50m in new export business for the motors alone.

CENTRE OF EXCELLENCE TO OPEN IN UK

Global automated handling specialist PaR Systems is opening a facility in Workington to support Sellafield Ltd with decommissioning projects. The facility will include workshops, specialised overhead cranes, demonstration facilities – including a ‘hot cell’, as well as office, classroom and conference spaces.

ATLAS COPCO BUYS WALKER FILTRATION

Atlas Copco has acquired Walker Filtration Ltd, a compressed air, gas and vacuum manufacturer, for an undisclosed amount to become part of its Medical Gas division in the Compressor Technique business area.

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ROBOTIC PRODUCTIVITY

MACHINING MANUFACTURER CNC
Robotic is helping manufacturers increase connectivity between digital and automated systems with its cloud-based software, CNCR-Live, that has been developed with support by business support programme LCR 4.0, part of the Liverpool City Region Local Growth Hub, and Sensor City. Integrating real-time diagnostic technology, CNCR-Live remotely monitors robotic data to predict when maintenance is needed. This prevents failures in the production process that can cause a slowdown or shutdown and as a result, boosts productivity. “Being able to utilise the specialist skills and resources at Sensor City has been a game-changer for us,” said Madina Barker, director at CNC Robotics. “We are all very excited by the potential that the new CNCR-Live remote diagnostic technology will offer to the manufacturing industry.” The prototype is currently being tested and implemented in Sensor City’s engineering lab and CNC Robotics’ facility in Bootle, Liverpool. Part funded by the European Regional Development Fund, the LCR 4.0 programme is being delivered in partnership by some of the region’s key knowledge and scientific assets, including The University of Liverpool.

Battery project develops UK supply chain
A UK RESEARCH programme, funded through the Advanced Propulsion Centre, has enabled Nissan to produce high-density battery technology for the new LEAF, strengthening the electrified supply chain capability in the UK. Nissan collaborated with Hyperdrive, the University of Newcastle, Warwick Manufacturing Group and Zero Carbon Futures to develop a manufacturing process at Nissan’s Sunderland plant, which allows the carmaker to produce 40kWh battery cells in the UK and for European markets. The batteries improve the vehicle’s range and reduce production costs. The facility is the first major producer of the new high energy density batteries in the UK and is currently the largest in Europe. Hyperdrive, which utilises these battery cells in low volume highly-customised non-automotive applications, has also installed its own pilot line to produce prototype battery modules using the 40kWh cell, and will integrate them into its latest products rather than importing them from South Korea.

SOLUTION TO LAST MONTH’S COFFEE TIME CHALLENGE
The solution to last month’s challenge of finding a way to stabilise wine glasses at a picnic is “Glass on the Grass” from Australian start-up Breathe Create. The Glass on the Grass coasters are durable, reusable, stackable, lightweight and washable. They come in a variety of colours and are designed to slip onto the base of a wine glass to provide a wide, stable support on uneven surfaces such as grass. Breathe Create founders, Stephen Flewellen and Lee Drury had Star Rapid create prototypes. It supplied them in a high-impact recyclable K-resin PB-5925 clear acrylic plastic, alongside as the production-ready plastic injection mould tools.
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Among the various technologies on show at SolidWorks World 2018 in Los Angeles appeared what could be the next step in generative design.

Generative design is a form-finding process used by designers to optimise the strength-to-weight ratio of parts. It mimics the way natural structures evolve to create the strongest possible structure while minimising material use.

For example, human bone has intricate internal and external features; the hard outer (Cortical) bone forms a rigid outer layer, but also allows blood vessels to pass through it into the honeycomb-like matrix on the inside. This honeycombing is made from collagen fibres and gives the bone incredible tensile and compressive strength.

As such, honeycomb structures have been incorporated in parts from aeroplane turbine blades to the humble cardboard box. In all these applications, the honeycomb makes the parts stronger and lighter. This is especially important when they are being transported – or being used to transport people and cargo – because less fuel is used to do so.

In the quest to make ever stronger parts while minimising waste and reducing material cost, generative design has become an invaluable tool. Using this software, designers can iterate hundreds, or even thousands of different designs without having to create a single physical prototype. This plethora of designs is created by inputting different parameters such as varying levels of stress, temperature or humidity to which the part could be subject in its working environment.

The drawback of this is that the parameters must be input manually. But now, one manufacturer is looking to change that so that organic generative design can be carried out in true real time.

“In order to get additive to compete with traditional manufacturing processes, you need to bridge the gap between CAD and 3D printing”
including changes in parameters. The company also wants to provide this for 3D printed metal components.

Desktop Metal has been exploring a solution to simplify generative design for 3D printing. The result of this research is ‘Live Parts’, an experimental technology that applies morphogenetic principles (i.e. the mimicking of organic cell behaviour) and advanced simulation to auto-generate part designs in minutes.

Jonah Myerberg, chief technical officer of Desktop Metal says: “That’s where generative design is going to come in and be a very important process. This is why Desktop Metal is creating tools like Live Parts – to help engineers be more efficient.”

Live Parts goes beyond the ‘standard’ generative design software, however. Where traditional software mimics biology and uses natural-looking features in its designs, Live Parts recreates the cellular mechanisms that create natural structures like plants and animals to generate parts automatically.

Andy Roberts, senior software engineer and inventor of Live Parts, explains: “In nature, nobody sketches a tree and then puts it in place. Instead, everything grows from cells. You start with a single cell, you grow it into an embryo, the embryo grows into an organism and as it’s growing, it’s adapting to its environment in real time.”

If this all seems a bit abstract, what it really means is that, rather than set an envelope constraint in which you want your part to be built, you simply mark out the areas where you want...

REAL-TIME SIMULATION

Another company looking to bring instant feedback to design engineers is multi-physics software developer ANSYS. Its Discovery Live platform allows changes to be made to a CAD model to show how fluid or air flow is affected in real time and can be used by anyone, not just specialists.

Instead of taking days, months or weeks to set up, run and analyse digital prototypes with traditional engineering simulation solutions, Discovery Live allows engineers to examine the impact of their design changes immediately. Users can pose hypotheticals upfront in the design process to explore thousands of design options rapidly and receive immediate feedback – enabling the user to explore the impact of changes digitally while results update immediately.

For the first time, engineers can rapidly explore design options and receive instant and accurate simulation results with cutting-edge technology that can be run on most standard laptops.

“We’ve rewritten, from the ground up, the classic simulation algorithms to run natively on the GPU architecture, and that’s what gives you the speed,” says Mark Hindsbo, vice president and general manager at ANSYS. “And it’s not some insane graphics card, it’s a modern 4GB NVidia graphic card with a number of CUDA cores to run on.”

Discovery Live supports fluids, structural and thermal simulation applications. Users can run an analysis-first approach as they design – enabling them to iterate with a 3D model and interactively explore the impact of simple and complex changes.
to plant your ‘seed cells’ (from which the part will grow), ‘attractor zones’ (where the cells should grow to) and ‘keep out zones’ (which should be left clear for the part to be attached to another component).

Roberts continues: “The seed cells grow towards their target in the same way that plants grow towards the light. What this part is doing is effectively growing to support the loads that are being applied.”

In response to load placed upon the part, the cells communicate in a similar way as natural cells, they divide and produce ‘child cells’ which thicken and strengthen the part in the areas where load is causing the most stress, spreading it evenly over the surface of the part.

At the same time, in areas where there is no stress being exerted, cells are not needed and so they are literally ejected and fall off the part towards the bottom of the screen.

Another important aspect of the software is the ability to apply multiple forces to the part, which, thanks to some complex algorithms, reacts in real time, producing flanges and other support structures to compensate.

“What would happen is, we’d define the load in a certain direction and the part would grow perfectly for that case,” says Roberts. “But then there’d be this little tweak or anomaly and the whole thing would crash and fall down.

“That’s because we hadn’t anticipated all the different load cases, so we’ve built in background gravity waves that constantly oscillate in a way that creates forces that are unanticipated on the organism. We call these transitional forces and this gives us the ability to create parts that can handle not only the forces that you define but also forces that may be unexpected.

“You don’t want to create parts where if you accidentally drop them on the floor they shatter because that was not an anticipated case.”

Live Parts is able to react so quickly because it runs in the cloud and via a 3000 core GPU, the kind that is used in autonomous vehicles.

Desktop Metal has struck a deal with SolidWorks that sees Live Parts integrated as a feature-based add-in to its software. This means design engineers can set where the seed cells are planted and where the attractor and keep-out zones are to be placed, and upload this to the cloud. Here, Live Parts will grow the part, the designer then smooths it off and exports it back into SolidWorks where features can be added or cut out. Finite element analysis and mechanical analysis can also be carried out to put the part through its paces.

Myerberg adds: “This is the foundation of a new tool. It’s a new environment in which engineers can create extremely complicated geometry and we are very excited to be working with SolidWorks and making this new tool available early to the SolidWorks community.”

Live Parts is still in active development so, as users explore it, Desktop Metal is looking for feedback to make it more effective. For example, one of the next big features currently in development is the ability to add material properties so engineers can really tune in the factors of safety that are needed to use these parts in real-life applications.
Hydrolysis and temperature resistance requirements

Thermal management is very important for efficient running of electric vehicles; in particular to maintain the high voltage battery, power electronics and electric motor at the correct temperature level. Here, for example, liquid-cooled, water-based systems are used. EMS-GRIVORY has developed the new product Grivory HT1VA for cooling system applications. This material has outstanding resistance to hydrolysis and cooling agents and can withstand long-term use at moderate cooling agent temperatures. After around 12,000 hours in water at 95°C, Grivory HT1VA exhibits 30% higher strength values compared to a traditional PPA under the same conditions. A further advantage of this product when used in electric vehicle applications is that it is equipped with electro-compatible stabilisation. This makes it extremely suitable for production of electronic components as in combination with electrical conductors, no ionic migration and in warm climates, no corrosive effects are created. This property profile makes Grivory HT1VA extremely well suited for challenging applications in cooling systems of electric vehicles, such as auxiliary water pumps or thermal management modules.

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ON THE TOPIC OF VIRTUAL REALITY

DRIVING RETURNS FROM VR

Virtual reality is finding a multitude of uses, but how effective is it at generating revenue? Yulio Technologies’ managing director Robert Kendal outlines several ways in which VR can increase return on investment.

There’s been a lot of talk around the novelty value of VR. Novel is good and VR creators across the world are continually rolling out ever more ingenious ways of bringing the medium to life for everyone to enjoy in the comfort of their armchair.

When it comes to using VR for business, however, novelty alone doesn’t cut it and to prove itself as a long-term fixture there must be a return.

Several years ago, the rapid rise of the smartphone led to the hasty commissioning of ‘killer’ mobile apps. The problem was the vast majority of these apps had no obvious value to customers. They were novel but not useful; clever but not compelling. Worse, they didn’t solve real customer problems.

Marketing, development and design teams worldwide are currently being tasked with investigating VR. This is because the immersion VR allows is going to represent a significant change to the way people perceive services and buy products. Lazy content will only lower the bar and create experiences with no value.

Taking the time to think through great content that serves a need is absolutely worthwhile. In fact, VR content has been shown to deliver 27% higher emotional engagement and 34% longer engagement than 2D content, and the average response rate with VR experiences is 15% compared to just 1% through direct marketing.

MAKE IT USEFUL... AGAIN AND AGAIN

For anyone looking to boost their return on a VR investment, it is important to bear in mind the return on investment (ROI) formula of benefit of the investment divided by cost.

Based on this, it stands to reason that, as VR can be expensive to create, the more uses VR content
can have, the better chance it has of driving positive returns.

VR content can give and give. Investments can be amortised over multiple uses that might include demonstrations at events or trade shows. These could range from publicity on a company website or social media platforms to arming sales teams with a rich portfolio held in their pocket on a mobile device.

Content can be used across numerous consumer-facing touch points and with that, the value it has and returns it delivers become far more meaningful.

NOT ALL CONTENT SHOULD BE VR

A slideshow of still images does not make a movie and, in my experience, putting a VR label on content not created for, or useful within the medium has very limited value. Head of Stanford’s VR lab, Jeremy Bailenson put it best when he said: “Most things don’t work in VR. If you show me 20 ideas, I’ll say 19 of them would be better in another medium.”

For VR truly to make sense to a business and deliver a return, the content must be considered, ideally be of high visual quality and inherently useful.

As a guide, VR comes into its own when virtual experiences are able to make real:
1. Things that are too far away to be experienced first hand
2. Things that do not yet exist
3. Things that are too large, expensive or complex to model

MAKE APPLICATIONS THAT MATTER

When environments, products or buildings can be created and experienced virtually before a single prototype has been created or brick has been laid, there are opportunities for businesses to generate considerable ROI in the virtual sphere.

The automotive industry has put VR through its paces in several ways such as using the technology to whet the appetites of potential customers by taking them through exhilarating experiences in virtual high-performance cars.

Audi, is using virtual technology to encourage people to come back to its physical showrooms – an activity that has fallen out of favour as consumers become more used to researching new vehicles online. With hundreds of millions of possible configurations of models and specifications, VR has enabled Audi sales centres to demonstrate every single one to visiting customers versus only the handful of examples dealers might have housed in their showroom.

Ford designers and engineers have begun using VR to test elements of new cars, estimating a saving of $8 million in one year alone and Volvo is working on virtual test drives of cars that are not yet on sale.

Taking the lead in using VR where the real thing is simply too complex (or unsafe) to model, UCLA surgeons are using VR headsets to test run highly technical and sensitive surgeries before they operate. In doing so they are perfecting techniques and pre-empting potential issues without any lives being at stake.

Numerous businesses are now experimenting with the power VR has to bring people and their products together in meaningful ways.

- The North Face stores now use VR to transport their customers to a virtual Yosemite National Park, where they can virtually experience products in some of the most majestic and inspiring environments in the world.
- Carnival Cruises created a VR experience that gave people the chance to virtually explore its cruise ships and vacation destinations.
- Sotheby’s International Realty has been enticing potential buyers using VR to host open houses to sell luxury homes across international destinations.

In each of these cases, the immersion being delivered via VR would be impossible using another medium. VR is the difference between seeing and experiencing. These experiences deliver real, tangible value to users in a way that has been proven to make them more responsive, more receptive, more engaged and more loyal. With benefits like that, finding ROI from VR should be easy.
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SimScale was officially founded in 2012 in Munich, Germany, aiming to change the way engineers, designers, and students design products by giving them access to sophisticated yet easy-to-use multi-physics simulation methods for virtual prototyping to develop better products, faster, and more cost-efficiently.

A powerful, cloud-based CAE platform supporting multiple simulation types including solid mechanics, fluid dynamics and thermodynamics, Simscale requires no specialised local hardware, software or licenses. A standard web browser and broadband internet connection are sufficient to set up and run a numerical simulation, having access to a fully-fledged high-performance computing-powered simulation environment.

Since its official launch in Munich in 2013, SimScale has prided itself on challenging the ‘status quo’ of the traditional CAE software market by offering a fully cloud-based engineering simulation solution with zero hardware and software footprint, available at a fraction of the price of its competitors.

The SimScale platform is completely accessible via a standard web browser, with an easy-to-use interface that supports numerous simulation types including: structural mechanics, fluid dynamics, thermodynamics, acoustics, and particle phenomena.

By harnessing the power of the cloud for simulation, SimScale, it is claimed, eliminates the hurdles that accompany traditional simulation tools such as high installation costs, licensing fees, deployment of high-performance computing hardware, required updates and maintenance.

By the nature of the service, users always have the latest version of SimScale. With the SimScale community, all users have free access to hundreds of simulation projects. From beginners to advanced users, the community is a place for ‘crowdsourcing’ simulation knowledge and collaboration. Individuals, small businesses, and large enterprises worldwide have introduced SimScale into their workflow to test and validate preliminary designs virtually rather than using costly physical prototyping. The ‘pay-as-you-go’ nature of the service can mean that the rewards involved in using the service can often be far in excess of the costs.

“Our vision at SimScale is to enable every designer and engineer to take full advantage of engineering simulation – independent of budget”

DAVID HEINY, CEO AND CO-FOUNDER OF SIMSCALE
A good example of this can be seen in the experience of Carlsson Autotechnik, which – among other things – develops and sells grafting programmes for Mercedes-Benz vehicles. While large automobile companies obviously maintain a number of development departments with their own test stations for engine, chassis and body development, Carlsson is facing the challenges of managing the same tasks with limited resources. Playing a vital role in the automotive industry and especially in structural stress optimisation, aerodynamics, and cooling, engineering simulation can remove technology barriers.

However, using SimScale’s pay-as-you-go model, Carlsson’s team was able to use the simulations for everything it needed, paying only for what they used. Due to its browser-based deployment of software, computing capacity and data management, the SimScale platform enabled the engineers to do a flexible implementation of the whole simulation array without high fixed investments.

On the basis of the simulation results, it was possible for Carlsson’s engineers to examine and optimise the aerodynamics of the vehicle. Besides the resulting forces for air drag and downforce – or rather the related dimensionless benchmarks that are calculated automatically – there are various physical quantities available in the entire flow domain, such as pressure, velocity, and turbulence. These can be visualised as desired with cuts and streamlines and subsequently saved as image files. In contrast to wind tunnel tests, the impact of a changed design could not only be quantified but also investigated in detail.

To give some idea of the cost-effectiveness of this solution, the overall cost of this simulation to Carlsson was just €60 and the simulation time was five hours. “Our vision at SimScale is to enable every designer and engineer to take full advantage of engineering simulation — independent of budget, hardware and know-how,” says David Heiny, CEO of SimScale.

The latest development of SimScale integrates both Siemens’ Parasolid software and Tech Soft 3D’s HOOPS Exchange to enable a more convenient and seamless simulation workflow, while at the same time further increasing simulation result accuracy — both in FEA and CFD.

Parasolid is the industry-leading 3D geometrical modelling component for computer-aided design, manufacturing and engineering analysis (CAD/CAM/CAE) solutions, while HOOPS Exchange is the leading CAD translation software development kit (SDK).

The developers behind SimScale say this double integration will enable a more convenient and seamless simulation workflow, also increasing simulation result accuracy both in FEA and CFD. All processes can take place within a web browser, making simulation as simple as possible with zero hardware and software footprint.

“This latest implementation of Parasolid in a cloud-based application will enable engineers to simulate, test and modify 3D models using only a web browser,” says Jim Rusk, chief technology officer, Siemens PLM Software. “In selecting Parasolid, Simscale also obtains translation-free interoperability with hundreds of other applications that integrate Parasolid to design, edit and exchange high-precision 3D models based on the Parasolid XT data format.”

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Laparoscopy, better known as minimally invasive or keyhole surgery, is a medical advancement that benefits patients by reducing recovery time and pain as well as lowering the risk of infection that can be caused by open surgery. This, in turn, is good news for medical institutions, since it means they will achieve higher patient turnover, thus saving money.

Laparoscopy places great demands on surgeons, however. They have to wield very long, thin instruments, working through small pivot points cut into the patient’s body. This requires instruments to be held in awkward positions for long periods, potentially causing fatigue, repetitive strain injuries, neck and back problems. It can also limit the number of hours during which older surgeons can operate.

Robotic devices have been introduced in recent years that hold these instruments in place, freeing up staff from the physically demanding task of holding them completely still for the duration of the operation. However, the few robotic systems that are currently available are relatively bulky and expensive.

CMR Surgical – previously Cambridge Medical Robotics, was set up in 2014 with the aim of solving these problems.

Luke Hares, CMR Surgical’s technology director outlines that “Fundamentally, we’re trying to solve a big problem: the restricted availability of laparoscopic surgery because surgeons don’t have a good enough tool.”

To this end CMR has developed Versius, a system that includes a set of ‘wrists’ that allow the robotic arms to mimic the way human surgeons hold them. Additionally, all the motors involved in moving the robotic...
arms are contained within them rather than in a control box under the operating table. This makes Versius much more compact and allows it to be disassembled easily in order to be moved to where it is needed rather than remain static in one operating room. Hares highlights the system’s ease of use, saying that rather than taking 30 hours for a surgeon to learn to tie a knot using manual laparoscopic tools, he could teach anyone how to do it with Versius in 30 minutes.

“Everything in the Versius design is about driving up utilisation,” he explains. The critical design element that enables that, he explains, is the robot arm wrist joint.

“If you look at a conventional industrial robot,” he says, “What you’ll see is that the wrist joint is made up of three joints: a roll joint in the forearm, a pitch joint, and then a roll joint at the end. That’s enough to rotate a payload in any particular direction.”

This is fine if you want to hold instruments at a 90° angle, Hares says, but to hold them straight out like a surgeon would mean the roll joints would be parallel, instantly losing one degree of freedom. This would mean it is possible to move the instrument up and down, but the whole robot would need to rotate 90° to allow left and right movement, which is unacceptable in surgery as you need free range of movement.

“Our wrist design, rather than having three wrists, has four,” Hares continues. “The two middle joints form a coaxial pitch/yaw. Essentially, it’s a driven universal joint. That gives us the flexibility and the ability to do the surgery, but with a robot arm that’s small enough to fit round the patient.”

Versius uses conventional electric motors controlled by power and control electronics developed using electronic manufacturing technology from the mobile phone industry, all of which is contained within the arms of the robot. CMR’s electronics design engineers and mechanical engineers had to work extremely closely to provide a fully-integrated system that is both lightweight, strong and stiff.

Every joint on the system has a torque sensor that monitors how much force it is exerting and can respond accordingly. This sophistication in the sensing is matched by the robotics and software to provide what is claimed to be a straightforward interface for the user.

Although the system provides haptic feedback to the surgeon to warn when they are close to exceeding range limits on the arms, haptic feedback is not currently a feature of the Versius.

This is because surgeons have never had very good ‘feel’ through manual tools. However, haptics are being considered for future iterations of the system.

Another area of advance offered by medical robots is the ability to use a stereo endoscope, which is twice as heavy as a standard endoscope and combats the loss in depth perception encountered by surgeons.

“We can then feed that [extra data] to a 3D medical monitor that the surgeon views wearing glasses that use the same basic technology as 3D cinema,” says Hares. “It’s just like it’s laid out in front of you, expect it’s magnified and better lit.”

CMR expects the Versius to gain regulatory approval by the end of 2018, whereupon the ‘significant number of units’ it wants to place into hospitals will be ready to start working.

Hares likens Versius to modern mobile phones, which have, he says, “enabled huge swathes of the world to jump easily from traditional telephone technology to the latest way of doing it”.

“Ultimately, we anticipate this being a global product,” he concludes. “There are six million people a year getting open surgery who should get keyhole surgery. To solve that problem will require many thousands of systems out in the world.”
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How is it possible to create reliable ground or earth connections to vehicle body panels? It is a challenge the automotive industry has been grappling with for a long time.

One of the long-term issues in the automotive industry has been how to create reliable ground or earth connections to vehicle body panels. The traditional method of welding nuts, studs or nut stud assemblies to body panels and brackets has often been found wanting, due to poor weld performance, corrosion, and long-term reliability.

The recent trend towards using lightweight materials, such as aluminium and the mix of materials within vehicle body structures and sub systems, has now further complicated the issue. Add to that the increasing number of electrical features expected to be in vehicles for convenience and safety systems, and powertrain management, then the drive to find a more reliable and consistent solution is paramount.

A new solution tried and tested by many premium brand automotive manufacturers is the KSB nut and stud assembly from Profi Verbindungstechnik. According to the German company, it has taken some years to perfect the design to be suitable for use in automotive applications in both steel and aluminium.

**HOW IT WORKS**

One of the clearest advantages of Profil grounding studs is that they are self-piercing. This means that each stud makes a neat hole through the sheet metal component. This technique provides a proper, clean metal to metal contact between the stud and the sheet metal part in thin sheet applications (0.7mm to 2.1mm).

An additional design is available for thicker materials (2.2 to 4.0mm), which is also self-piercing. However, this product does not pierce fully through the parent material. Furthermore, due to this specific riveting process, the connection point is rolled in. This characteristic means the connection point is protected against many external influences. As there is no sheet metal corrosion, there is no reduction in conductivity.

During Profi's manufacturing and assembly process, the nut is installed to a controlled torque figure and then, within the same assembly machine, a locking feature is created on the top face of the nut. This ensures two things: first, the nut cannot come loose during transportation, handling and installation into the sheet metal; secondly, the pre-applied torque ensures that there is no electro coat nor paint ingress between the faces of the nut and stud, ensuring a clean metallic surface is maintained, ready for cable shoe connection in the final assembly area and throughout the service life of the vehicle.

When the wiring cables are installed, the nut of the stud is disassembled, which presents a proper clean unpainted metallic contact face for cable shoes. The same nut is then re-used to secure the cable shoes and a good ground contact is assured.

**CUSTOMER ADOPTION**

Validation tests of Profil's grounding nut and stud assembly by major global OEMs have shown improved and more consistent conductivity, compared to the classical welding solutions, states the company. In addition, the Profil system is suitable for use in both steel sheet metal, steel sandwich materials and aluminium sheet metal, so for manufacturers such as JLR, which produces steel, aluminium and mixed metal (steel and aluminium combined) bodied vehicles, the Profil solution works for all applications.

The Profil nut and stud assembly is used on Jaguar XE, XF, F-pace and E-pace, as well as on Range Rover Velar, Land Rover Discovery and Discovery Sport. “It is now the default choice for grounding.”
connections on all JLR products in both dry internal applications and also wet area applications,” says Profil. “Indeed, one could say that, given the off-road performance of JLR products, these are some of the most demanding applications in the automotive industry today.”

The Profil system has also been adopted by BMW, Porsche, Mercedes-Benz and Renault, especially in critical areas of vehicle bodies. Grounding studs solved the problem of grounding on steel sandwich material, as well as on aluminium structures. A good and consistent grounding system is essential to assure the functionality of all systems in vehicle electrical systems, from engine management through safety features such as air bags etc.

Another OEM uses the studs on the critical point around the fuel system. The OEM’s validation and corrosion tests are showing good conductivity, compared to classical welding solutions. There is especially an advantage with the increased use of lightweight materials, such as aluminium, where the installation of grounding studs by welding is increasing, due to the more complex welding process of aluminium.

One OEM that has changed to the Profil system has been able to reduce their average ground points per vehicle from 30 down to 22, which gives significant cost savings in inventory and process time, as well as being more environmentally friendly, reducing energy consumption, along with pollution and manufacturing carbon footprint.

The flanged nut of these studs has a special design to avoid any paint bleed in between the nut and the stud. The nut has a full metal prevailing torque feature, which prevents the nut dismounting itself. This ensures that, even in the most rigorous conditions, a good ground contact is maintained.

**RELIABILITY FACTOR**

The studs can be installed manually for low volume or prototype situations, or by fully automatic processes integrated into customer body assembly facilities. The various systems are already developed and have proven their reliability for customers for a long period of time, adds Profil.

The studs can be supplied with different surface coatings. Profil recommends a galvanic coating, which provides optimal installation performance. However, the specification can be defined in liaison with OEMs to remain in keeping with the car makers’ demands. Profil studs are already in place at some manufacturers operating in China.

The ongoing demands from the automotive Industry in general – driven by international legislative requirements to reduce CO2, while improving both passenger and pedestrian safety, moving towards lighter, but stronger, body assemblies and customer demands for more vehicle connectivity – are presenting many new challenges and opportunities to fastener suppliers in general. The Profil approach to use mechanical attachment techniques is geared specifically towards fulfilling those demands with new and innovative solutions, such as the KSB ground stud assembly.
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A collaborative project involving CENSIS, the Innovation Centre for sensor and imaging systems; Thales; and the University of the West of Scotland (UWS), has created a system which helps a device detect, improve the resolution of, and classify objects at a distance of up to 1500 metres.

Emulating the way the human visual cortex processes and visualises information, the system is ‘trained’ to identify a range of different visual signatures, classifying them based on common characteristics. This is achieved by incorporating machine learning techniques to improve detection and visualisation.

The training process involves presenting the machine with hundreds of images of a subject to analyse at a variety of angles, distances, and with different obstructions. Over time, this allows it to build up an understanding of how particular people, vehicles, or items should appear.

Still in its development stages, the system can already detect and classify humans and six different types of vehicles, including: saloon cars, pick-up trucks, 4x4s, vans, estate cars and people carriers.

The technology could find extensive application in a variety of industries, with the security, surveillance, engineering and construction sectors among those that could benefit most.

“The system we’ve created is a unique piece of technology,” claims Dr Pablo Casaseca, senior lecturer in Signal and Image Processing at UWS. “It significantly enhances detection and classification capabilities on thermal imaging cameras at a long-range.”

If the system were to be presented with enough high-quality data, it could detect a host of objects with a very small number of pixels.

The more training data presented to the machine over time, the better the system responds – even to objects or compositions it hasn’t encountered before.

“In security and surveillance fields, for example, the system could help staff monitor video feeds or footage,” says Dr Casaseca.

“Observing security cameras over long periods of time can lower concentration levels. Our system could assist by pointing out objects of interest in the distance and suggest what they might be.”
FIRST ON-ROAD TESTS FOR SELF-DRIVING JAGUAR LAND ROVERS

Another industry that could benefit from the kind of technology being developed by CENSIS, Thales and UWS is automotive – especially in autonomous vehicles. Jaguar Land Rover is the latest manufacturer undertaking its first UK road tests for autonomous and connected vehicles.

As part of the £20 million UK Autodrive project, Jaguar Land Rover is testing a range of research technologies on the roads of Coventry that will allow cars to communicate with each other as well as roadside infrastructure, such as traffic lights. The trials will also explore how future connected and autonomous vehicles can replicate human behaviour and reactions when driving.

UK Autodrive is the largest of three consortia launched to support the introduction of self-driving vehicles into the UK. It is helping to establish the UK as a global hub for research, development and integration of automated and connected vehicles into society. The consortium has already proven these research technologies in a closed track environment and the start of real-world testing is the next step to turning the research into reality.

Nick Rogers, executive director – product engineering at Jaguar Land Rover, says: “Testing this self-driving project on public roads is so exciting, as the complexity of the environment allows us to find robust ways to increase road safety in the future. By using inputs from multiple sensors, and finding intelligent ways to process this data, we are gaining accurate technical insight to pioneer the automotive application of these technologies.”

With the launch of the trials, Coventry joins just 12 other cities in the world in conducting tests on public roads. The trials will continue through 2018.

before they approach,” he says. “In construction or infrastructure, if a camera embedded with the technology was placed on a UAV or drone, it could identify small cracks on larger structures, such as a bridge, by detecting the defect and focusing on it.”

CENSIS brokered the relationship between UWS and Thales after conducting a technical landscape survey, identifying an academic partner for the company. The Innovation Centre, which recently announced its 50th project, aims to bring together Scotland’s academic institutions and industrial base.

Dr Matt Kitchin, algorithms engineer at Thales in Glasgow, says: “The outcome of phase one has been encouraging – the classification results have yielded very high success rates over a wide range of imagery.”

Due to the findings and the potential opportunities the project has unveiled for both Thales and UWS, a second research and development phase has been launched. For this, Thales in Glasgow has appointed two algorithm engineers to work on the implementation of these machine learning algorithms and to help fine-tune and better understand how the collaboration can apply the technology in a range of industries.

CENSIS also provided project management support to Thales and UWS for the duration of phase one, and the three organisations have agreed to jointly fund a PhD at UWS as the project launches into phase two.

Gavin Burrows, project manager at CENSIS, says: “This project is a great example of what can be achieved when the right academic institution is paired with industry specialists. Thanks to their partnership, Thales and UWS have created a technology that could revolutionise detection and classification capabilities in a range of industries, placing them at the forefront of research and industrial applications in this area. We look forward to seeing the results of the next research and development stage.”
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Can designing fluid power components from first principles with additive manufacturing in mind pay dividends?

Improved size, weight and design freedom are the chief benefits of additive manufacturing and it is these that have ensured its appeal to designers in a range of applications. One such application is fluid power equipment, where designers are increasingly seeing the benefits inherent to the use of metal additive manufacturing.

One company, however, has gone further, believing that the use of this technique offers the opportunity for a completely new design paradigm for fluid power components. Domin Fluid Power has spent the last few years designing and developing hydraulic products such as valves, pumps and more complex subsystems that are manufactured using metal additive manufacturing (AM) with other techniques for some simple components.

According to Marcus Pont, general manager of Domin Fluid Power, this new design paradigm allows the engineer to rid themselves of the constraints of subtractive machining and open their eyes to the brave new world of metal AM. He believes that this technology creates two big step changes in how fluid power products are designed. The first, he says, is that, rather than simply tweaking existing designs, it means that products and components need to be designed from first principles. He says: “Crucially we are trying to design complete products and systems from the ground up rather than focusing on component optimisation…If you don’t start from first principles based on the manufacturing method, you end up with something that’s not right for older methods or for the methods that are there now.”

He continues: “If one starts off tentatively and redesigns a pipe that turns a 90º corner, while there is an obvious benefit to pressure drop in that pipe, the product will remain relatively unchanged. Is the small benefit worth the potentially large increase in cost? Or should one think big and go back to first principles to try and redesign a complex fluid power product that has remained largely unchanged for decades? Historically when a new material/manufacturing paradigm comes along, there is a period of time when people apply the new paradigm to an old design. We are looking to change that now.”

The analogy he offers is of Sir Thomas Telford’s iron bridge in Ironbridge, Shropshire. “When you look at that, you see a bridge that is made of iron, but looks like it’s made of wood because the engineer didn’t yet appreciate the ways in which the new technology could transform design principles. As we see it, that’s still the case for a lot of engineers with additive manufacturing. People are often just tinkering with the design rather than taking a holistic view that ensures it makes the most of AM’s capabilities.”

The second change that Pont believes AM is bringing to design is that it is aided by leaving the big decisions to a single lead designer rather than a team of designers with different areas of responsibility. Again, says Pont, this comes down to the need to design differently for the technology. He says: “We find additive manufacturing makes those decisions too complex for those outside the design to offer useful information. Disruptive techniques require the individual engineer to have a much broader skill base.”

A range of the parts produced by Domin Fluid Power
Of course, this would seem to fly in the face of modern principles of collaborative design, but Pont feels that designers with responsibilities for different outcomes will often end up pulling in different directions. He says: “Say you have one person responsible for stress analysis and another for weight loss. Weight is directly proportional to cost in AM, while stress is directly proportional to cost. That means there’s no incentive for the two engineers to work in each other’s interests and you end up with a fight between the two rather than a harmonious design.”

Reduced cost is another benefit that Pont believes can be achieved using a ‘first principles’ approach to AM-based design. This may seem counter-intuitive, of course, since few people would naturally associate additive manufacturing with lower costs. “What is the cost of AM?” he asks. “The cost is in the weight of additive you use. The problem we see in the additive world is that people are trying to use the technology to create a value benefit rather than a cost benefit. So they’ll use the design capabilities to cut the component count, but forget that because they’ve used a lot of AM material they’ve actually increased the cost.”

By contrast, he claims, a good, first-principle AM design should use the technology to render the overall design more efficient while remaining cost-effective in its use of materials and processes. “By starting from first principles on one design, we reduced the complex components from 21 to seven, but only one of the components was 3D-printed because it was only there that it brought rewards. By making sure that we don’t use too much of the additive to create the function we need, we can ensure cost-effectiveness. As long as the function achieved is of greater value than the value of the additive material used, we are able to ensure economic viability.”

The fluid power market, Pont believes, is particularly fertile ground for this approach precisely because it has seen relatively few innovatory leaps in recent times. “The fluid power industry has largely remained unchanged for 50 or 60 years – indeed, you could say that it’s been pretty boring,” he says. “What that means is that it’s ripe for innovation in the form of additive manufacturing. However, so far people are just looking at making minor changes to existing ranges of products. That’s understandable, if you have an existing range of products, it’s really expensive to change them to accommodate a new manufacturing method.”

“Where we have an advantage,” he claims, “is that we don’t have an existing range of products in this field, so we were able to start with a completely blank sheet of paper. The result is that our products will look topographically quite different to existing fluid power products, but perform the same function – only more efficiently.”

The first product to emerge from this process will be a new servo valve. The L Series Direct Drive Valve, according to Domin, is an innovative step change in performance of direct drive valve technology. Domin claims it offers performance improvements on the current state of the art with respect to response, efficiency and size and weight but can be sold at a highly competitive price. “We believe we have developed a product that has an increase in performance on the current state of the art without having to ask the customer to increase their costs,” says Pont.
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MORE SUPPORT FOR SMES

For the UK to become a global manufacturing powerhouse and driver of Industry 4.0, SMEs need more government support, according to Autodesk.

Autodesk’s manifesto ‘Enabling the Art of the Impossible: How Britain can lead the 4th Industrial Revolution’ focuses on two core principles the company felt were not adequately reflected in the recent Made Smarter Review (MSR), the recent Budget announcements, nor its Industrial Strategy White Paper (ISWP). These are: thinking beyond productivity and treating design and manufacture as one entity.

The manifesto is being launched at a time when efforts are focused on accelerating the rate and scale at which manufacturers adopt Industry 4.0. Research has found that although 62% of manufacturers plan to undertake some form of move to Industry 4.0, only 23% of them are doing something about it.

Asif Moghal, senior manufacturing industry manager at Autodesk, says: “If British manufacturers are to rival those in countries such as China and India, there needs to be a fundamental shift in the industry. We feel the MSR and ISWP are great steps towards achieving this. However, a number of areas within it would benefit from further refinement.”

The manifesto lays out the following four recommendations to drive these changes and create a more sustainable strategy for the UK’s manufacturing industry:

1 **Develop home grown leadership** – While the Government announced it is to invest an additional £406m to help address the shortage in STEM skills, what is needed is a ‘pull’ from the industry and greater collaboration between the two. This involves creating National Design & Manufacturing Days for students; championing STEM skills; helping SMEs better understand Industry 4.0 and developing a leadership curriculum for businesses owners.

2 **Enable full spectrum innovation** – Both the 2016 Autumn Statement and 2017 Budget pledged to increase funding for R&D in the UK, but this is currently limited mostly to early stage projects. By expanding the funding scope, more UK companies would be able to develop and commercialize a broader range of product and business model innovations.

A range of tax or financial incentives should also be created by Government to support this.

3 **Simplify the skills issue** – The creation of more skills institutions, as outlined by MSR, should be abandoned. There should rather be greater support from Government for the Institute for Apprenticeships; the scaling up of existing digital catalyst programmes; and an effort to making the Apprenticeship Levy easier to navigate to help upskill the future workforce.

4 **Connect everyone** – The Government’s March 2017 Connectivity paper and commitment in the 2017 Budget for full fibre broadband and 5G are welcomed. However, a report in August 2017 suggested the UK’s average broadband speed was just 16.5Mbps, placing it 31st in the world. Creating a secure and reliable digital backbone for businesses must be a priority for Government, so that industry can access transformative technologies and platforms that enable collaboration and break down the barriers between design and manufacturing. The manifesto supports accelerated investment into the UK’s digital infrastructure, including faster broadband, better security and a digital connectivity rating.

Moghal continues: “We believe these four areas would drive a transformation for UK design and manufacturing and we welcome a conversation with the Department for Business, Energy & Industrial Strategy, the Made Smarter Review board and wider industry on our proposal.”
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PAIRING UP

We’ve all been there: you’re on your way out to a posh do and you need your best shoes, the ones that only ever see the light of day at the occasional wedding. But, where are they?

You curse the fact you keep forgetting to buy a shoe rack as you delve through a mountainous pile of shoes in the cupboard under the stairs. Finally, the left one is found! But the right one is nowhere to be seen? Shouldn’t this be easier?

THE CHALLENGE

This month’s challenge is to come up with a high-tech way to keep your shoes in pairs, or at least make them easier to find. Perhaps a sensor-based – Internet of Shoes (IoS) – system is the way to go, or some sort of imaging technology? If you must go for a design based on a shoe rack, at least over-engineer it to be something like a robotic multi-storey car park or something.

The idea we have in mind will be revealed in the May issue of Eureka! Until then see what you can come up with. Submit ideas by leaving a comment on the Coffee Time Challenge section of the Eureka! website or by emailing: editor@eurekamagazine.co.uk

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