EUREKA
THE MAGAZINE FOR ENGINEERING DESIGN

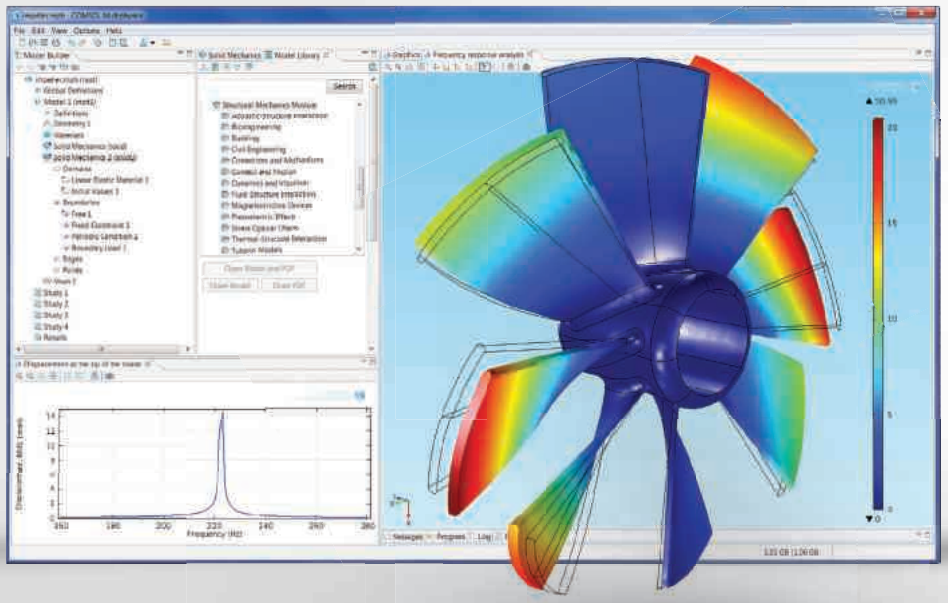
In this issue: Motors • Materials • Fastening & Adhesives • Design Software • Aerospace

On the grid

Can motorsport define the future of low-carbon vehicles?

COMSOL Multiphysics 4.3a
Now Available!
www.uk.comsol.com/4.3a

IMPELLER DESIGN: Frequency response analysis to a pressure load applied to all free boundaries.



Verify and optimize your designs with COMSOL Multiphysics®

Multiphysics tools let you build simulations that accurately replicate the important characteristics of your designs. The key is the ability to include all physical effects that exist in the real world. Download a free product booklet at **www.uk.comsol.com/booklet**

Product Suite

COMSOL Multiphysics

ELECTRICAL
AC/DC Module
RF Module
MEMS Module
Plasma Module

MECHANICAL
Heat Transfer Module
Structural Mechanics Module
Nonlinear Structural Materials Module
Geomechanics Module
Fatigue Module
Acoustics Module

FLUID
CFD Module
Microfluidics Module
Subsurface Flow Module
Pipe Flow Module

CHEMICAL
Chemical Reaction Engineering Module
Batteries & Fuel Cells Module
Electrodeposition Module
Corrosion Module

MULTIPURPOSE
Optimization Module
Material Library
Particle Tracing Module

INTERFACING
LiveLink™ *for* MATLAB®
LiveLink™ *for* Excel®
CAD Import Module
ECAD Import Module
LiveLink™ *for* SolidWorks®
LiveLink™ *for* SpaceClaim®
LiveLink™ *for* Inventor®
LiveLink™ *for* AutoCAD®
LiveLink™ *for* Creo™ Parametric
LiveLink™ *for* Pro/ENGINEER®
LiveLink™ *for* Solid Edge®
File Import *for* CATIA® V5

Contact: +44 (0) 1223 451 580 info.uk@comsol.com

COMSOL

CONTENTS

Volume 33 Number 2 February 2013

www.eurekamagazine.co.uk

MICRO-EPSILON

More Precision.

Worlds First 50 kHz, self contained Laser Sensor with Ethernet interface

Smart

Micro-Epsilon's optoNCDT 2300 is the only 50 kHz, self-contained laser displacement sensor with Ethernet interface and measurement resolution of 0.0015% F.S.O = 0.03 μm over 2mm working range!

Performance

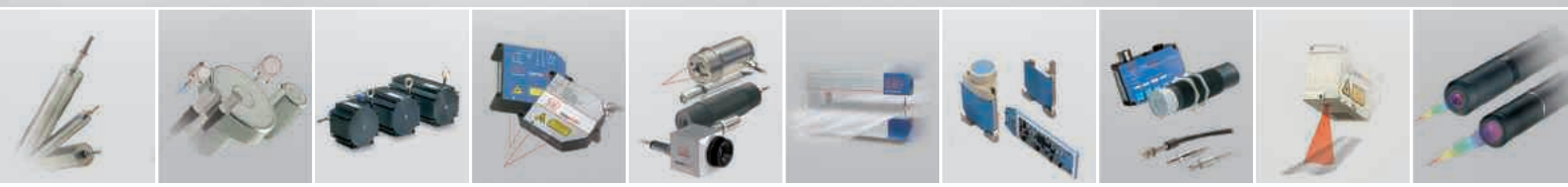
The sensor uses Micro-Epsilon's new A-RTSC (Advanced Real Time Surface Compensation) technology, which enables the sensor to automatically compensate in real time for difficult-to-measure surfaces.
Many user selectable filtering options allow measurements of virtually any surface, including first peak (for transparent targets) and rapidly changing surfaces.

Universal

Ethernet (and EtherCAT) interface allows configuration and optimisation of the sensor via web browser from anywhere in the world. Connect to the sensor using a dedicated IP address. Analogue outputs can also be selected via Micro Epsilon CSP 2008 DIN Rail controller
The self contained sensor design is ideal for simple integration into new build applications or retrofit.

Features

- Measuring ranges (mm): 2 | 10 |20 |50 |100 |200
- Linearity max. 0.4μm
- Resolution max. 0.03μm
- Advanced Real-Time-Surface-Compensation A-RTSC
- User Adjustable measuring rate up to 49.02kHz
- Remote configuration and diagnostics
- Outputs: Ethernet, EtherCAT or RS422



Displacement ▪ Distance ▪ Position ▪ Dimension ▪ IR-Temperature ▪ Colour

Call to speak to a sensor expert +44 (0) 151 355 6070 or visit **www.micro-epsilon.co.uk**

Editor
Paul Fanning
pfanning@findlay.co.uk

Deputy Editor
Justin Cunningham
jcunningham@findlay.co.uk

Web Editor
Laura Hopperton
lhopperton@findlay.co.uk

Group Editor
Graham Pitcher
gpitcher@findlay.co.uk

Art Editor
Martin Cherry

Technical Illustrator
Phil Holmes

Advertising Sales
01322 221144

Sales Director
Luke Webster
lwebster@findlay.co.uk

Deputy Sales Manager
Simon Bonell
sbonell@findlay.co.uk

Sales Executive
James Slade
jslade@findlay.co.uk

Production Manager
Heather Upton
hupton@findlay.co.uk

Circulation Manager
Chris Jones
cjones@findlay.co.uk

Publisher
Ed Tranter
etranter@findlay.co.uk

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

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

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

Origination
CC Media Group
Printed in UK by
Pensord Press Ltd

Findlay Media is a member of the Periodical Publishers' Association

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

Reaching for the sky

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

An adjustment in my sense of scale is one of my abiding sensations whenever I have the good fortune to visit the United States. Be it what Americans think of as a short car journey (usually at least long enough to get one from London to Birmingham) or what they consider a light snack (usually enough to induce dyspepsia in most Britons), the relative size of things is one of the major cultural differences the visitor to the USA from these shores is forced to acknowledge.

This phenomenon applies to questions of engineering as much as to everything else. At the recent SolidWorks World 2013 event in Orlando, Florida, not only was the event itself on a large scale, but many of the keynote speakers reflected this.

Perhaps the person who brought this home most clearly was Tom Aicheson, chairman and founder of Mavericks Civilian Space Foundation*, an educational foundation dedicated to facilitating STEM education and competition as an enabler of civilian space explorers. Through its Explorers programme Mavericks offers high school students with a gift for STEM subjects the chance to participate in the challenge of conducting sub-orbital space flight missions. That's right: high school students build and launch rockets that fly to the edge of space.

Sadly, it is difficult to imagine schoolchildren in this country – however gifted – being allowed anywhere near projects of this scale and complexity. And yet here were their US counterparts successfully launching both a space flight and their careers in engineering.

The last thing I would want is for it to be thought that the efforts being made in this country to inspire the next generation of engineers, but this address did make one wonder if we might do better to think bigger.

** Visit www.rocketmavericks.com to find out more*

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

SKF begins legal action over counterfeit bearings

Bearings specialist SKF has summoned Bearing International Holland to court for having sold counterfeit products under its name.

The court action represents the latest in a series of moves by the company to crack down on the sale of illegal merchandise, as part of its bid to cut off the circulation of the counterfeit trade.

In November 2011, customs authorities in China seized counterfeit SKF bearings on their way to Bearing International Holland. Later, during a raid on a non-authorised distributor in Austria in June 2012, authorities seized counterfeit SKF bearings that were bought from Bearing International Holland.

It was at this point that SKF commenced a civil action against the company for infringing its intellectual property rights, which was resulted in the current court action.

SKF is urging customers who suspect that they may have taken delivery of counterfeit SKF products to send a photograph and a copy of their invoice to genuine@skf.com.

Great progress claimed for Government's Catapult network

The Technology Strategy Board has made "great progress" in establishing a network of "world-leading technology and innovation centres" (the Catapults) according to its chief executive Iain Gray, speaking late last month in the House of Lords.

Outlining the milestones reached since the Prime Minister announced late in 2010 that the Technology Strategy Board would be establishing the advanced engineering and science Catapults, Gray confirmed that all seven will be open and in business this year.

He also insisted that, with investment of around £1 billion over the coming few years, the Catapults represent one of the most important developments in UK innovation and technology, and will make a major impact in the coming decades.

Gray was speaking as a new report on technology and innovation centres by the Big Innovation Centre was published, which outlines how the success of the Catapult programme might be judged and sets out recommendations for working with businesses, universities and public bodies.

www.innovateuk.org

ReWalk exoskeleton gets an upgrade

Argo Medical Technologies has unveiled an upgraded version of its ReWalk Rehabilitation exoskeleton.

The 2.0 system has new software features that support beginner users and new sizing that allows each system to fit a broader range of patients.

"The ReWalk Rehabilitation 2.0 offers an experience that is very close to natural walking and this new model will improve the learning curve to allow ReWalkers to quickly gain comfort as they begin to walk independently," says Argo's CEO Larry Jasinski.

The ReWalk (which was featured in *Eureka*'s October 2012 issue) relies on on-board computers and motion sensors to restore self-initiated walking without requiring tethers or switches to begin movement.

It uses patented technology with motorised legs that power knee and hip movement. It controls movement using subtle changes in centre of gravity, mimics natural gait and provides functional walking speed.

A forward tilt of the upper body is sensed by the system, which triggers the first step. Repeated body shifting generates a sequence of steps, which allows natural and efficient walking.

www.argomedtec.com

Engineering design show

New exhibitors to grace Engineering Design Show

This year's Engineering Design Show will take place on 2nd-3rd October at the Jaguar Hall, Ricoh Arena, Coventry and will offer even more than last year's hugely successful event.

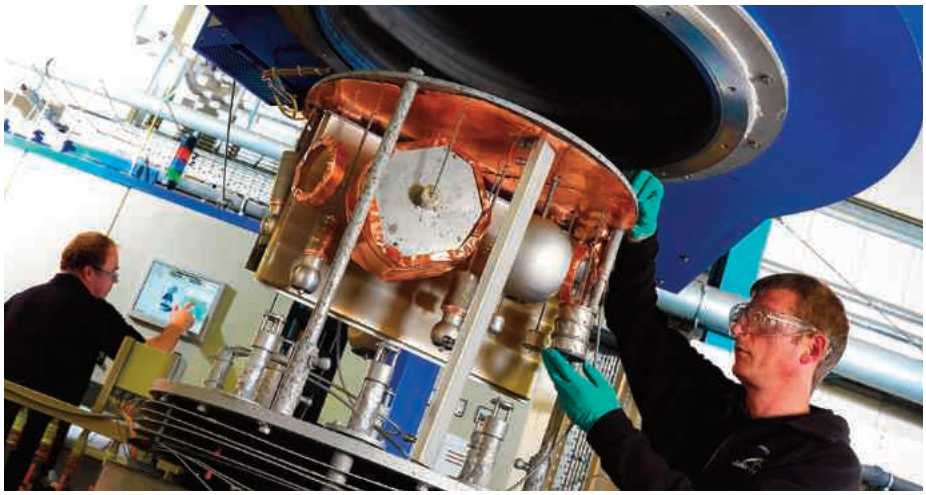
With over 70% of stand space now sold, the show will feature more than 200 exhibitors across two of the Ricoh Arena's three exhibition halls, with the third taken up by the new Electronics Design Show. Overall, the events are expected to attract 2,500 design engineers.

A new feature within 2013's show will be Engineering Materials Live!, an integrated section of the show featuring materials suppliers and processors able to offer visitors new ideas and options in this key sector.

Engineering Materials LIVE!

Given the growth of the event, there will naturally be a lot of new exhibitors at the 2013 Engineering Design Show. These will include names such as Cotsworld Plastics, Dynamic Ceramic, EJOT, Ensinger, Fibracon

Hardide secures grant for new coating



Advanced surface coating specialist Hardide Coatings has secured a grant of up to £250,000 under the Technology Strategy Board's 'Smart' scheme to commercialise a novel coating that will enable a new generation of hardfacing materials for use on drilling tool and wear parts for industries including oil and gas, mining and construction.

The 'development of prototype' grant from the UK's innovation agency will part-fund a two year project to further develop, manufacture and test a new Hardide coating for use in a hardfacing material that will enable drilling tools and high-wear parts to operate at peak performance in severely abrasive environments where current technologies fail.

The new material will complement Hardide's existing range of wear and erosion resistant coatings and offer a level of durability and protection that is not currently available from any surface technology in the market.

The grant will pay up to £250,000 against agreed expenditure over two years.

'Smart' is a Technology Strategy Board scheme offering funding to small and medium-sized enterprises (SMEs) to engage in R&D projects in the strategically important areas of science, engineering and technology, from which successful new products, processes and services could emerge.The Smart scheme supports R&D projects which offer potentially significant rewards and could stimulate UK economic growth.

www.hardide.com

Twin, Goodfellow, Heason Technology, HPM, The Institute of Spring Technology, New Technology CADCAM, Nylacast, SD Products, Springtech, Tesa, Trumpf and FATH.

As in 2012, the show, whose headline sponsors are Schaeffler, Heidenhain and RS Components, will once again feature a comprehensive Conference and Workshop programme. While the exact details of these sessions remain to be confirmed, they will cover a broad range of themes and topics of relevance to design engineers from all industry sectors and disciplines.

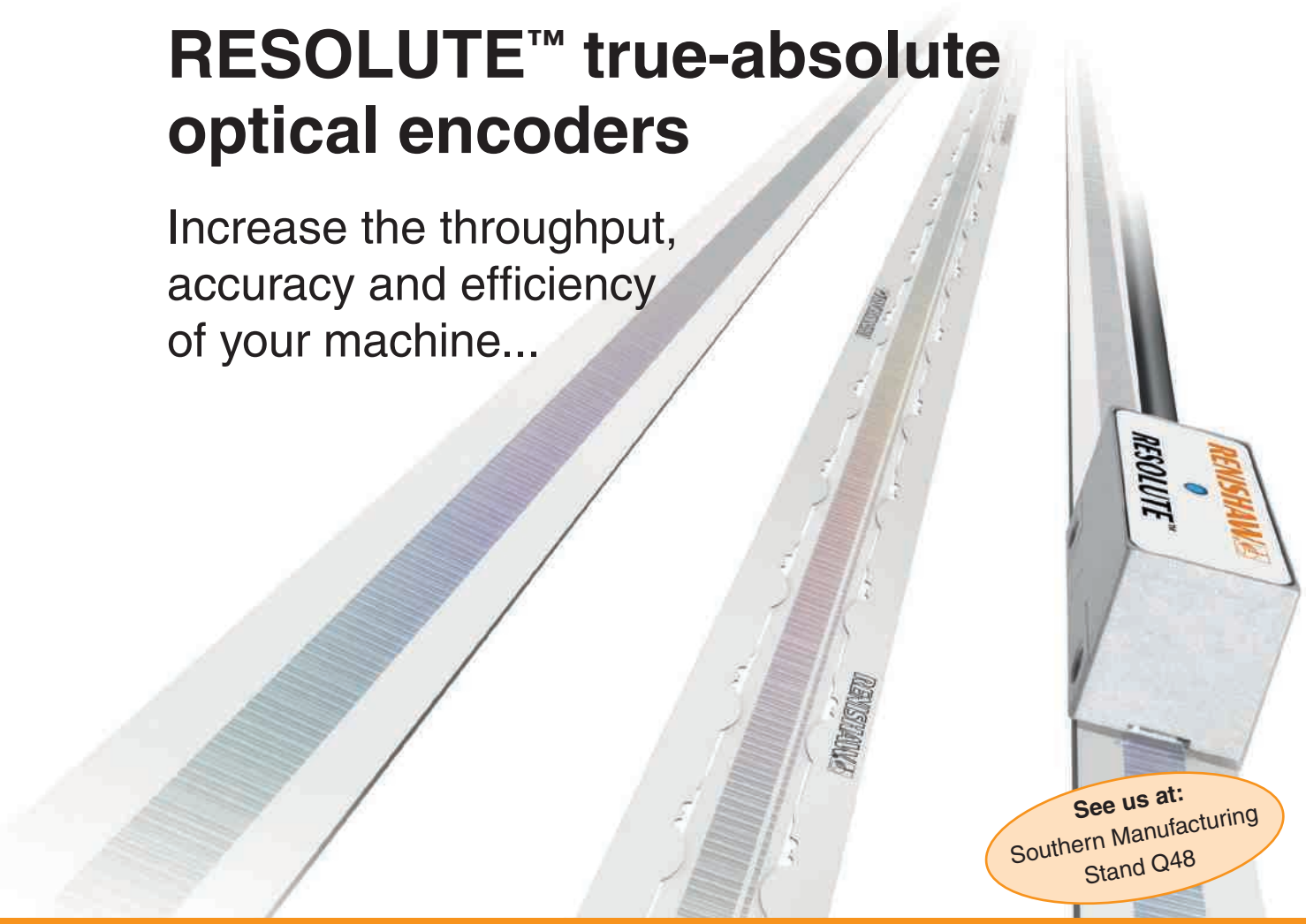
For more details on the event or to exhibit at the Engineering Design Show, contact Luke Webster on lwebster@findlay.co.uk.
Should you wish to take part in the Conference, contact Paul Fanning at pfanning@findlay.co.uk.
To register to attend, visit www.engineeringdesignshow.co.uk

www.engineeringdesignshow.co.uk

RENISHAW
apply innovation™

RESOLUTE™ true-absolute optical encoders

Increase the throughput, accuracy and efficiency of your machine...



See us at:
Southern Manufacturing
Stand Q48

In markets that demand higher accuracy and throughput, RESOLUTE true-absolute encoders are the key to getting ahead of the competition.

Choosing RESOLUTE encoders for your machine means highly dynamic axes can be run harder, for longer; increasing work output and maximising up-time. Axes run more smoothly and less heat is generated in linear motors.

Furthermore, RESOLUTE is a true-absolute encoder, so it acquires position immediately at switch-on: gain full control and start work immediately. Combined with a maximum speed of 100 metres/second and class-leading accuracy, just imagine how much more you can achieve...

RESOLUTE encoder scale incorporates redundant data which is cross-checked by error rejecting algorithms within the readhead to confer outstanding immunity to dirt and contamination. Further data-processing continually monitors the decoded position to ensure the integrity of output data and hence safety of operation.

Whether you want to achieve a higher cph rating, drill PCBs faster, improve the accuracy of PV manufacturing processes or reduce inspection times, RESOLUTE allows you to redefine your machine's performance.

For more information please visit:
www.renishaw.com/resolute

Renisahw plc New Mills, Wotton-under-Edge, Gloucestershire GL12 8JR
T +44 (0)1453 524524 F +44 (0)1453 524901 E uk@renishaw.com
www.renishaw.com

Bodine adds to gearmotor family

Bodine Electric Company has launched a new generation of its type E and F gearmotors. The new 42A5-FX is a completely redesigned permanent magnet DC (PMDC) parallel shaft gearmotor that provides up to 40% more torque than previous E/F models. 40 new stock models are offered with either 12/24 VDC or 90/130 VDC-rated motor windings.

New synthetic lubricant allows the FX gearhead to operate at a wider temperature range, while at the same time improving overall gearhead performance. Stronger, hardened helical steel gears and new needle bearings provide more torque and 25% longer product life.

The 42A5-FX gearmotor is ideal for medical equipment, packaging machines, conveyor systems, printing equipment, and factory automation applications. The 12/24 VDC gearmotor models drive portable or remote applications where connection to an AC line is not possible.

www.bodine-electric.com

Bosch Rexroth launches pump

Bosch Rexroth has launched a new, open-loop axial piston pump, the A4VBO. The new pump works at a higher pressure than previously possible, making it ideal for applications in the open die forging industry.

Specially designed to provide a long service life and low level operating noise, the A4VBO pump keeps future maintenance, and therefore unexpected costs, to a minimum. The modular design and excellent power to weight ratio aids installation and ensures performance, whilst a short response time helps to assist productivity.

The A4VBO pump comes in sizes 71cc, 125cc and 450cc. The nominal operating pressure is 450 bar and peak 500 bar, in comparison to traditional A4VSO models which reach 350 bar. It also includes an electro proportional flow and pressure control option with various through drive options for mounting pilot and auxiliary pumps to the back of the A4VBO pump.

www.bosch-rexroth.co.uk

Solution to last month's Coffee Time Challenge

The Solution to January's Coffee Time Challenge of how to improve upon the white cane as an aid for the visually impaired comes in the form of Télétact, an ingenious add-on to the traditional white cane that uses infrared detection and vibration feedback to identify hazards and obstacles, to help users move through the urban landscape.

Created by French company IN3G, Télétact consists of a small box that can be attached easily to a standard white cane. The box emits a harmless infrared beam that is projected horizontally along the ground up to 70cm ahead of the user. The beam is also projected upwards at an angle of 45°. When the infrared beam strikes an object, the Télétact box inducts a vibration in the cane, which increases or decreases according to the proximity of the object.

The prototypes of the various component parts of Télétact were initially completed internally by IN3G, using additive 3D printers. However, when it came to validating and testing the mechanical parts (for example, the opening of the battery cover), achieving a perfect fit and preparing the tools for injection moulding, IN3G turned to Proto Labs. After two rounds of creating prototypes Proto Labs produced ten moulds and delivered one hundred Télétact cases. The external casing and battery housing is made of black polycarbonate, designed to protect the infrared light system, the power supply, circuit boards and vibration device.

www.protolabs.co.uk

LINEAR POSITION SENSOR BASED ON POTENTIOMETER

Variohm EuroSensor has released a new low-cost range of linear position sensors, combining a sealed membrane potentiometer in a robust support housing that makes installation straightforward for medium precision measurement from 50 mm to 1m.

The new IPL series linear sensors are available in nine standard position or displacement measurement ranges with independent linearity to +/- 3% and average repeatability to +/- 0.5 mm. For higher precision use, a membrane potentiometer with independent linearity to 1% is available on request.

Aimed at demanding linear measurement applications across all industries, they are particularly well-matched to door and gate closures, valves and vents, lifting and handling machinery, and other areas where low-cost position verification is essential. The simple design of the IPL can be manually driven with minimal force required, or provide position feedback in combination with electric, pneumatic or hydraulic automated actuators.

www.variohm.com

RP CONCEPT CLOSES DEVELOPMENT GAP

Fastener Express from Arnold Umformtechnik ensures production-ready fasteners straight out of the development phase.

The Fastener Express team performs a production readiness check in the development phase for the functional part concerned. It indicates the best fabrication method for the machine part in subsequent series production: as a turned part or as a formed part. Deciding on the appropriate method at an early stage saves a lot of time and money. The system, dubbed 'functional prototyping', is built around a dedicated rapid prototyping team. This eliminates time lost to administrative procedures. The Direct Acceptance process also avoids the request handling delays typically seen in the industry. It automatically results in a prompt technical assessment of the request in order to determine the proper fastener materials, as well as the mechanical properties of the joint.

Quasi-simultaneous incorporation of the 3D CAD data in the product results in additional time savings. The tooling design and tooling procurement steps are eliminated entirely. Instead, the blank parts go directly into production-ready final machining using automated lathes and comprehensive in-house machining centres.
www.arnold-uk.com

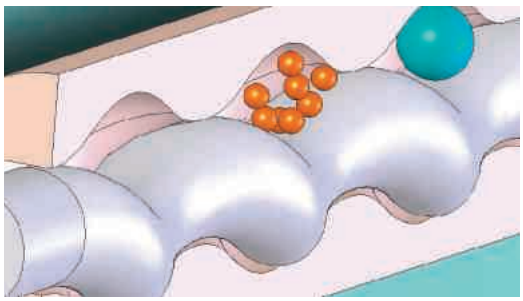
Stemmer offers Smart 3D sensors

Gocator 3D smart laser distance sensors from LMI Technologies are available from Stemmer Imaging. Designed for high resolution measurement over ranges up to 2 metres, the self-contained Gocator 1100 and 1300 Series of 3D displacement sensors provide high-speed, non-contact dimensional measurements such as distance, height, thickness, or surface roughness.

With scan rates up to 32 kHz,

the Gocator Displacement Sensors are ideal for automating non-contact distance measurement processes and real-time closed loop control. Completely self-contained in an IP67-rated enclosure with integrated laser & optics, the new smart sensors provide laser measurement & data processing in a single unit. The sensors are delivered pre-calibrated and are ready to deliver real world measurements straight from the box. No additional hardware is required to generate decisions based on the measurements.
www.stemmer.co.uk

Microcapsules dispense precisely



An ideal dosing system must impart no shear stress on the material, and be highly precise. Intertronics are delighted that they have within their portfolio the 'endless-piston' technology from ViscoTec GmbH which offers these features. These preeflow positive displacement, volumetric dispensing pumps will dispense or dose independent of input pressure, material viscosity and ambient temperature. The special geometry of the stator and rotor configuration works as a progressive cavity pump. The rotor seals against the stator, forming a series of spaces or pockets, which translate along as the rotor rotates, keeping their form and volume. The pumped material is moved inside the pockets. In addition, the pockets are shaped such that they taper and overlap; the output is continuous, even and pulse free. Therefore it is possible to dose very shear sensitive and delicate materials without damaging them.

With accuracy of ±1% and repeatability >99%, this technology is extremely well suited for the pumping, feeding and dosing of fluids which contain microcapsules. Intertronics' Product Specialists are available to advise on the preeflow range of high-accuracy micro-dispensing equipment.
www.intertronics.co.uk

Danfoss VLT connects to Powerlink

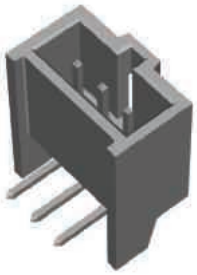
Danfoss has enhanced the current version of its VLT AutomationDrive FC 300 series with a Powerlink interface.

As well as intelligent plug-and-play technology, the current VLT AutomationDrive FC 300 series covering motors from 0.25 to 1,400 kW features a modular design and in its more sophisticated version also integrates safe stop functionality suitable for EN ISO 13849-1

category 3 installations. These features provide substantial benefits in terms of commissioning, operating and maintenance.

While USB and RS 485 connectivity are on-board, standard features, fieldbus interfaces are selectable options. The latest addition to the VLT AutomationDrive FC 300 series' connectivity options is Powerink.
www.ethernet-powerlink.org

Moving to the Third Dimension



RS Components in the world of 3D: Supporting engineers with free, online 3D models and design tools

Increasingly, engineers need to think in three dimensions – it's not just the two-dimensional footprint of their printed-circuit-board (PCB) design that is crucial to delivering space-saving designs. The addition of extra connectivity or an unplanned heatsink can make a real difference to a design that was a totally low-profile affair in the early product mock-up stages, introducing significant delays in time-to-market and additional costs.

CROSSHEAD TO ENTICE THE READER?

As an example, heat is a major concern for many designs. A performance-demanding application may run the microprocessor towards its thermal limits, meaning a large heatsink will be needed which could block the cooling airflow for other critical components. While it is hard to see how airflow might be constricted from the pure two-dimensional view of a PCB layout package, a much clearer picture emerges only in the move into the 3D world to see how the PCB, components, connectors and packaging fit together. The ability to do this earlier in the design – rather than waiting until it becomes apparent that there is a problem – is crucial to keeping project lead times to an absolute minimum.

The constant development of 3D CAD tools is making them increasingly suitable for the creation of concept designs. And even if they are not always ideal for initial development of 'back-of-the-napkin' ideas, these tools are now making it significantly easier at the next stage to move the design forward in the product development cycle. It is clear that 3D design is becoming increasingly vital to the modern design engineer, and in fact it is estimated that approximately 70 percent of all design in Europe are now being done in 3D.

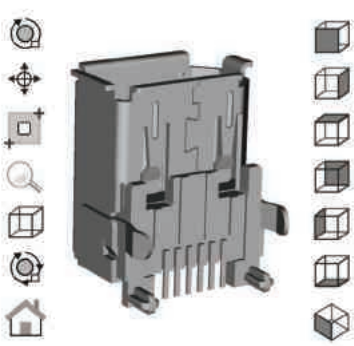
A crucial tool in the 3D design armoury is a product or component model library. In 2010, RS Components (RS), the world's leading high service distributor of electronics and maintenance products, launched its 2D/3D model CAD programme to provide engineers globally with access to an extensive library of 3D models downloadable completely free-of-charge from the company's website. Since that time, RS has recorded more than 300,000 downloads of 3D CAD models from the RS website, achieving this major milestone in just over two years. The 3D models cover key technologies including electronics, electromechanical, mechanical, pneumatics and automation and control.

The RS 3D programme offers more than 31,000 3D models from 45 manufacturers. The company is also introducing an additional 1000 models every month from both new and existing suppliers. Key suppliers represented in the 3D element of the company's 'ModelSource' component library are the global strategic partners of RS Components, including TE Connectivity, Molex, Omron, Schneider and SMC, in addition to specialist manufacturers such as Harting, IGUS, Finder, Lemo and Hirose.

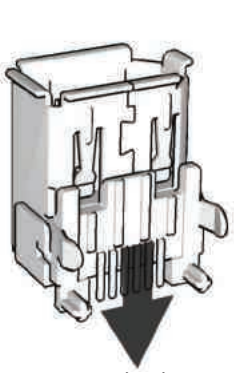
CROSSHEAD TO ENTICE THE READER?

3D CAD models from RS Components are downloadable free of charge in more than 20 native CAD file formats, including SolidWorks, AutoDesk and pro-E. These models are ready to import directly into all of the most popular computer-aided-design software, speeding up integration of products into design projects.

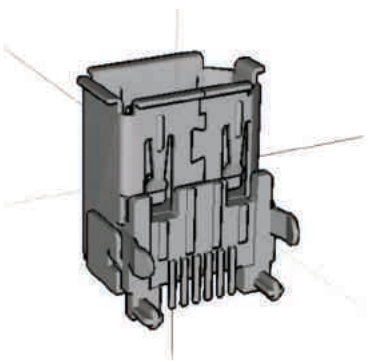
RS also has a dedicated landing page at rswww.com/3d, which provides customers with fast and easy access to the models. Users can search for the 3D CAD models by product category and by manufacturer, making it significantly easier and quicker for engineers to locate, view and download the appropriate model required for their design from a vast selection of components, including connectors, relays, switches and semiconductors.



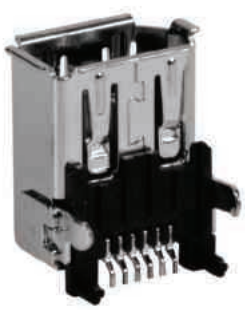
View



Download



Design



Prototype

rswww.com/3d

Driving the next

Motorsport is an onslaught on the senses. The sound, the speed, the smell; it's an experience. But, while some enjoy motorsport, others see it as a a frivolous with little crossover or relevance to any 'real' engineering.

Interestingly, even some of those working within motorsport have begun questioning its relevance. With many of today's races taking place in what is known as 'spec' series – where all the cars are made up of the same design and engine – innovation is hard to come by.

It frustrated one British racing car designer to such an extent he had to do something about it. "I was trying to find tiny incremental performance changes and there was little difference to what we were making," says Ben Bowlby, designer of the Deltawing. "And, I couldn't stand the spec racing phenomenon and thought it was awful for our industry. We need to be realigned with the automotive industry and we aren't when we go spec racing."

Bowlby had something of an epiphany; realising that the tough targets the mainstream automotive world faces around carbon emission reduction and energy efficiency created an opportunity for motorsport. He wanted to step outside the tightly regulated world of spec racing to build one of the most efficient racing cars ever conceived.

Just as fast, twice as efficient

"We put this crazy idea out there where we could be as fast as LMP2 (Le Mans Prototype) cars but twice as efficient," says Bowlby. "We halved the weight, halved the size of the engine, halved the aerodynamic drag, and doubled efficiency; halving the carbon footprint."

Following a meeting with motorsport governing bodies, it was decided the Deltawing could run at last year's Le Mans under 'Garage 56'. The 56th Garage is reserved, and allows for, experimental and innovative cars to run unclassified, meaning while it can compete it is ineligible for points or awards.

The Deltawing is different from any other racing car ever produced and, while it might look like Bruce Wayne's latest runabout, it has shaken up the motorsport industry by showing just what is possible today.

"We didn't invent a new powertrain for the Deltawing," says Bowlby. "We used existing technology that we know about today and just packaged it differently. It was actually fairly simple and not as complex as you might think."

The Deltawing halves aerodynamic drag, downsizes its engine to a 1.6l turbo and is ultra lightweight – thus neatly encapsulating three key drivers in the modern mainstream automotive industry.

The rules that govern the future of motorsport are critical in defining the direction of its innovation. Some recent moves, such as F1 downsizing engines and Le Mans making efficiency the deciding point of a race, are significant in trying to align motorsport innovation with the requirements of the automotive industry.

But other rules, believes Bowlby, are less useful. "Having a minimum weight is like saying you have to have a minimum fuel burn," he says. "There is no minimum weight on a road car, so why do we have a regulation like that? We have very thorough crash testing now. When a minimum weight was imposed, we didn't. We have to make our rules relevant and credible so that we can support the road map of the automotive industry.

"Our car is very light in comparison to the other cars we race against. Yes we are vulnerable and an incident has happened twice now. We are going to have to lightweight road cars that are next to huge articulated lorries, so we have maintain occupant safety in these structures."

Changing perceptions

"Motorsport has the power to change people's perceptions of a technology" is a phrase coined by Ulrich Baretzky head of engines, at Audi Motorsport. He was one of the key figures behind Audi's winning diesel Le Mans car in 2006 and also won last year with a diesel hybrid. He believes hybrid systems and lightweight structures can be showcased to the world through motorsport to make them increasingly popular and acceptable to the mainstream.

To a degree he is right. Racing with diesels has helped to popularise the technology among the general consumer in Europe and even more so in the US. It has also helped support the mainstream automotive diesel engine builders with performance. No longer are diesels the slow, dirty engines they use to be.

The hope is that Audi can repeat a similar trick with hybrids, and efficiency in general. The car industry has strict targets for 2020 when, if

generation

The Low Carbon Racing Conference at Autosport International saw a gathering of 'petrolheads' talking green. Justin Cunningham finds out about the future of motorsport and why it is vital to the mainstream.

the average CO_2 emissions of a manufacturer's fleet exceed 95g/km it has to pay an excess emissions premium for each car registered of €95.

"That will wipe out OEMs," says Baretzky. "So this is an essential thing, and we in motorsport have a unique chance, more than ever before, to take technical leadership.

"In 20 years I think we'll realise that now was the deciding point for motorsport. However, the efficiency has to be credible. We can't bend the rules or exploit any loopholes we find. We don't want to end up in two or three years with a powertrain that has turned out to be the most efficient in Le Mans but is not in daily life. Then we have missed the point."

The UK is the Silicon Valley of motorsport and many want to see the skills and expertise that exist here to be leveraged. As an increasing number of hybrid and all-electric vehicles are developed, there is a significant opportunity for the UK to take a lead in green vehicle design and technology.

Road relevance and technology transfer are increasingly requirements for getting investment from the automotive industry as they provide direct benefits to road car development. For this reason, a motorsport roadmap has been produced by Ricardo in conjunction with the Motorsport Industry Association (MIA) to in order to do just this and to align the sectors much more closely.

"Motorsport needs to think of the automotive OEMs as its customers as well as the people who watch the sport," says Steve Sapsford, global market sectors director for high-performance vehicles and motorsport at Ricardo. "We therefore need to speak with one voice, as that helps the regulators and can help motorsport access technology funds.

The Audi R18 e-tron quattro last year became the first hybrid car to win Le Mans

"Motorsport has the power to change people's perceptions of a technology."

Above: Drayson Racing Technologies is a leading champion of electric racing
Top: Green GT's H2 will race at this year's Le Mans

"We need, however, some energy storage breakthroughs. We need to make huge improvements in cost, energy and power density, which to date have been disappointing. We need that for mass market appeal."

This has led to the FIA last year launching Formula E, the highest class of competition for single-seat electrically-powered racing cars. The championship will begin in 2014 with the first team confirming entry headed by former Minister of Science in the Department for Business, Innovation and Skills Lord Drayson.

Drayson Racing Technologies has been an outspoken champion of electric racing cars for the last few years, competing in last year's Goodwood Festival of Speed hill climb with the electrically modified Le Mans Prototype – the B12/69 – in an impressive 53.91s finishing 11th overall, as well as attempting an electric vehicle land speed record later this year. As an equivalent, the current electric vehicle land speed record set by Nemesis last year was 151.6mph.

The B12 is reported to top out at just under 200mph, does 0-60 in three seconds and it has an output power equivalent to 850hp (640kW). Drayson Racing hopes to put all the lessons learned so far into making an even quicker single-seater electric racing car for the Formula E championship.

"This is a journey we have been on since 2007," says Lord Drayson, team principle of Drayson Racing. "Motorsport can accelerate innovation, speed the development of these technologies and make green technology exciting."

As well as transferring technology into the mainstream automotive industry, the motorsport industry is also good at finding technology from other industries. Over the last 30 years, motorsport has frequently taken ideas from aerospace technology and this was what inspired the Green GT project.

"Seven years ago when I did a project on KERS for a GP2 project, we started looking at electric engines and electric solutions," says Jean-Francois Weber, managing director of Green GT. "It was crazy to continue developing mechanical engines, as we are at the end of the learning curve. If we compare efficiencies, an electric engine can be more than 95% efficiency. The only problem is the energy storage inside the cars."

Based on that, Weber started looking at what was used on space shuttles. He found that the Russian Soyuz rocket used electricity created by a hydrogen oxygen fuel cell. "If aerospace uses that technology it is secure, reliable and efficient and they have never had a problem in space," he says. "They are also lightweight and resist g-force. That is exactly what we need in motorsport. When I saw it I thought: 'I want this in a race car'."

The price, however, was €4million without a guarantee. But, with the help of a colleague and an investor, Green GT developed a full car with a different type of structure to accommodate the fuel cell, the fuel tanks, gearbox and fuel cell.

"We've built the carbon fibre chassis," says Weber, "We've done the crash tests for FIA rules, and we are ready to go and race at Le Mans this year."

The H2 will race at this year's Le Mans out of Garage 56 with a new 400kW high-temperature membrane, 18-stack fuel cells. In its distinct orange and black colours it is unmistakable. For a start, the hydrogen is stored in two large, literally bulletproof cylinders at 350bar in two composite fuel tanks under each side pod. The exhaust emits only air and water.

The car uses two electrical turbochargers to force air inside the fuel cell, working between 10,000 and 120,000 rpm. The rear wheels are connected to two Type 2 synchronous three-phase permanent magnet motors which will give a massive 4000Nm at the rear wheels.

It will reach a top speed of 186mph, weighs around 1240 kg, and is ready to race. And for those that are worried about the sound: "It is linked to the two turbochargers," says Weber. "When the driver pushes down the pedal, we have a compressor in front of it to put the air in and it sounds is like a helicopter turbine, but it is in relation to the foot of the driver. I think people will find we have a nice sound."

www.deltawingracing.com
www.draysonracing.com
www.greengt.com
www.the-mia.com

Good on paper

Mcor's 3D printing machines are unique in a number of ways and could make the technology available to the average consumer. Paul Fanning reports.

The last few years have seen a massive increase in public interest in 3D printing and rapid prototyping techniques. Inevitably, this has led to speculation about the future, much of which has revolved around the possibility of every home having a 3D printer.

The major obstacle to this democratisation of technology at the moment, however, is the sheer cost of the machines and – as significantly – the materials required. However far the cost of particular machines may fall, the need to purchase expensive proprietary materials has tended to put this type of prototyping out of the range of all but the wealthiest amateur.

A technology that may put 3D printing within the grasp of the many, however, comes from Irish company Mcor, whose machines circumvent this problem by using ordinary office paper as their medium.

Dr Conor MacCormack, the company's CEO, founded Mcor alongside his brother (and Chief Technical Officer) Fintan. And it transpires that the mission to democratise was there from the start. "The reason we got into this is that – as corny as it sounds – we really wanted to upset the status quo and make a difference to this market," he says. "When we started, the machines were very expensive and the consumables even more so. So we thought: can we make a entry-level machine where the cost of the parts was going to be irrelevant? So we asked what's the lowest-cost, entry-level sheet material you can get? The obvious answer was paper."

Mcor's machines (the Matrix 300+ and the new Iris True Colour printer) use information based on a 3D scan. They then use three reams of standard A4 office paper one sheet at a time. Before loading, a layer of adhesive is applied to the paper, which is then pressed down. The machine's cutting head then cuts out the 2D profile with a tungsten carbide blade.

The adhesive presented a problem, as Dr MacCormack was keen that the technology should be environmentally friendly. "Water and paper don't mix," he says. "Traditional water-based adhesives blistered the paper. So we had to spend a couple of years in R&D developing a water-based dispensing device."

The new Iris machine takes the colour information of the scan as well as the dimensional data. It then sends that information to a 2D machine that prints that colour and profile information in duplex in very high resolution. Thus, the Iris only puts the colour where the cut is going to go. The ink permeates, but does not saturate the sheet. Thus, when the shape is cut out, there is colour all the way through the edge.

Says Dr MacCormack: "It's a specially-modified ink that permeates the media. If you didn't do that, you'd get a layer of white when you made the cut. Then, when you remove the waste material, you have the full colour prints." Although this ink is proprietary, it in fact costs less than more standard colour printer inks.

It is this machine that has excited the interest of office supplies giant Staples, with which Mcor recently struck a deal to launch a new 3D printing service called 'Staples Easy 3D'. This will offer low-cost, coloured, photo-realistic 3D printed products from Staples stores. Customers will simply upload electronic files to the Staples Office Centre and pick up the models in their nearby Staples store, or have them shipped to their address.

"Water and paper don't mix. Traditional water-based adhesives blistered the paper, so we had to spend a couple of years in R&D developing a water-based dispensing device."

"The deal with Staples has had a big impact," says MacCormack. "Traditionally, we were dealing with engineers and product designers, architects, medical and dental, etc. We've always felt that, because of our technology, there's a natural synergy with a big, paper-based company like Staples. So what we've found since the Staples agreement is that we have a lot of reprographics and 2D printing industries interested who wouldn't have looked at 3D printing before."

This 'copy shop' model has been mooted before, but without success. Dr MacCormack believes this has had much to do with cost. He says: "Our competitors have tried to put their technologies into these areas before, but it hasn't worked because, by the time you've factored in your consumables and the mark-up you want to make, then you're talking about hundreds of dollars per print. On the other hand, if you're talking about $10 or $20, then the consumer will pay that up front."

This approach, Dr MacCormack believes, is indicative of the opportunities for 3D printing technology in the consumer market. He says: "Is every home going to have a 3D printer? I doubt it. I know plenty of people who have difficulty getting the Sky box to record, let alone using a 3D printer. On the other hand, if you can go down to a store and get something 3D printed for a reasonable price, then that's a different matter. I think that every consumer household will have a desire for 3D printed content, but that doesn't mean they'll want a 3D printer."

www.mcortechnologies.com

A new dimension

Dr MacCormack is a former site manager for a 5th Framework European project with Airbus and principal investigator with SPS Technologies in the US in the aerospace sector. He has a PhD in mechanical engineering and in-depth experience in the CAD/3D printing field. He has worked as a consultant with companies such as Boston Scientific, ABS Pumps, Aisle Master, Mantis Cranes, Tanco Autowrap, Keenan Systems and Dromone Engineering. He has been CEO of Mcor Technologies since 2007, and in that time the company has won two national competitions and generated worldwide demand.

From This Day, Forward

3D technology is all around us. It's changing how we design and manufacture products, make movies, heal our bodies and interact with the world. Work that used to take place on a page or screen now reaches into space. And faster than ever before, 3D technology is transforming our world.

To see the impact of 3D, look to the realm of design. Designers led the way in embracing 3D CAD and then 3D printing, incorporating more and more physical models into their iterations and thinking with their heads and their hands. And they've reaped the benefits: design problems surface sooner and solutions are less costly. Inspiration happens faster. Ultimately, products are better and consumers are happier. Black & Decker makes a safer tree trimmer and Lamborghini makes a faster car because reviews and trials are more frequently executed on models very much resembling a final product.

A few examples of the Stratasys 3D Printer line.

Now, 3D printing applications are expanding from design into production, and freeing manufacturers to build without traditional restrictions. DDM stands for direct digital manufacturing, a way to produce a finished product, part or tool straight from a computer design. More importantly, DDM means the rewards of faster, leaner, smarter methods are coming to the production floor. When we at Stratasys (and publications like The Economist, Forbes and The New York Times) call 3D printing "the next industrial revolution," we're not exaggerating.

A hundred years ago, the assembly line changed the world with mass production. It brought luxuries to the middle class, good wages to workers and economies of scale to investors. Today, companies like BMW already know that DDM is mass production's heir apparent. One factory-floor fixture, a nameplate-application device, offers an elegant example. Liberated from tooling constraints, BMW engineers reduced the

WHATEVER YOUR GAME, 3D PRINTING IS GOING TO CHANGE IT.

3D printing means virtual inventories and low-volume production, which for manufacturers is the next big step.

This rover includes about 70 FDM parts, including housings, vents and fixtures.

device's weight by half and replaced its blocky stock-metal handles with ergonomic grips — a great relief to workers who might lift the fixture hundreds of times per shift.

Today, NASA can shape a complex, human-supporting vehicle suitable for Martian terrain, despite the fact that its parts are too complex to machine, too rapidly iterated to outsource and too customized for traditional tooling.

In a 3D world, we leave behind injection molding, casting and machining, gaining economy without the scale. 3D printing leads us beyond mass production and into mass customization. It's how a researcher at a Delaware hospital creates a durable ABS-plastic exoskeleton customized to perfectly fit one child, Emma, allowing her to play, explore and hug for the first time. Then that researcher can make a 3D-printed exoskeleton to fit a different child. And another. And a dozen more. Now 15 children with rare disorders can raise their hands because of mass customization.

Ideas born today — your ideas — are freer to solve problems faster than ever before. Now,

A pediatric engineering research lab has developed and 3D-printed custom devices for their smallest patients.

two innovators who helped spark this revolution have fused to lead the charge together, and more great changes are at hand.

Welcome to the new Stratasys, leader of the next industrial revolution.

– By David Reis, Stratasys CEO

They look like shoes. They feel like shoes. But they're actually prototypes. Printed layer by layer on a 3D printer. Every day, 3D printing rewrites another rule of how things are made. 3D printers are at work in product design studios, engineering departments and manufacturing plants. In schools and hospitals and dental labs. Wherever speed, efficiency, and accuracy matter. It is the next industrial revolution. And Stratasys is here to lead it. Come explore the game-changing possibilities of a 3D World at Stratasys.com.

3D printing means prototypes like these, that help product designers put their best foot forward.

Stratasys
FOR A 3D WORLD

Learn more at **StratasysForA3DWorld.com**

Superconductors to enhance motors

The use of high-temperature superconducting material is set to improve the performance of electric motors. Justin Cunningham looks at the challenges in making it happen.

A variety of future systems will depend on higher power density, more efficient, compact motors. However, conventional materials and technologies are reaching a limit. With an increasing demand for multi-megawatt levels of power for advanced transportation and power generation systems, there is a clear need for a 'breakthrough' technology.

The development of higher-temperature superconducting materials is therefore exciting many parts of the engineering and applied science fraternity, and has made remarkable progress during the last several years. The property of superconductivity allows large quantities of electrical current to flow through a material virtually without resistance.

"Efficiency, thermal management and fatigue life are typically sacrificed as conventional electric motors are given higher rotational speeds to reduce size and weight while maintaining a high power output," says Dr Sab Safi, a consultant at SDT Drive Technology. "Simply scaling conventional electric motor technology is not plausible."

The application of superconductors has long been desired by engineers for reducing energy losses and increasing the power density of electric motors. However, despite being proven in the lab, the practicality of superconductivity can thus far only be achieved at extremely low temperatures.

Superconducting properties were originally known only to exist near absolute zero, making it prohibitively expensive and inherently brittle. However, in 1986 eight new materials were found that exhibited superconducting properties at 77K (-196°C), the temperature of liquid nitrogen, which is much easier and less costly to achieve. The energy required to cool to 4K is about 25 times that required to cool to 77K.

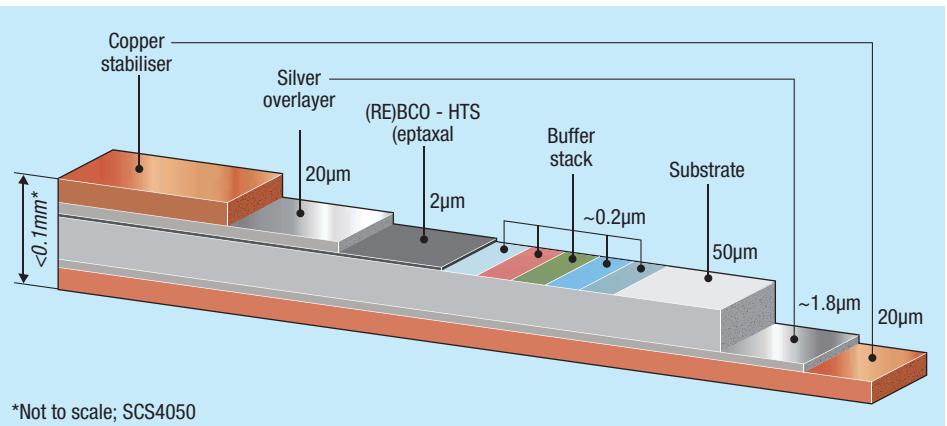
Ironically known as high temperature superconductors (HTS), this second generation of superconductor has recently achieved a critical current density of 106Amps/cm^2 in small samples of YBa2Cu3O7 (YBCO)-coated conductors, stimulating interest in manufacturing long-length YBCO-coated conductors. With the cost of applications dropping by orders of magnitude, long-length wires are no longer confined to the boundaries of laboratories and academic institutions and the first viable products appear to be within reach.

To contribute to solving the problem, SDT Drive Technology has been working for several years on the development of high power density superconducting motors for propulsion drives and renewable energy. It is producing HTS tapes to improve electric motors and generators, and it is keen to form strategic partnerships to develop the technologies further.

"The next step is developing the design techniques and manufacturing processes," says Dr Safi. "This leads on to commercial applications such as electric vehicles which are demanding ever higher power density in motors and generators."

The application of HTS in machine design has been mainly concentrated in the MW range where the increased costs incurred by using superconducting technology can be balanced by the reduction of motor volume and increased efficiency.

"Advances have already been made in the development of HTS electric motors and related subsystems for ship thrusters," says Dr Safi. "It is inevitable that attention will eventually turn to



*Not to scale; SCS4050

HTS materials in motors and generators, particularly in applications where mass and bulk need to be minimised, such as marine propulsion systems and wind turbines.

"The use of HTS wire in rotating machines provides us with significant competitive advantages by enabling reductions in size, weight and manufacturing costs."

Several companies are actively developing super machines. These include AMSC, Rockwell Automation, Siemens and General Electric. AMSC is to develop a 36MW HTS motor for naval propulsion which is based on 5MW technology and experience.

There is also interest from wind turbine manufacturers that has resulted in larger permanent magnet-based hybrid and direct drive generators being produced. However, these configurations are also reaching a practical limit on what is possible, with the current technology likely to reach a limit between 6-8 MW.

"HTS coils are today able to carry more than 100-150 times the current of a conventional copper wire of similar size," says Dr Safi. "However, the refrigeration and overall reliability for the cryogenic support system needs to be carefully designed and optimised and not drive the installed cost for the complete system."

The application of superconductivity still retains the basic configuration and operation of conventional AC motors. A superconducting magnet creates a magnetic field high enough that iron teeth are not needed to enhance the magnetic flux, either in the rotor or the stator. This means that the current densities in the active regions are not limited by iron saturation. The stator only requires the use of back iron acting primarily as a shield to keep magnetic flux inside the machine.

A resulting HTS air-core configuration, with high flux density, is significantly smaller and lighter than conventional AC synchronous motors. The lack of iron teeth in the rotor and stator eliminates the need for winding slots, reducing cogging torques that lead to radiated noise. This also decreases the inherent armature [stator] reactance, resulting in improved dynamic performance.

The lack of iron leaves more room in the stator and rotor structure for winding conductors, increasing the power density and efficiency. It also serves to lower synchronous and sub-transient reactance, resulting in lower torque angles during operation and improving its transient stability. The HTS motor harmonic content is nearly zero because the machine does not use saturated iron in the stator.

"Despite advances the cost of HTS wires still needs to be reduced," says Dr Safi. "It is imperative that resources remain focused on creating a robust, high-performance HTS wire to develop reliable and efficient electric power equipment. The basic cost of materials has decreased by a factor of 1000 over the past 10 years, so cost and performance trends are very promising."

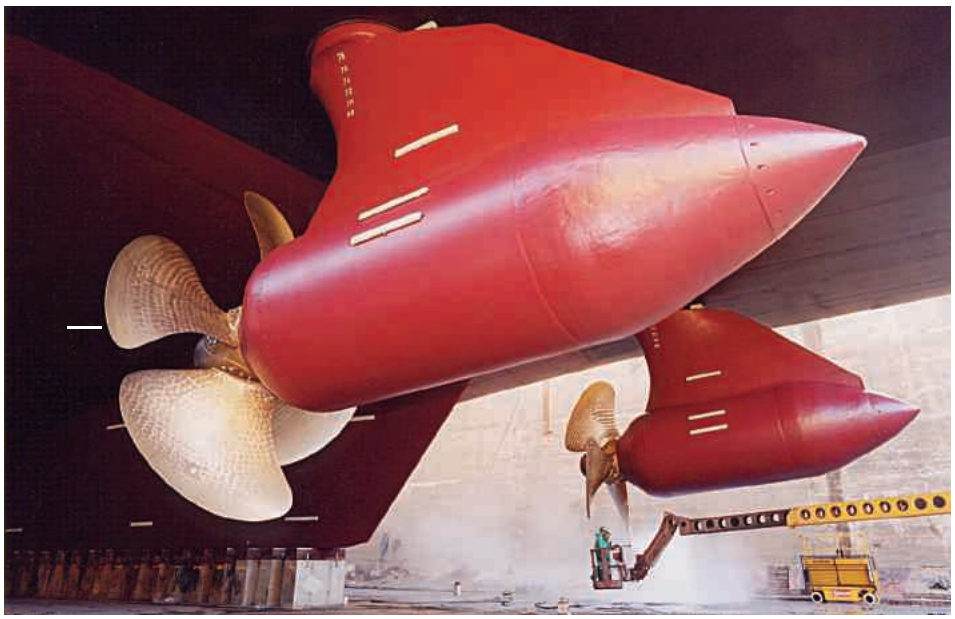
www.sdtdrivetechnology.co.uk

The problem with LTS Wire

When a superconductor's temperature exceeds its operating level, quenching can result. Quenching occurs when the material loses its superconducting properties. In order to prevent quenching, LTS wire has to be operated at a very low temperature (4K), which requires expensive and complex cooling systems, preventing further development for any propulsion applications.

The advantage of HTS Wire

First generation (1G) HTS BSCCO wires are made of Bismuth 2212 and 2223. The wires are much smaller than traditional copper wires yet when kept at the right operating temperature handle much larger current. HTS wire is more resistant to quenching as it can absorb more heat energy without a drastic increase in temperature. Also, HTS wire loses its current carrying capacity gradually. This advantage makes it possible to use refrigeration and cooling systems that are less complex and expensive. The 1G HTS wire is still expensive and needs to be cooled to 20-30K to carry high currents in high magnetic fields. Since superconducting, electric machines may need fields as high as 5 Tesla, the 2G of HTS YBCO is preferred. YBCO has excellent behavior at liquid nitrogen temperatures (65-77K) and can support high currents in magnetic fields up to several Tesla.



item
it's a system

Non-Stop Innovation

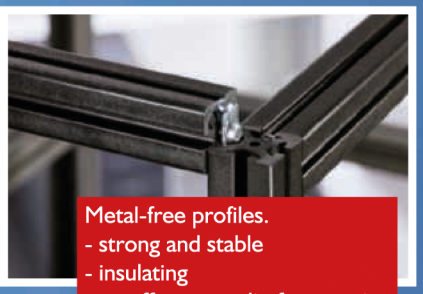
The most comprehensive aluminium framework system in the world

Easy-access cable entry protectors for conduit systems.

Combined castor and baseplate for speed and economy.

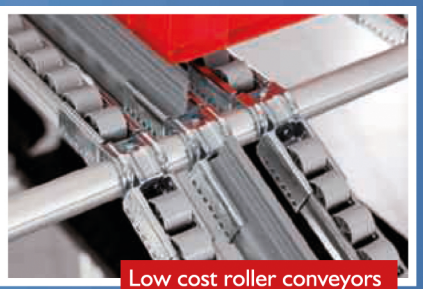
Robust free running belt driven slide.
High moment-loading capability.
All our belt driven slides can be produced rapidly to any desired length.

One piece shelf profiles.
Quick and economical.



Metal-free profiles.
- strong and stable
- insulating
- no effect on radio frequencies

Coloured tubes for new D30 tube system.



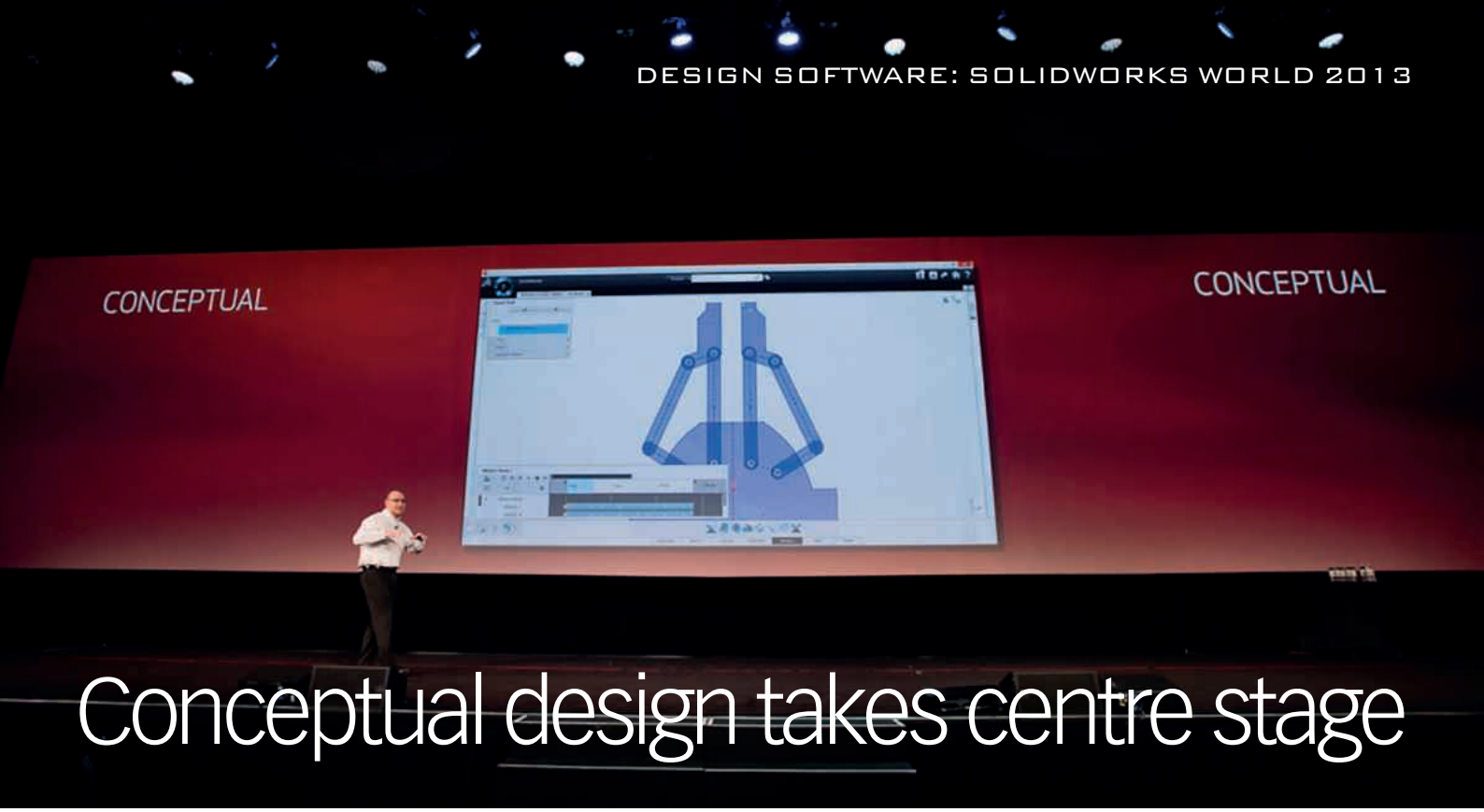
Low cost roller conveyors for lean manufacturing.

Greatly expanded ergonomic workbench range with new accessories and parts trolleys.

Low cost manual platen assembly system.
Most of the advantages of a powered system - but without the expense!

Machine Building Systems Ltd
Heage Road Industrial Estate, Ripley, Derbys DE5 3GH
Tel: 01773 749330 Fax: 01773 749560
email: sales@mbsitem.co.uk www.mbsitem.co.uk

Same day despatch is standard.
Huge stocks always available.



Conceptual design takes centre stage

An absorbing SolidWorks World 2013 was dominated by the announcement of a new application called Mechanical Conceptual. Paul Fanning reports.

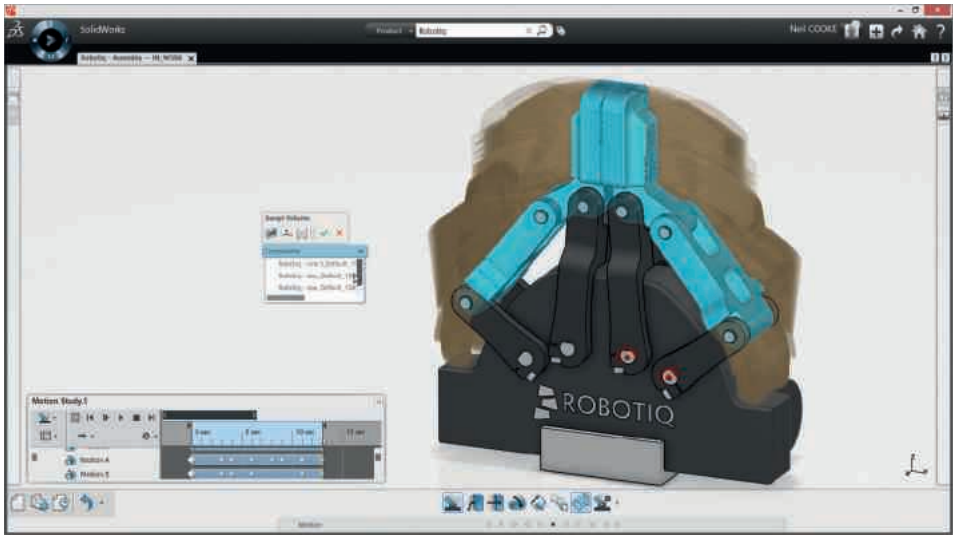
Held in Orlando, Florida, the 15th SolidWorks World event welcomed 4,500 delegates to the Walt Disney World Swan and Dolphin Hotels and was the occasion for parent company Dassault Systèmes to announce its 2 millionth licence sold. Further milestones included the announcement that the 3D ContentCentral sharing site registered its one millionth user and the introduction of My.SolidWorks, a new free service that aggregates company and community knowledge.

The most significant announcement, however, concerned the launch of a tool for conceptual and mechanical design called (logically enough) SolidWorks Mechanical Conceptual. The first app to be designed on and for the Dassault Systèmes 3DExperience Platform SolidWorks Mechanical Conceptual is designed to be complementary to other SolidWorks products, allowing the user to capture ideas digitally, quickly create 3D concept models, get feedback from internal and external stakeholders, and easily manage multiple concepts before committing engineering time to build.

This announcement is part of a trend amongst CAD companies in addressing the conceptual phase of design with direct-editing programs that are easier to learn and use than typical parametric CAD software. Other products in this market include Autodesk Inventor Fusion, PTC's Creo/Direct and Solid Edge with Synchronous Technology.

Fielder Hiss, SolidWorks' vice president product management, explained the decision to concentrate on conceptual design, saying: "If you think of the concept process today, there are a lot of challenges: the ideas are not always captured digitally; it's often difficult to get concepts into 3D digitally; you need to get various approvals from various stakeholders, which can make communication and collaboration with them difficult. You also need to manage multiple concepts."

Hiss went on to outline the significance of the conceptual design phase and the ways in which it could be facilitated. He claimed that 31% of project time is spent working with concepts, with six conceptual iterations in any individual design and three out of four engineers engaged in that process. "SolidWorks is the best for detailed design," said Hiss, "but detailed design can limit some of the creativity necessary to the conceptual process. Mechancial Conceptual takes these needs into account. It will allow you to capture ideas digitally, include multiple concepts



Mechanical Conceptual will be beta tested among SolidWorks users from May and is scheduled to launch in October

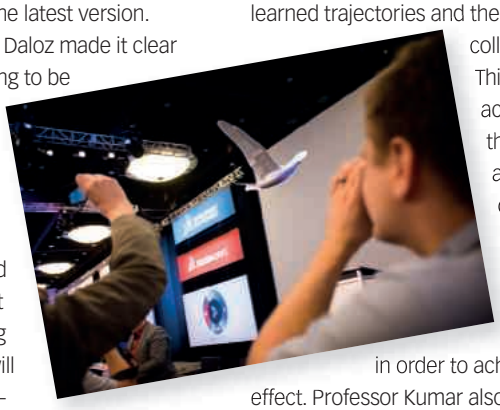
and iterate through them as well as communicate and collaborate with stakeholders."

Mechanical Conceptual is designed to be instinctive to use, claimed Hiss. "It's smart," he said. "It's always saving designs and capturing iterations as you work. This is great because concepts are fundamentally iterative. It's easy to go back to a previous idea and develop it further. Evolving a concept is really where Mechanical Conceptual saves the most time. Most of the time designers have to think about things like structure bill of materials [BOM], the bodies, the parts the assemblies and sub-assemblies. We're introducing a single modelling environment. This will allow users to evolve concepts from layouts to 3D geometry to parts and assemblies without ever considering the structure. This is a natural way to do concept design. You think about organisation when you're further along and your thoughts are actually more organised and you know how you actually want to structure things. This flexibility eliminates wasted time in starting over and rework."

In addition, the application is designed to be social in nature, with social innovation capabilities built into its foundation. At any point, the designer can engage 'stakeholders' in the process by posting concepts to their private communities. These individuals are notified that there is a concept to review and can provide feedback using simple and familiar web concepts.

SolidWorks Mechanical Conceptual is always connected to the design database and to other users. This gives us the ability to secure your data, prevent data loss from any crashes, and automatically save iterations of each concept. Users are always working together on the same design so that there is no time wasted, or confusion as to what is the latest version. When a team member makes a change, all users are updated in real time with the latest version.

While Dassault's Pascal Daloz made it clear that there are certainly going to be more and more 3D Experience products to come, SolidWorks CEO Bertrand Sicot was careful to point out that this new app-based approach would not have a negative impact on the core product, saying that such development, "will not be at the expense of — I shall repeat — will not be at the expense of SolidWorks".



In May of this year, SolidWorks will be working with select customers to beta test Mechanical Conceptual, with a full release expected in October – possibly at around the same time as SolidWorks 2014 is announced.

Talking of SolidWorks 2014, no SolidWorks World would be complete without some announcements of what is to be expected from the next release. This year, some of the promised features included: angular running dimensions; BOM enhancements; order independent transparency; SolidWorks electrical harness enhancements; CircuitWorks thermal properties and flow simulation link; bolt mapping; fixed length spline; Slots in hole wizard; modelling environment themes; Streamlined save as copy; eDrawings with augmented reality; sheet metal brackets with corner gussets; and lofted bend transitions.

Beyond the product-focused presentations, of course, SolidWorks World 2013 also featured a number of keynote speakers. One of the particular highlights in this regard included a presentation from Art Thompson, technical director of Sage Cheshire, the engineering team behind Felix Baumgartner's record-breaking leap from the edge of space. Thompson discussed how, with a design team of just 12 people in a process he likened to "having a five-year baby", Red Bull Team Stratos took the project from conception to design and execution.

Day two saw a focus on robotics, beginning with a fascinating talk from Professor Vijay Kumar, of the School of Engineering & Applied Sciences, University of Pennsylvania, on his work creating swarms of agile aerial robots. These, he revealed can be used in construction, as well as search and rescue operations. He also went into detail on the robots' abilities to navigate obstacles via learned trajectories and the nature of their collaborative behaviour. This, he revealed, was achieved by imitating the group behaviour of animals such as ants or flocks of starlings, whereby individual robots would act independently based on local information in order to achieve a collaborative effect. Professor Kumar also showed some astonishing videos of the robots engaged in formation flying, building structures and even at one point playing the James Bond theme!

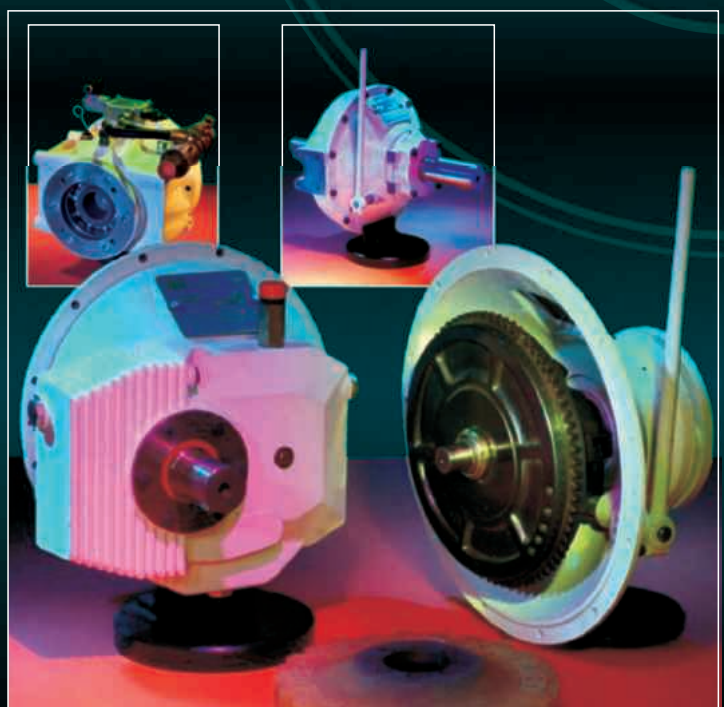
Even this was upstaged, however, by Elias Knubben, head of Corporate Bionic Projects at Festo, who demonstrated some of the concepts derived from the company's Bionic Learning Network. While *Eureka* has covered these topics before, it was impossible not to be impressed by the live demonstration of the Smart Bird as it flew just a few feet over the audience's heads.

www.solidworks.co.uk
www.sagecheshire.com
http://t.co/3RnpnhRa (Robots playing James Bond theme tune)
www.festo.com

jbj TECHNIQUES LIMITED

AN EXCELLENCE IN ENGINEERING

www.jbj.co.uk/clutchesgearboxes.html



Mechanically and hydraulically actuated over-centre clutches are available in two mounting styles. 'BD' series for close couple to diesel engines with SAE style flywheel facility. 'BDS' for independent, in-line arrangements, Capable of accepting high radial loads and transmitting powers of up to 850 kW as standard.

Versions are also available to close couple hydraulic pumps to the clutch output shaft. jbj's 'RM' version gearboxes are specifically designed for close coupling to industrial diesel engines and are available in either speed increasing or speed reducing format.

Gearboxes can be supplied with output shaft either same or opposite rotation to input shaft. Input to the gearbox can be made either by rigid/flexible coupling or via a 'BD' series clutch.

'RM-BDS' series are designed as free standing versions with input via a 'BDS' series clutch.

More detailed technical information available from:
jbj Techniques Limited technical office,
telephone: **01737 767493**
email: **info@jbj.co.uk**
www.jbj.co.uk/clutchesgearboxes.html

---

prototypeprojects

▶ 3D Printing ▶ CNC ▶ Vacuum Casting ▶ RIM Moulding ▶ Concept Modelling

Excellent Prototypes. **Exceptionally Fast.**

Prototype Projects have been living and breathing prototyping for 30 years, providing a full range of rapid prototyping and model making services to product designers and manufacturers.

SLA, SLS or FDM parts. Fast.

- ✓ Send us your 3D CAD model
- ✓ Specify quantity and materials
- ✓ Leave the rest to us
- ✓ Delivery as fast as next day

Take advantage of our three **Viper SLA** rapid prototyping machines... over **20,000 hours of high quality SLA capacity** per year.

We work fast at Prototype Projects.
For a fast quote on all your 3D printing and rapid prototyping requirements, call today on **01763 249760** or email us at **pp1@prototypeprojects.com**

scan the QR code to visit our website

Prototype Projects | t 01763 249760 | e pp1@prototypeprojects.com | w www.prototypeprojects.com

Over 200,000 Automation and Control products from the world's leading manufacturers, delivered to your door next day.

OMRON ABB SIEMENS

PHOENIX CONTACT SMC Schneider Electric

rswww.com/automation-control-gear

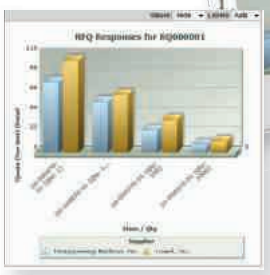
RS

PLM 360 finds its niche

In the 12 months following its launch, who are the cusomers for Autodesk's PLM 360 solution and how has it worked for them? Paul Fanning finds out.

Having been announced at Autodesk University in December 2011 and launched as a product in February 2012, Autodesk's PLM 360 cloud-based PLM platform has, depending on your viewpoint, either recently passed or is about to pass its first birthday. And, according to the company, the first year has more than vindicated the product.

More than 350 companies worldwide are now using and evaluating PLM 360, which translates as more than 8000 users who have created 40,000 workspaces and are managing around 2m items. A survey undertaken in November asked early adopters why they selected Autodesk PLM 360, what are they using it for and how were they benefitting from a cloud-based PLM solution?



The survey revealed that two-thirds of respondents selected PLM 360 for its immediate access to data it offered and 64% cited improved flexibility and responsiveness using the cloud. Perhaps more telling in terms of its target market, though, were the facts that 28% had no PLM system prior to using PLM 360, only 11% had used a competitive product prior to using PLM 360 and 61% were using Microsoft Office to meet their PLM needs.

The obvious conclusion, then, is that PLM 360 is filling a gap for companies for whom the cost of traditional PLM solutions had always been a barrier, something Richard Blatcher, Autodesk's Senior Industry Marketing Manager PLM, makes clear, saying: "We like to democratise technology and make it available to everyone. We've done it for 2D design, 3D design, simulation and now PLM. That has been one of the key attractions to the small-to-medium businesses."

This "sweet spot" among SMEs has not come about by chance, of course. Autodesk's decision to join the PLM market late gave it time to identify the gaps in the market. As Blatcher puts it: "It was no accident. Carl [Bass, Autodesk's president and CEO] made it very clear that we would only get involved in the PLM marketplace when the time was right. He's been quoted for many years on the theme that the only people to really benefit from traditional PLM were the PLM vendors. So the availability and accessibility of cloud computing was really the tipping point that allowed us to enter the market with the next-generation product."

One of the early adopters of PLM 360 is Irish company Suretank, which manufactures Cargo Carrying Units (CCUs) for the offshore oil industry.

Suretank's engineering manager David Keeley was tasked with implementing a PDM system when he joined the company, but has chosen instead to implement PLM 360, which he describes as "the single most impressive software application I've seen since I first started using CAD".

Having had experience of PLM systems prior to joining Suretank, Keeley believes that many traditional PLM systems are difficult to use and force companies to adapt to them rather than being adaptable to the company. He says: "I realised that we were having to make significant compromises in order to fit into the application. That made sense at management level but at the front line of engineering, it makes your life more difficult. You start to think 'this thing has supposedly been put in to make my life easier and it's doing the opposite'."

Where PLM 360 scores, Keeley believes, is in its simplicity and flexibility. "You can be up and running with this in a day. We've only needed one day's consultancy from Autodesk in implementing PLM 360… what Suretank needed was an application that was going to solve our immediate information management problems that could be scaled and changed in the future to adapt to the requirements of the business. When we started looking at PLM 360, it became immediately obvious that it was the best solution."

www.autodesk.com
www.suretank.com

Eliminating the weak points

Ceramic armour is lightweight and blast proof but is not without compromise. Justin Cunningham reports on a project that aims to remove its shortcomings.

When advanced engineering materials are mentioned, ceramics may not immediatey spring to mind. Yet ceramics possess a number of attractive properties that can be utilised in a variety of applications in a number of sectors.

Lockheed Martin has recently teamed up with the University of Surrey to develop a lightweight material that could improve the protection and survivability of armoured vehicles, including those used by the British Army and Special Forces.

Ceramic materials have increasingly replaced steel in armour plating because they are extremely resistant to penetration and possess low density. This means that they offer high ballistic protection and lighter weight than more traditional methods of armour plating.

The armour is usually made up of small ceramic plates – generally around 10cm^2 – that are fixed to a composite or metallic backing plate. These plates can be rectangular, circular or hexagonal. If a round hits the armour it will only take out a single plate and leave the remaining plates intact. It also makes it easy to tailor the armour to different shapes and parts of a vehicle.

The project looked at both aluminia and silicon carbide ceramic plates, which are bonded to a composite backing. This type of armour generally consists of a ceramic front face with an energy-absorbing rear face made from metal or composite materials. The brittle nature of ceramics means that mechanical fasteners are not appropriate for attachment to supporting structures, so they are usually bonded adhesively.

The efficiency of this protection method is reduced, however, by weakness in the adhesive used in bonding the ceramic plates. This project is looking specifically to improving the strength of the adhesive bond of the ceramic plates and composite backing.

Protective challenges

Andrew Harris, an engineering doctorate research engineer at the University of Surrey, says: "Although ceramic armour has a great number of advantages over other protection methods, there are still some challenges. Our relationship with Lockheed Martin has developed a method of treating the ceramic that will considerably improve the effectiveness of ceramic armour plating."

The adhesive bond is usually achieved using polyurethane or epoxy, which encapsulates the ceramic. However, neither of these bonding materials can completely withstand the stress resulting from the plating being struck by a projectile.

When a bullet hits most armour, it transmits a massive amount of energy into the ceramic. This shock can cause the ceramic tiles to delaminate and even come off the backing material altogether. This means that ceramic armour can be substantially less effective after just one impact, which is clearly not acceptable.

"Although ceramic armour has a great number of advantages over other protection methods," says Dr Harris, "the weakness in bonding the ceramic plates to the backing has been a problem since this type of armour was first used. Our assignment has developed a method of treating the adhesive that will considerably strengthen the effectiveness of ceramic armour plating."

The work by the team at Surrey University has focused on improving the adhesive bond strength between the ceramic and the backing to improve the ballistic performance for single and multi-hit impacts.

The key to the step change in performance, proven in tests, is the pre-conditioning of the ceramic surfaces prior to

bonding onto the support structure. Test results show that using this technique on alumina and silicon carbide surfaces leads to increased bond strength.

"You can get around this by over-designing the ceramic armour, making it heavier," says Dr Harris. "What we've done is improve the bond strength; we tested it and found that the armour performance is improved."

When a 14.5mm armour-piercing incendiary round was fired at the panel, it remained intact despite multiple hits without showing the classic signs of the ceramic armour falling off its supports due to poor shock resistance.

Steve Burnage, head of design at Lockheed Martin UK, says: "Our work with the University of Surrey is particularly valuable for Lockheed Martin UK as we grow our business in designing and integrating turrets for land vehicles. The reduction in weight of armoured vehicles is also increasingly important for the Army as it looks for more rapid and agile deployment into regions of conflict."

The processing and progress of ceramic armour for penetration mechanics are significant areas of ongoing academic and industrial research both in the UK and abroad. Another area of special activity pertains to personal protective vests. Large, torso-sized ceramic plates are complex to manufacture and subject to cracking in use. Monolithic plates also have limited multi-hit capacity as a result of their large impact fracture zone.

Advanced techniques

European developments in spherical and hexagonal arrays have resulted in products that have some flex and multi-hit performance. In addition, advanced ceramic processing techniques require adhesive assembly methods. One novel approach is the use of hook and loop fasteners to assemble the ceramic arrays.

Morgan Technical Ceramics is also finding and developing innovative applications for ceramics in the defence sector. It has been producing ceramic square panels which are flat packed in to a pre assembly ready to be easily and quickly integrated in to products.

It has also recently launched a range of large piezoelectric (PZT) ceramic discs developed for the defence and commercial sonar markets, thanks to a major breakthrough at the company's manufacturing facility in Ruabon, North Wales.

Using an innovative new process, Morgan Technical Ceramics can press, fire and machine discs and components up to 304mm in diameter. These are considerably larger than those previously manufactured at the site and offer a much lower radial frequency output than smaller PZT discs, allowing for improved acoustic range and drive.

These are manufactured in a range of dimensions and are available in machined thicknesses of 3mm to 30mm in PZT Navy I and Navy III types, and 3mm to 35mm in PZT Navy II, Navy V and Navy VI type piezoelectric formulations. However, Morgan says larger sizes are available on request with thickness and frequency variations also able to be tailored for individual requirements.

The discs are supplied with fired-on silver electrodes to ensure a good adhesion for soldering and bonding, and to a thickness which can safeguard durability in high drive applications. These components can also be manufactured with Wrap-Around silver Electrodes (WAE) if bonding and soldering is required on the same face of the PZT component. The design of the WAE can be made up of many configurations or to a specific design need.

Richard Carus, product sales manager for piezo components at Morgan Technical Ceramics, says: "We have a wealth of experience in both the design and manufacture of PZT ceramics. As a market leader in the field, we need to keep pushing the boundaries to see what can be achieved. This latest manufacturing-led innovation has seen not only a major breakthrough in our core process, but it has created a range of products for our defence and commercial sonar customers."

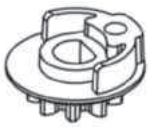
www.lockheedmartin.co.uk
www.surrey.ac.uk
www.morgantechnicalceramics.com

"Bonding the ceramic plates to the backing has been a problem since this type of armour was first used... What we've done is improve the bond strength and found that performance is improved," Dr Andrew Harris

Real parts. Really fast.

A product development team needs parts to meet its rapidly approaching deadline.

Upload 3D CAD file.



firstcut®
CNC Machining Service

Receive FirstQuote® interactive quote.

Finalise confirmation, order with credit card. Computerised automated toolpaths sent to CNC machine.

Machining begins.

Part ready for shipping.

1–3 Days

1-10 parts
How Many Parts?
10-10,000+ parts

Receive ProtoQuote® interactive quote.

Finalise quote and submit P.O.

Mould design and milling.

Part ready for shipping.

protomold®
Injection Moulding Service

Receive order confirmation with gate and ejector layout. Approve.

Part production.

1-15 Days

Check out our video design tips!

It's easy to work with Proto Labs. Just upload your 3D CAD model and choose the best process for your project: CNC machining in 1–3 days or injection moulding in 1–15 days. Real parts in real materials, in days—not weeks. And that's the real story.

proto labs®
Real Parts. Really Fast.™

Rapid Prototyping Technologies

Visit **www.protolabs.co.uk/parts** today to receive your FREE copy of our comprehensive comparison of rapid prototyping technologies. Enter source code EUEU13

Call **+44 (0) 1952 683047** or visit **www.protolabs.co.uk**

Material intelligence

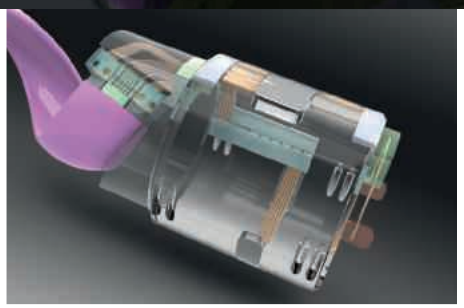
Electronic intelligence is being incorporated into polymer materials to bring to market the next generation air-to-air refuelling system. Justin Cunningham reports.

The integration of smart electronic systems into materials is slowly moving from the world of Formula One to more robust aviation applcations. This can be seen in a new, next-generation, air-to-air refuelling system.

Icon Aerospace, a specialist in engineered polymer products and a leading supplier of refuelling hoses to Tier 1 suppliers and air forces across the globe, has developed a key enabling technology to create the first 'Intelligent Connector' for in-flight refuelling.

The IconIC hose system draws on the company's pioneering approach and technical innovation in mechatronics and polymer-to-polymer technology, to safely and securely accommodate power with telemetry cables and fibre-optics for data transfer – something previously considered unattainable.

This provides for a range of key control and communication functions to take place between a tanker and receiver aircraft while the receiver aircraft undergoes mid-air refuelling. The technology is able to play a key role in enabling precise, remote positional control of the refuelling hose, particularly appropriate as the use of unmanned combat air vehicles (UCAVs) and autonomous unmanned aerial vehicles (AUAVs) continues to grow. The



integration of data transfer capability allows for diagnostics, reprogramming and a host of other functions.

Calvin Tan, chief technology officer of Icon Aerospace, says: "The IconIC refuelling hose system opens up a whole array of possibilities for functions such as drogue location and hose positioning as well as computer diagnostics and on-board reprogramming.

The integration of power supply and data transfer capability heralds a new era in hose technology which, while developed for advanced flight systems, has applications across many markets including wind power generation, oil and gas and ship-to-aircraft."

At the end of the hose is an embedded termination collar that connects into a 'clamshell' user-defined interface, switchable in flight, into which a variety of functions can be integrated depending on user requirements.

Tim Pryce, chief executive of Icon Aerospace, says: "Icon has consistently invested in technology and particularly in aerospace applications. We are all immensely proud of this innovation, which is being extremely well received by the major global players in the sector."

Icon has more than 60 years' experience of in-flight refuelling component technology, development and manufacturing. The company has always been at the forefront of innovations in materials, processes and mechatronics, meeting the exacting standards set by integrators and Tier 1 suppliers. Icon's Flexiflow products are currently widely established as the refuelling systems of choice for leading tanker platforms across the globe.

The company also currently produces Flexiflow, and in-flight refuelling hose. Icon Polymer has designed and manufactured safety-critical in-flight refuelling hoses for military applications for over 30 years. During this time, it has worked in close partnership with end-users and suppliers to deliver solutions that optimise weight, durability and flow rate within the restricted confines of an aircraft.

www.iconpolymer.com

Multiple heads are better than one

Train carriages and other critical constructions achieve benefits from multi-head friction stir welding. Tom Shelley reports.

Improved integrity, overall weight and cost savings are now being routinely achieved by using multiple head friction stir welding (FSW) in the manufacture of aluminium alloy railway carriage bodies.

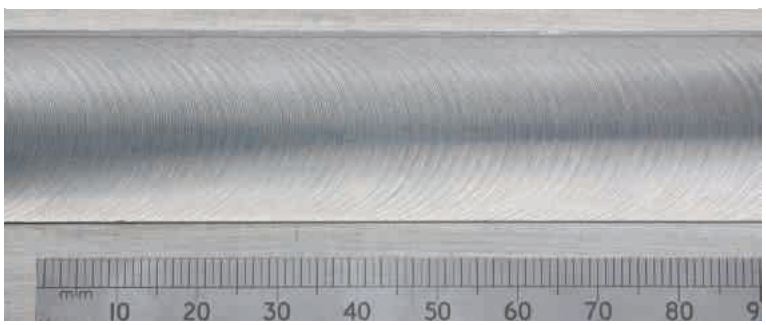
Friction welding, whereby two metals are joined by rubbing them together has been known for decades. Friction stir welding on the other hand, whereby one or more rod end tools rotate in a substrate softened but not melted by the heat, was only patented as a means of joining sheets of metal by TWI in 1991.

Subsequently, the idea of using two contra-rotating tools was devised, one above and one below the sheet join, with one slightly displaced in the direction of travel relative to the other. This offers advantages that include reducing reactive torque, producing a more symmetrical weld and generating a full, through-thickness joint. The tools should not touch each other but should be sufficiently close that the softened material around the tool tips overlap.

One of the most striking successes in the use of FSW is its suitability for successfully making very long, butt seam welds in aluminium railway carriages. Most aluminium alloys owe their strength to the formation of very small precipitate particles in the matrix. Traditional welding techniques that involve melting the material take these precipitates back into solution in the weld pool. This causes growth of precipitate particles in the heat-affected zone, which drastically reduces strength.

Friction stir welding, because it requires only the brief softening of the alloy, is much less problematic. The end result of this is that the tensile strength of the weld can be within a few percentage points of the parent material, while the fatigue strength is very similar and the fracture resistance at least as good.

Multi-head, friction stir welding has proved particularly successful in making long, butt seam welds in aluminium railway carriages



Friction stir welding of train carriages was pioneered by Hitachi in Japan, although it has since been taken up by companies in many countries. More than 376 friction stir welded carriages have, for example, been ordered from Bombardier for the latest upgrade of London's Victoria underground line.

The process is used to join stiff longitudinal extrusions, which constitute the carriage body's side walls. The welding has been sub-contracted to Swedish supplier Sapa Profiler, which holds a TWI friction stir welding licence. TWI says that FSW is likely to be used on future contracts for more than 2200 more new trains over the next decade.

Aluminium train carriage bodies reduce weight and the amounts of energy needed to accelerate and decelerate them. They also cut rail wear.

FSW is also appropriate for aerospace, commercial ship building and automotive applications. TWI says that there are currently more than 170 licence holders worldwide, with the greatest take up in Japan. Wayne Thomas, who with colleagues, published the first

article about TWI's simultaneous multi-tool developments, claims that Hitachi is already using some of these techniques, as is Sapa.

The original paper also describes a number of other variants, some of which are believed to be in commercial use. One such variant involves a machine with a series of contra rotating tools, side by side able to make a number of butt seam welds in parallel.

Another idea that has been investigated at length by TWI is the use of one tool that pre-heats and another to weld. This is known to have been used elsewhere for lap welding steel plates. In this instance, the tools were being rotated in the same sense.

TWI has investigated three variations involving tools rotating in opposite directions. One of these is to have two tools side by side, transverse to the welding direction. Another is to have two tools in line in the welding direction, while a third has the tools staggered to ensure that the edges of the weld regions partially overlap.

The first variant, which TWI calls, 'Parallel twin-stir', enables defects associated with lap welding to be positioned between the two welds.

The second variant, 'Tandem twin-stir', reduces reactive torque. It also improves weld integrity by having the following tool disrupt and fragment any residual oxide layer remaining within the first weld region. The second tool travels through already softened material and does not have to be as robust as the first.

The third variant, named, 'Staggered twin-stir' produces an exceptionally wide common weld region. The tools are positioned with one in front and slightly to the side of the other so that the second probe partially overlaps the previous weld region. In lap welds, the wide weld region produced provides greater strength than a single pass weld.

Residual oxides within the overlapping region of the two welds are further fragmented and dispersed. One particularly important advantage of the staggered variant is that the second tool can be set to overlap the previous weld region and eliminate any plate thinning that may have occurred in the first weld.

Trials at TWI produced welds of good appearance using plates of Aluminium 6083-T6 alloy. The two exit holes weld showed that a similar footprint was achieved for both the lead and following tool.

Metallographic observations revealed a marked refinement of grain size in the weld region and comminution of oxide remnants and particles. This is consistent with the microstructure features previously observed in conventional rotary stir welds in aluminium alloys.

www.twi.co.uk
www.hitachi-rail.com
www.sapagroup.com

Friction surfacing, joining to ceramics and Bobbin stir welding

Two more variants of friction stir welding that are becoming increasingly popular are friction surfacing, where the rotating tool is a consumable that is spread on the surface, and Bobbin stir welding, where the tool goes right through the parts to be joined, so there is no need for an anvil support plate.

Friction surfacing is mainly used to apply a metal coating to a metal substrate. The coating material can either be used as is, as a coating that can be extruded with the substrate, or as a joining material.

The surfacing material generally has a lower softening temperature than the substrate, but any increase in temperature differential enhances the deposition mechanism and allows comparatively harder materials to be deposited onto nominally softer materials.

The substrate need not necessarily be metal and some years ago TWI developed an aluminium pin that had been friction welded onto an alumina ceramic wafer in order to ease fastening problems.

This development subsequently led to the development of a process whereby aluminium conducting tracks can be laid down by friction onto an alumina substrate. In tests, the aluminium consumable was 3mm in diameter, the same diameter as the pin attachment.

Aluminium becomes plastic at about 300°C, and TWI has had no trouble is laying down tracks less than 50µm thick. Examination of the cross sections of the joints between the aluminium and the ceramic show some mechanical keying. TWI says that from adhesion tests, bond strengths are excellent.

Bobbin stir welding comes in two flavours: fixed gap, and 'adjustable' or 'adaptive', which pertains to the spacing between the shoulders.

A variant of the fixed gap is the 'floating bobbin' tool, which is a fixed-gap tool that has is able to float in the direction perpendicular to the workpiece.

The self-reacting principle of the bobbin technique means that the normal down force required by conventional FSW is reduced or eliminated.

Most of the research developments at TWI to date have involved aluminium alloys, which reflect the biggest present day commercial applications. It should be borne in mind, however, that friction welding works with almost any metal alloy that softens at temperatures that are not especially high.

John Guest®

The Push-fit People

INNOVATIVE PUSH-FIT SOLUTIONS FOR OEMS

Made in the UK.

Over the last 50+ years, John Guest has worked closely with OEM design engineers to offer highly innovative and high quality push-fit technology solutions to their products, adding greater value by simpler Installation

info@johnguest.com
www.johnguest.com

EST. 1961
AS BRITISH AS THE DAY IT WAS BORN

Your global trusted partner in **bolt optimization**

The Nord-Lock Group is a world leader in bolt securing systems. We offer a unique combination of bolting expertise and a wide product range, including wedge-locking solutions and Superbolt tensioners.

Our mission is to safeguard human lives and customer investments by securing the world's most demanding applications.

NORD-LOCK®
Bolt securing systems

TÜV SÜD

Nord-Lock Ltd • Tel +44 (0)198 084 7129 • Fax +44 (0)198 084 7674
enquiries@nord-lock.co.uk • www.nord-lock.com

Power from powder

With certain additive manufacturing processes now qualified for use on aero engines, Paul Fanning looks at an early example of this application.

If one were to choose an industry sector whose acceptance of additive manufacturing would seem to signal its arrival as a fully-fledged production technology, aerospace would probably be top of the list. This is because its safety-critical nature makes it understandably risk-averse and relatively slow to adopt new technologies. Thus, to become accepted, a process must be proven thoroughly and under the most rigorous tests possible.

Thus, the qualification of both laser and Electron Beam Melting (EBM) processes in September 2012 for use on aero engines represented a highly significant step forward for additive manufacturing. One of the first companies to capitalise on this is Italian aerospace manufacturer Avio, which is now manufacturing turbine blades in Titanium Aluminide (TiAl).

TiAl has a density of 50% compared to current alloys, but it is rarely used in engines due to being very difficult and expensive to cast. Avio, however, has shown that blades of different configurations and sizes can be manufactured in TiAl by using EBM.

EBM is a type of additive manufacturing for metal parts. The technology manufactures parts by melting metal powder layer by layer with an electron beam in a high vacuum. Unlike some metal sintering techniques, the parts are fully dense, void-free, and extremely strong.

This solid, freeform fabrication method produces metal parts directly from a metal powder. The EBM machine reads data from a 3D CAD model and lays down successive layers of powdered material. These layers are melted together using a computer-controlled electron beam, thus building up the parts.

The process takes place under vacuum, which makes it suited to the manufacture of parts in reactive materials with a high affinity for oxygen such as titanium.

No additional treatment

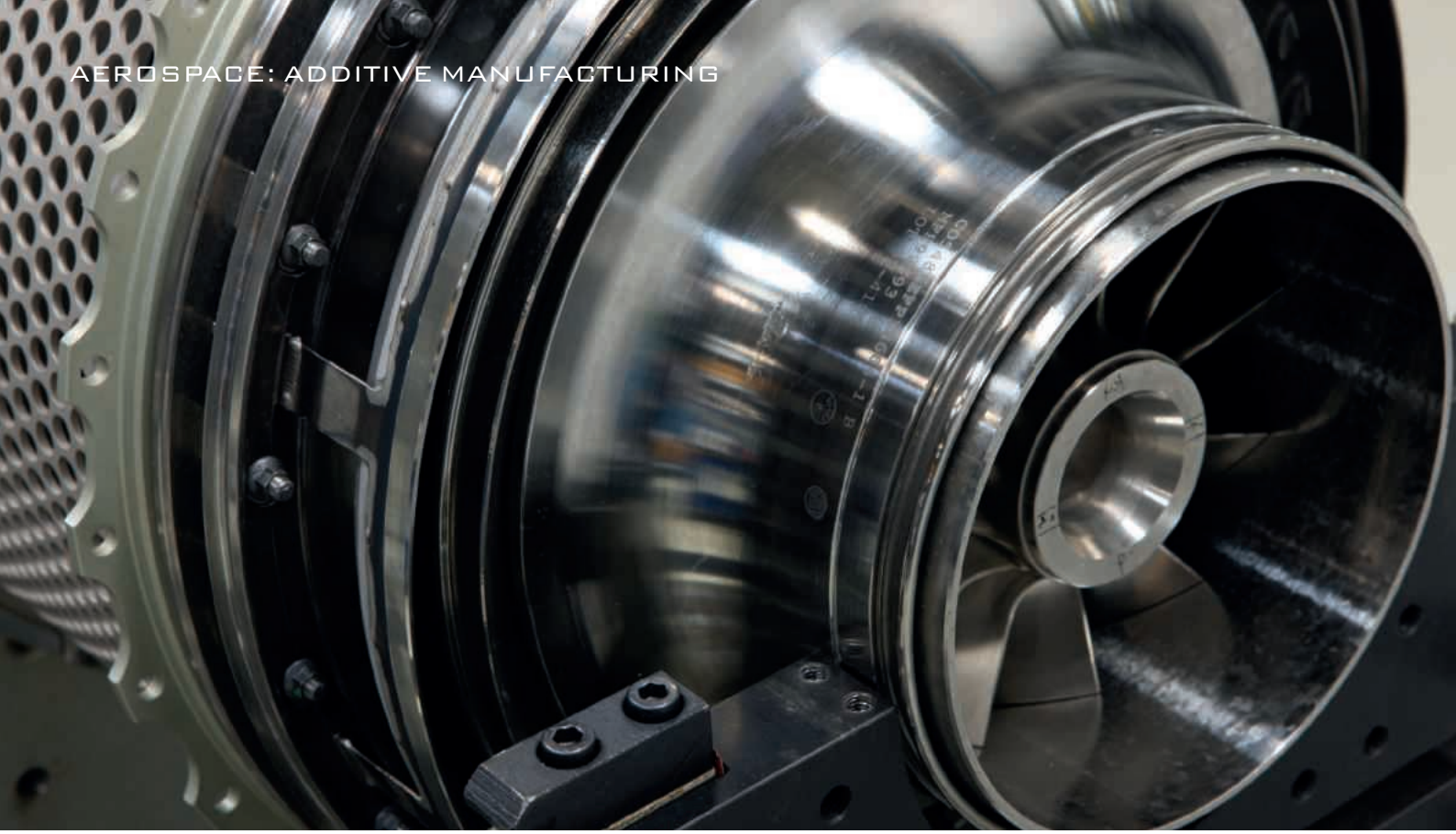
The melted material comes from a pure alloy in powder form of the final material to be fabricated – there is no filler. For that reason, the electron beam technology doesn't require additional thermal treatment to obtain the full mechanical properties of the parts. This aspect allows classification of EBM with selective laser melting (SLM), whereas competing technologies like SLS and DMLS require thermal treatment after fabrication. Compared to SLM and DMLS, EBM has a generally superior build rate because of its higher energy density and scanning method.

The EBM process operates at an elevated temperature, typically between 700 and 1 000°C, producing parts that are virtually free from residual stress, and eliminating the need for heat treatment after the build. The melt rate is up to 80cm^3/h., Minimum layer thickness is just 0.05 mm (0.0020 in), while the tolerance capability is +/- 0.2 mm.

Above: Italian aerospace manufacturer Avio is using Electron Beam Melting for the manufacturer of turbine blades in Titanium Aluminide

Additive manufacturing offers a number of particular commercial benefits to the aerospace industry. Not the least of these is the fact that in the aeronautical sector, what is known as the 'buy-to-fly' ratio – or the weight of raw material required to make one kilogram of finished product. This can reach as high as 15 or 20:1 for many flying components due to complex geometries adding a lot of cost. The EBM process, by contrast, offers an opportunity to produce lightweight titanium components with a Buy-to-Fly ratio close to one.

Another significant advantage to aerospace manufacturers and designers conferred by the additive manufcaturing process comes about because, by the nature of the process, no complex tools are needed and everything takes place under the strict control of a software



programme. The fact that fewer tools are needed of course means greater speed, lower costs, and ease of repeatability. Equally, much lower levels of manning are required.

However, there are also a number of advantages from a design perspective, These include much greater freedoms in areas such as geometry and in the ability to select more complex materials.

Perhaps most crucially, however, additive manufacturing offers designers the freedom to change a design during development without any negative impact on cost and timings. It also enables them to create completely new and innovative lightweight designs using advanced lattice structures.

Of course, additive manufacturing process are particularly useful where production volumes are relatively low, part geometries are complex, or materials used are expensive or difficult to process by conventional means. This again means that it is particularly well-suited to the aerospace industry.

Additive manufacturing is particularly useful where production volumes are relatively low, part geometries are complex or the materials expensive

As well as offering though, potential cost and time savings in production and design, though, additive manufacturing is also a more environmentally-friendly manufacturing process than many alternatives. This is because no materials are wasted, it creates less pollution and consumes less energy. Indeed recent comparison between so-caled 'e-manufacturing' and traditional technologies on a titanium component weighing one kilogram saw 95% less titanium used, 90% less greenhouse gas emissions and 90% less energy consumption.

These are the reasons why Avio believes in additive manufacturing for aerospace and why it has invested heavily in the process since 2007. As the first company in the sector to have personnel, machinery, processes, software and materials fit for reliable and repeatable production, it is also the first company to produce turbine blades in titanium aluminide (TiAl) using additive manufacturing – currently being used in the GenX engine powering Boeing's 787 Dreamliner.

In 2013, Avio will unveil its new plant in Cameri, Italy. This will be the company's Centre of Excellence for all addtive manufacturing technologies. This will involve 2,000m^2 of advanced technologies located only a few metres from the Italian Air Force's major logistical centre. This year, Avio will begin serialised production of aeroengine components, demonstrating how it can create 'power from powder'.

This process has taken place with the help of machine manufacturer Arcam, which developed the unique EBM additive manufacturing process with its ability to provide a combination of high productivity, excellent material properties, high resolution and good surface finish.

Arcam's A2 machine is described by the company as "the ultimate solution for Additive Manufacturing for the Aerospace and Defence industries", being specifically designed for manufacturing of large, complex metal parts from a range of different materials.

A robust production platform, The Arcam A2 is delivered with two interchangeable build tanks, one for wide builds and one for tall builds. It also comes complete with MultiBeam parameter themes and the latest and most modern software, the EBM Control 3.2.

www.aviogroup.com
www.arcam.com

Product Design Engineer

Location: Hampshire
Type: Permanent
Salary: £30k-£40k per annum

Job Details:
This company – with a varied product offering, manufactured with a range of CNC and other machinery – is looking to recruit an experienced Design Engineer.

Key Responsibilities to include:
- Design products right through from brief formalisation to full production, using SolidWorks CAD
- Understand and gain ongoing knowledge of relevant British standards, and ensure products developed are compliant to standards and current legislation
- Production of process/assembly control instructions
- Maintain and gain accurate knowledge of best manufacturing process solutions.

Experience and Skills to include:
- HNC or equivalent in Product Design Engineering
- Innovative and highly practical
- Experience in designing industrial outdoor electrical/lighting products
- Proficient in SolidWorks CAD
- Excellent PC skills (Word/Excel/Outlook).

For full details online, enter reference: ProdDesEng010213

Internal Sales Engineer

Location: Abingdon, Oxfordshire
Type: Permanent
Salary: Competitive

A vacancy has arisen for an Internal Sales Engineer based at Abingdon.

Reporting to the Engineering Manager, the successful candidate will be responsible for providing both commercial and engineering support.

Other duties will include the responsibility for customer quotations, hydraulic system design and support to both internal and external sales and service personnel.

The successful candidate will be qualified to either a degree or HND level in engineering, with knowledge of the hydraulics industry, have a good commercial understanding, know how to develop new business and be prepared to make customer visits.

For full details online, enter reference: SaleEng010213

Assembly Technician

Location: Leatherhead, Surrey
Type: Permanent
Salary: £20k-£23k per annum

This manufacturer of scientific instrumentation (Spectrometers) for research purposes is seeking an Assembly Technician, with City & Guilds level 1&2&3, or Apprenticeship in Mechanical and/or Electronic Engineering.

Must have experience in mechanical assembly, probably in the instrumentation field, and ideally from working with optical components. Good methodical, meticulous work routines and consistent high standard of work. A flexible, positive attitude to the work, and good team skills are also essential.

Must speak clear and fluent English. Candidate would form part of a small team in the production department.

Primary roles:
Assembly and test of instruments to despatch status
Following written procedures and quality management system (ISO9001). Must be familiar with using PC based software. Some light electrical wiring skills.

For full details online, enter reference: AssTech010213

LASCAR electronics

ELECTRONICS DESIGN ENGINEERS
£35K - £40K

Lascar Electronics Ltd is a leading provider of digital panel instruments, data loggers and custom design & manufacturing solutions. Our group HQ is located in a pleasant rural environment close to the New Forest with facilities in Hong Kong and the U.S.A.

Due to expansion, we require experienced Electronics Design Engineers. The role involves all aspects of product design, development and technical support. Applicants will have a good knowledge of analogue electronics, digital design and experience of developing embedded firmware in C. They will possess a suitable qualification in electronics and have extensive design experience. Experience of ADCs, interfacing sensors, EMC techniques, PCB CAD layout and writing efficient code in C & C++ is an advantage.

A competitive salary and benefits package, with opportunities to visit our overseas offices, awaits the right candidate. Career development within our Group is actively encouraged.

Applicants will be based locally and possess their own transport. Applications including full CV and salary expectation to:

Lascar Electronics Ltd, Module House, Whiteparish, Salisbury, SP5 2SJ

Or e-mail: ***personnel@lascar.co.uk***

Let us spray

Spray nozzles for cleaning fluids cause a lot of accidents to young children. So how can they be made more child-resistant?

The answer to last month's Coffee Time Challenge, how to improve on the white cane for the visually impaired, is in our Technology Briefs section on page 9

Child-resistant caps on bottles of cleaning fluids such as bleach are widely accepted as an effective means of preventing children (not to mention a high proportion of adults) from accessing their potentially harmful contents.

Less effective in terms of child safety, however, are the nozzles of spray bottles. These bottles often contain equally harmful ingredients to their equivalents in conventional bottles but, rather than a genuinely child-resistant cap, they usually only have a nozzle that controls the stream configuration or closes the spray bottle. These nozzles cannot be truly said to be child-resistant, not least because the nozzles themselves a relatively easy for young children to manipulate on their own. Equally, such nozzles are only effective if the user turns the nozzle back to the 'closed' or 'off' position after each use. And, since the a pilot study has found that 75% of the nozzles on the cleaning product spray bottles were not left in this position, it is therefore reasonable to conclude that these bottles posed a potential hazard to young children in the household.

Quite how serious this problem is can be seen in a 2010 study from US organisation Nationwide Children's, which revealed that spray bottles were the most common source of exposure to injury in an estimated 267,269 children of five years of age or younger treated in U.S. emergency departments for household cleaning product-related injuries between 1990 and 2006.

The Challenge

Clearly, then, the challenge is to come up with a spray mechanism that is both safer (ie extremely challenging for young children to operate), yet will allow adults comfortable use. At the same time, it needs to provide a safety mechanism that is not subject to human error, but instead takes effect automatically as part of general use.

Of course, it is possible to introduce any number of complicated mechanisms that would prevent a child using such spray bottles. After all, anything up to and including a combination lock could be introduced, but this would be both impractical (after all, how many people forget the combination for the locks on their briefcase or suitcase?) and add hugely to the cost of what are ultimately disposable items of packaging.

The solution we have in mind is a mechanism that offers much greater security, but does not impinge on the usability of the spray bottle for most adults. However, there is nothing to say that you cannot come up with something better.

Adhesives

Radically Improved Instant Adhesive

Loctite 3090 is a clear, two-part cyanoacrylate that increases the versatility of instant adhesives. Alongside traditional benefits, 3090 allows exposed adhesive outside of the joint to harden within minutes – removing the need for a post-assembly activator. Gap sizes up to 5mm are readily accommodated and the gel viscosity means it's suitable for vertical or overhead application.

It can be used on plastic, rubber, wood, stone, leather, fabric or metal and can withstand a force of 20N/mm². Easy to use, 3090 comes in a pack containing a dual syringe with seven mixer nozzles – and no application gun is required.

@: technicalservice.loctite@henkel.com
✆: 01442 278100

www.loctite.co.uk/3090

Coatings

WS2 Stops galling of SS and Titanium

Stainless Steels and Titanium are both prone to galling and seizing. WS2 is a very low friction dry lubricant surface treatment, developed by NASA for use in deep space. It has been shown to provide a very cost effective solution, preventing both problems on threads and other sliding surfaces.

WS2 works well from -273° to 450° C and down to 10-14 Torr. WS2 has been applied to bearings and gears to extend life.

Design Out maintenance problems with WS2!

@: sales@ws2.co.uk
✆: 01430 861222

www.ws2.co.uk

Educational Experience

Sapa Profile Academy

In recent years, aluminium has become an increasingly popular material for use in a whole host of different applications and solutions. However, knowledge of aluminium and the possibilities of the profile and in particular die design remains relatively low. Sapa Profiles have responded by creating their bespoke educational experience, the Profile Academy. The next Academy will take place on 26-27th March at Sapa's Redditch and Cheltenham plant.

Sapa Profiles have developed their Profile Academy, with the sole aim of raising skills and knowledge of the material. The educational course covers two days with a chance to meet Sapa design engineers as well as attending workshops and lectures with experts.

The course gives training on how to design the optimum profile solution and in turn, gives companies that attend a competitive advantage.

@: sapa@shawandunderwood.co.uk
✆: +44 (0) 1773 872 761

www.sapaprofiles.com/uk

Hot Air

www.welwyntoolgroup.co.uk

Inserts

Spirol's Pin Insertion Technology Provides Solution for Surgical Tool Manufacturer

Spirol Industries has come to the assistance of a manufacturer of surgical tools looking for a means to automatically install a miniature pin, less than ø2 mm outside diameter and 10 mm long. The pins were proving very difficult to manipulate by hand and to meet specific clean room process specifications, Spirol recommended instead the use of a standard Pin Insertion machine, customised to meet the specific application needs of the customer.

The pin to be inserted would ultimately be used in the human body and therefore there were strict cleanliness requirements to prevent any risk of contamination. For example, the pin could not come into contact with epoxy paint or steel during the installation process. Therefore all the parts of the Spirol Pin Insertion machine which would be in direct contact with the pin had to be manufactured from a specific list of materials and finishes.

@: uksales@spirol.com
✆: +44 (0) 1536 444800

www.spirol.com

Rotary Atomiser

Fine Droplets without High Pressure

The small electric rotary atomiser produced by Newland Design is an efficient way of creating small, consistently-sized droplets by means of high-speed rotation alone, without need of compressed air or any high pressure.

The Newland Atomiser rotates a small porous plastic cylinder at speeds up to 35,000 rpm and emits droplets of less than 40 micrometres in diameter.

Applications include:

- Humidification, Moisturization, Evaporative Cooling
- Gas scrubbing and Odour Control
- Dust suppression
- Emulsification.

Flow rates up to 20 litres per hour. Power input 10 - 25 Volts DC, consumption less than 40 Watts. Evaluation units always available.

@: newland.design@btconnect.com
✆: 01524 733 424

www.newlanddesign.com

Relief Valves

Bifold, Official Partner of the Marussia F1™ Team have linked Safety with Performance to provide the widest range of relief valves for pneumatic & hydraulic applications

Bifold provide the widest range of relief valves for pneumatic and hydraulic instrument applications.

Our relief valves are suitable for safety applications.

The Bifold pneumatic relief valves have a very high flow and low dead band. The relief valves are a safety device designed to match Bifold's high flow filter regulators. The device will limit the over pressure to less than 110% of the set point in the event of a filter regulator mis-operation.

Bifold precision relief valves have very high sealing forces along with accurate and narrow dead bands allowing system design pressure to be reduced.

Precision relief valves should be used in preference to sprung relief valves where there is a risk of vibration induced leakage or where dead bands are important to system performance. Sprung relief valves typically will have a narrow dead band when tested on a static dead weight tester but will have a much wider dead band under flowing conditions that will require a significant drop in system pressure to enable the valve to reseat.

For innovative and reliable valve solutions, visit our website www.bifold.co.uk.

@: marketing@bifold.co.uk
✆: +44 (0) 161 345 4777

www.bifold.co.uk

Andy Fulcher
Elite Applications Engineer

"Not only did Andy have a great understanding of the Simulation package, but it was refreshing to have someone who also had an in-depth knowledge of the core problem – structural mechanics."

Adam Willmott, Managing Director, Ithon Engineering.

"TEST IT IN SOLIDWORKS. SPEND LESS ON DEVELOPMENT AND BE FASTER TO MARKET."

Affordable, integrated software for rigorous function simulation.

Easy to learn and use, supported by our industry-leading team of SolidWorks Applications Engineers.

SOLIDSOLUTIONS

For leading 3D CAD design software, and all-round user support – we're Solid.
Find out more on 01926 333777

www.solidsolutions.co.uk/support SOLIDWORKS reseller of the year 2004 – 2011