THE ELECTRON

NEWSLETTER OF THE INSTITUTION OF ELECTRONICS

Issue 38: Summer 2018

MANUFACTURING EXTRAVAGANZA IN BIRMINGHAM

What was billed as a "manufacturing extravaganza" took place at Birmingham's National Exhibition Centre from 9th to 13th April with six related exhibitions each taking place simultaneously. Of these MACH 2018 was by far the largest with 560 exhibitors.

Opened by Sir Ben Ainslie, Olympic Sailing Gold Medallist and leader of the Land Rover BAR Team, the seminar programme included an update on the Bloodhound Project in which BLOODHOUND SSC will attempt to break the 1,000 mph land speed barrier on a dry lake bed at Hakskeen Pan, South Africa, in October 2018, plus presentations on '3D Printing: Unlocking the Digitalisation of Manufacturing', 'Virtual Machining and Robotic Assisted Machining', 'Measurement 4.0: How Measurement Technology contributes to a New Era of Digital Manufacturing', 'Avoiding the Pitfalls of Industry 4.0: Lessons from the Leaders', 'Designing, building and using the World's largest Metal 3D Printer: A 10-metre Dual-robot Monster', 'The Changing Face of Manufacturing in a Digital Age', and 'Additive Manufacturing: The National Strategy illustrated by the Challenges and Opportunities of using AM in Medical Applications'.

In welcoming delegates and visitors to the event The Manufacturing Technologies Association stated:

'This year a number of Zones have grown significantly including those for Additive Manufacturing and 3D Printing, Sheet Metal Working in the MMMA Zone, Industrial Lasers and IT for Manufacturing.

The Manufacturing Technologies Association has partnered with the AMRC Factory 2050 to produce a great feature entitled "Digital Meet Manufacturing". This glimpse of Industry 4.0 and the factory of the future may just change your perception as to what is possible.'

Supporting Exhibitions

Of the supporting exhibitions Smart Industry Expo (the future of integrated automation) had perhaps the most relevance for the electronics professional. In welcoming attendees Steve Brambley, Chief Executive of GAMBICA, the UK trade association for instrumentation, control, automation and laboratory technology, commented:

"Hello and welcome to the Smart Industry Expo, a future-facing event that looks at the latest concepts and systems available in smart manufacturing and industry.

The word 'smart' is useful shorthand for technology with greater intelligence, flexibility and usability, but it also covers greater integration of business systems, employees and the supply chain. That is why we are seeing the market evolve to bring together players in automation, IT, logistics, energy and security.

GAMBICA is delighted to be supporting the Smart Industry Expo and we share the same objective to raise awareness of the revolutionary opportunities that this technological leap can bring."

Smart Industry Expo had around 40 exhibitors. The other supporting exhibitions were Air Tech 2018 (40 exhibitors), Drives and Controls 2018 (124 exhibitors), Fluid Power and Systems (98 exhibitors), and Plant and Asset Management (28 exhibitors).

Below we present some of the highlights along with topical subjects from popular journals that were promoted at the events.

SMARTER FUTURES

Controls, Drives and Automation magazine have recently published a supplement with the above title, sponsored by Rexroth Bosch Group, Festo GB, Parker and Sick Sensor Intelligence, that provides a variety of perspectives on Industry 4.0.

Attitudes to Industry 4.0

In the first article the publication's Editor, Charlotte Stonestreet, presents the results of the *Controls, Drives and Automation* Attitudes to Industry 4.0 survey. This revealed that while 40 per cent of respondents said that they were either very aware or moderately aware of Industry 4.0, 27 per cent stated that they were not very aware, and a third (33 per cent) were not aware at all. With respondents coming from sectors such as Aerospace and Defence (10 per cent), Chemical and Pharmaceutical (17 per cent) and Manufacturing (20 per cent), the author described this discovery as "worrying" as here there should be "at least a basic understanding of Industry 4.0 and its importance in remaining competitive in an increasingly globalised marketplace".

The next question asked participants how important they felt Industry 4.0 was to the UK economy and here results showed that 30 per cent believed that it was very important, 47 per cent thought that it was moderately important, 7 per cent considered it to be not very important, and 16 per cent felt that it was not important at all. These results were then compared with the findings from the third question, i.e. how important participants felt Industry 4.0 was to their business. Here 20 per cent saw it as very important, 43 per cent viewed it as moderately important, 20 per cent not very important and 17 per cent thought that it was not important at all.

The author notes particularly that fewer respondents considered Industry 4.0 to be important to their business than felt that it was important to the UK economy. She then poses the question "if it is not important for them, then who is it important for?"

It is then noted that 83 per cent of respondents believed that it would be as or more important in the future which "seems to indicate an acknowledgment of the potential of Industry 4.0 and all that it brings in terms of digitisation, connectivity and big data".

With many of the technologies associated with Industry 4.0 predating its launch in 2011 as 'Industrie 4.0' in Hannover, the author suggests that it is tempting to assume that Industry 4.0 practices would be quite widely applied in the UK by now, but the survey suggests otherwise with zero respondents actually working in operations where Industry 4.0 technologies are used across most parts of the business. The 63 per cent that stated that their businesses do not use Industry 4.0 technology and had no plans to do so was described as "a worryingly large proportion".

The next element of the survey asked which businesses participants felt Industry 4.0 had a role in and here maintenance was top with 30 per cent. Manufacturing polled 27 per cent, Logistics 13 per cent, Safety 13 per cent, and ERP 7 per cent. No respondents, notably, cited robotics and automation, suggesting "a lack of education and knowledge about Industry 4.0".

As part of the survey participants were asked about their awareness of various technologies and trends associated with Industry 4.0. Here 33 per cent were aware of Big Data, 35 per cent were aware of the Industrial Internet of Things (IIoT), 60 per cent were aware of smart technology, and 23 per cent were either aware or moderately aware of IT/OT convergence. There was, however, just 3 per cent very aware of the Digital Twin, and no respondents at all were aware of Batch Size One. Both of these are important topics and in order to educate readers, a description of each is included by Ms. Stonestreet.

The Digital Twin

The concept of the Digital Twin has existed for about 15 years, but it is only with the development of Industry 4.0 and IIoT that it has become cost effective. The article describes the concept as follows:

'Essentially a virtual model of a process, a digital twin, brings together the virtual, or cyber, world with the physical, enabling systems to be fully evaluated before they are put in place. Data analytics prevents problems before they occur in "real life", reducing downtime and helping to develop new opportunities and plan for future output using simulations, as well as greatly improving speed to market.

To bring a digital twin to life smart sensors are used with a physical component to gather data about real-time status, working condition and position. The components are connected to a (usually) cloud-based system that receives and processes the data, which is analysed against business and other contextual data. The lessons learned in the virtual world can then be applied to the physical world.'

In manufacturing this knowledge is valuable because it can serve as a replica of what is happening on the factory floor in near real-time:

'Over a period of time, analysis can help uncover unacceptable trends in performance of the physical equipment, triggering an investigation and adjustment of the process as appropriate. It can also aid greatly in enhancing production line flexibility; each time a different item is produced the process can be fully simulated on the digital twin and any issues resolved prior to real-world implementation.

In addition to production line applications, examples of where digital twins have been used to great effect include the simulation of specific complex deployed assets, such as jet engines or mining trucks, in order to monitor and evaluate wear and tear and specific kinds of stress the asset comes under in the field.'

It is estimated that within three to five years billions of things will be represented by digital twins and this proliferation will require a cultural change:

'Digital twins of physical assets combined with digital representations of facilities, environments, people and processes will enable an increasingly detailed digital representation of the real world for simulation, analysis and control.'

Batch Size One

This concept relates to mass customisation whereby individual customers ordering online can configure a product to their own specified needs. The item is then manufactured, along with other items, on a flexible, highly automated production line that can respond to many different product iterations.

The author states:

'While this may sound futuristic, with today's consumers more and more often demanding something that is individually designed just for them, there are already plenty of real-world examples of the batch size one model in operation.'

An example is NIKEiD, through which trainers can be custom designed via a website, or ordered via NIKEiD Direct audio in Niketown London where colour and material selections are projected onto a shoe to provide a clear, immediate representation of the final product.

Ms. Stonestreet concludes:

'Batch size one is always going to appeal to many manufacturers because, in addition to making its product offering more desirable, it also enables them to go direct to the consumer, without the added steps and costs of going through an e-commerce reseller or a bricks and mortar retailer.'

Driving the Production of the Future

In this article Steve Sands, Head of Product Management at Festo GB, explains how his company's research department is actively engaged in shaping the production systems of the future.

Projects include ENTOC (Engineering Tool Chain for efficient and iterative Development of Smart Factories) which aims to significantly reduce the time taken and complexity of planning the engineering process for a given production plant:

'The ENTOC project is looking at how factory processes can be "virtually" planned and optimised, for example, how sequences of processes can be optimised and programmed before they are actually implemented on physical machinery.'

Another project is ARIZ (Work in the Industry of the Future) which is examining safe human/robot cooperation in production plants:

'With ARIZ we are researching how humans can work on the same production lines as robots, but without the need for protective cages, with robots incorporating sensors that monitor their movements.'

Also described is the all-new Festo Motion Terminal, the first in the world to be controlled by apps:

'We believe that OEMs can improve their machine offerings by using the latest technology upgrades and cloud connectivity in Industry 4.0 host environments. The Festo Motion Terminal can be used to make pneumatics digital, more flexible and communicative. End users can improve their production through the use of cloud analytics to drive optimisation of business and production processes, higher operational energy efficiency by predictive maintenance and shorter downtime by better diagnostic support.'

Festo was an exhibitor at Smart Industry Expo and may be contacted on 0800 626 422.

Smart Sensors

The contribution by David Hannaby, Product Manager for Presence Detection for SICK UK, focused on the company's revolutionary W16 and W26 smart sensors with 'BluePilot' alignment:

'Sensor applications that use a reflector, or a transmitter and receiver, need careful adjustment - tricky especially over longer distances. If the light spot is not in the correct position it could lead to production failures or stoppages sooner or later.

The BluePilot assistant uses a line of five LEDs mounted on the top of the sensor for quick, easy and accurate alignment of the light spot even over longer distances. The blue LEDs also provide an ongoing visual status indication to verify that the sensor is still in alignment. Thus, both set-up and maintenance time is minimised.

SICK's patented Twin-Eye technology enables reliable detection for reflective materials, contrast-rich or uneven surfaces. Thanks to the Twin-Eye's unique second receiving channel, "belt-and-braces" process stability is built-in. Even when the light spot is deflected by a shiny or wavy surface, the light is reflected back onto both receivers.'

Another revolutionary feature is the OptoFilter:

'With SICK's revolutionary new OptoFilter on board, the W16 and W26 sensors are completely immune to interference from unwanted light sources, including LED lighting, which is increasingly common in factories, and "hi-viz" workwear.'

There is also no longer a requirement for the manual adjustment of sensors, which can be challenging especially on parts of machines that are difficult to reach.

SICK (UK) Limited was an exhibitor at MACH 2018 and is located at Waldkirch House, 39 Hedley Road, St. Albans, Hertfordshire AL1 5BN. Email: info@sick.uk

Simplifying Analogue Integration

Integrating analogue signals via a networked control architecture has traditionally been difficult and costly. Shielded outputs from analogue devices need to be handled outside the network and terminated to conventional I/O cards, whilst additional machine-mounted network blocks may be required in order to ensure that a sufficient number of analogue ports are available. These difficulties are compounded by the large variety of analogue signal types e.g. voltage, current and thermocouple.

In *Smarter Futures* the article 'IO-Link Hub simplifies Analogue Integration' explains how Drives and Controls 2018 exhibitor Balluff Limited has sought to overcome some of these problems through the introduction of a new I/O-Link analogue hub which makes the handling of analogue signals a 'plug-and-play' process.

The new eight-channel analogue measurement hub utilises IO-Link to bring all measurement data through an IO-Link master module and into the controller seamlessly via the existing industrial network.

The article quotes Balluff's Product and Marketing Manager for Industrial Safety, Russell Smith, as follows:

"The classical approach to analogue integration required either purchasing expensive, controller specific two or four-channel analogue-to-digital input cards or purchasing a specific network-dependent remote analogue module. Balluff's new IO-Link-based analogue hub eliminates the disadvantages of both of these approaches."

The hub expands the already substantial capabilities of the master to host multiple analogue devices over a single IO-Link port. Customers have the choice either to use dedicated IO-Link sensors or conventional analogue sensors to scale and fit their solution.

Balluff may be contacted on 01606 812 777.

INDUSTRY 4.0 AND CONNECTED COMPRESSORS

One of the main trends that is emerging and was evident at all of the Birmingham co-located exhibitions is the fact that Industry 4.0 is now becoming much more industry-wide and manufacturers generally are beginning to move away from merely talking about the theory. Many are now wanting to know how it will be applied in practice, as is pointed out by Stef Lievens, Business Line Manager for Compressor Technique Service Operations at Air Tech 2018 exhibitor Atlas Copco.

In his article 'Connected Compressors and Industry 4.0' in the 2017-2018 issue of *AirUser* Mr. Lievens highlights the International Data Corporation's estimate that by 2021 global IoT spending will be approaching $1.4 trillion with manufacturing leading the investment. Within this he notes that "compressed air will undoubtedly have a significant role to play in shaping the smart factories of the future".

He states:

"The concept of adding intelligence to air compressors by connecting and enabling them to communicate over the internet is not new. Atlas Copco already has over 100,000 connected compressors operating at more than 35,000 customer sites in the world. These compressors are delivering in excess of 150 data measurements per second. This is proving vital, on the one hand, in enabling data mining engineers to intelligently analyse performance patterns and, on the other, by helping design teams to apply the data in the development of new and more customer-suited compressed air technologies."

Recent advances have enabled compressor controllers to become connected to mobile devices, tablets and smartphones through systems such as SMARTLINK, which facilitates remote monitoring over a secure network:

"The end result is that operators can keep track of key parameters including pressure, flow, motor and dryer speeds and then make adjustments when necessary via a compressor's manual interface. This enables varying production demands to be accommodated and can help plant managers improve efficiency and save energy."

In the future the author envisages replacement of the final manual stage currently undertaken by compressed air operators by a technique in which the air compressors themselves track and make improvements autonomously as independent cyber physical systems.

Another major advance has been in the field of preventive maintenance with technology that combines hardware with customisable monitoring software. With this engineers can track indicators such as specific energy and compressed air pressure calculations remotely such that immediate improvements can be made when needed.

The author states:

"Knowing the status of compressed air equipment at all times is the surest way for plant managers and maintenance professionals to spot any developing problems, uncover potential savings and achieve maximum uptime of both compressors and the production lines they support. These insights can be realised through a remote data monitoring system."

This is illustrated with the following example:

"When a period of cold weather caused a cereal manufacturer's compressor to run at a particularly low ambient temperature, a remote data monitoring programme picked up warnings from the unit's electronic condensate drains and triggered a visit to the site by a service engineer. This early intervention saw the customer fit temporary heaters to prevent the drains freezing, which could have led to compressor element damage, condensate reaching the air network, and substantial breakdown costs."

Atlas Copco may be contacted on 0191 456 4990.

INDUSTRY 4.0 AND 5G MOBILE COMMUNICATIONS

The article 'Is Manufacturing ready for 5G?' by Steed Webzell in the March 2018 issue of *Machinery* provides an update on 5G, the fifth generation of mobile telephony, and discusses its potential impact particularly on robot communications in manufacturing.

The technology of 5G is noted especially for its ability both to move more data and for its lower latency, making it more responsive with the ability to connect a lot more devices simultaneously, including sensors and smart devices located inside robots.

The author states:

'Latency is essentially the time span between when an input is initiated at one point in a communications link, and when it returns with error-free input from another point. Current 4G cellular networks have a round-trip latency of about 50ms, but to enable applications like connected robotics, the 5G standard recognises that less than 1ms will be required.

Reports suggest that global 5G roll-out looks set for 2020. But the race is on and US telecommunications giant AT and T, for example, says it expects to be the first with mobile 5G when it launches a network in twelve cities by the end of this year.

The advantage of using a 5G connection is that response times are quicker, and there are no peaks and troughs like those associated with Wi-Fi or current 4G networks. In turn this could make robots safer. At present robots are equipped with an emergency stop button to prevent them from harming humans or causing damage'.

In Europe Nokia and Bosch are noted for their pick-and-place robots that can be controlled wirelessly over a 5G connection , with the low latency and high reliability of 5G providing the ability to stop machinery instantly once an alarm is triggered.

The links between 5G and Industry 4.0 are discussed, with better wireless connectivity making for a better factory platform, as reconfiguring assembly lines becomes simpler when equipment does not require a wired connection.

The author makes specific reference in this regard to the collaboration between automation specialist Kuka and China's telecommunications expert Huawei X Labs. These companies are currently working on the design of collaborative robots that use 5G:

'Live demonstrations have already been showcased, with a pair of robot arms performing dancing and drumming in precise synchronisation and collaboration. According to Kuka, the 5G live demonstration highlighted some of the capabilities offered by the technology, achieving latency as low as 1ms with 1μs clock synchronisation and 99.999 per cent reliability.'

The author quotes CEO of Kuka Robotics Stefan Lampa as follows:

"5G cellular wireless technology will enable Kuka to provide robot-based production systems with even more flexibility through wireless machine-to-machine and machine-to-cloud communication."

Also mentioned is the Memorandum of Understanding that has now been signed between Huawei and Festo (see previous article) to jointly explore 5G network applications in manufacturing and promote the digital transformation of the industry through the use of 5G slicing technology.

The author states:

'The MoU centres on 5G cloud robotics, which is based on a moving robot platform that consists of a handling apparatus (robot arm) with six degrees of freedom. An ultra Reliable and Low Latency Communications (uRLLC) slice is used to fulfil the real-time and high reliability requirements of the closed control loop.'

The article concludes with a discussion of the ongoing work of telecomms specialist Ericsson, both with ABB to establish a joint 5G industrial innovation laboratory, and with robotics company Comau on 5G enabled projects related to the development of services and solutions for Industry 4.0 and smart manufacturing.

The lab is located at ABB's premises at Vasteras in Sweden and uses infrastructure and network services from Ericsson, including connection to the company's 5G virtualised core network, edge computing (local/distributed cloud), network slicing and Ericsson's IoT accelerator platform. The lab network will be optimised for better performance (low latency) than current public networks and will support new access types for the IoT. Projects are planned in areas such as process and factory automation and robotics:

'According to Comau, the 5G telecomms move will help companies exploit the full potential of digital manufacturing in the UK and within Europe as a whole, thanks to real-time interconnectivity between mobile devices (smartwatches, smartphones, tablets), enabling technologies (augmented reality, cloud, big data and cyber security), robotics-driven production processes and machine intelligence. Increased computing power is a fundamental element of Industry 4.0 and, as such, mobile communications become essential to enable seamless connectivity between robots, operators and the factory at large.'

5G Applications for Machine Tools

A further collaboration, which is discussed separately, is that between Ericsson and Germany's Fraunhofer Institute for Production Technology, which is exploring 5G applications in the field of machine tools.

The ultra-low latency, high data rates and capability to operate a multitude of devices simultaneously in a cell makes 5G technology highly suited to deployment in networked, adaptive production facilities with extensive measurement and control engineering, because running precision machine tools in complex production processes requires extremely high standards for stability and reliability of communications

For the first time the extensive use of wireless sensor connections for real-time data analysis will be possible, ensuring that the adaptive control of production processes can be undertaken through short reaction times.

At the Fraunhofer Institute for Production Technology 5G will be developed and tested specifically for use in production. Engineers at the facility in Aachen are planning extensive deployment of 5G technology for a diverse range of applications in which machines, production and communications systems, and databases are interconnected.

ROBOTICS IMPROVE PACKING OF MILK TROLLEY SHELVES

Bedfordshire-based Mechelec Automation has developed what has been termed a 'revolutionary' milk packing system for the dairy industry that collates bottles of milk and uses a robot arm to pack them into shelved trolleys ready for delivery to supermarkets.

The TP1002 automated trolley packer can load two static trolleys simultaneously, providing twice the packing speed of conventional systems with a similar footprint. The packer also has the flexibility to switch between bottle sizes and product streams and to pack or palletise shrink-wrapped products.

The article 'Robot packs Milk Trolleys at twice the Speed' in the April 2018 issue of *Drives and Controls* explains how the system can handle a variety of bottle sizes and shapes, avoids compatibility issues arising from differing designs or damaged trolleys, and reduces the need for manual labour:

'It has halved the number of operators typically needed for the trolley-packing operation from four to two. It also loads the trolleys in half the time taken by four operators, enabling a higher product output. The system can load 240 four-pint bottles (in a 4x5 format) every minute at a speed of 1m/s.'

Stainless-steel linear guides supplied by HepcoMotion were selected for two axes of the packing machine:

'One set collates the bottles into the required "shelf" format (two shelves being collated at a time). The other pushes the collated bottles into the head on the ABB robot. The SL2 guides, which can handle loads up to 1,000kg, easily cope with the loads of 20kg, and the 40kg load when pushing into the robot head. The application uses 44mm and 76mm versions of the slides.

One attraction of these slides is that they can be fitted to a surface with minimal preparatory work. They have a high level of built-in compliance that enables consistent running along the whole length of a slide, even when the mounting surfaces are not exactly flat.

Another attraction is that when the system shows signs of wear, an eccentric adjustment facility allows any play in the V bearings to be removed quickly and easily. When the bearings reach the end of their lives, they can be replaced individually, and not as an entire set, saving both time and money. This is a particular benefit in the highly demanding environment of the dairy industry.'

A video of the system in action may be viewed at https/youtu.be/KRebgsqmuIQ

CASE STUDY: TOMLINSON'S DAIRIES

Tomlinson's Dairies are a dairy goods manufacturer based in Wrexham. They supply around 25 million litres of fresh milk a year to some 300 outlets across Wales, the Midlands and Northern England. In December 2017 they installed the TP1002 on their production line. The case study 'Milk Bottle Trolley Packing' in ABB's recently published 'Engineering an Automation Nation: Examples of UK and Irish Applications of Robotic Automation for Manufacturing' explains more:

'Tomlinson's manually loaded its trolleys at the end of the filling line, but the company often experienced a bottleneck, with trolleys becoming jammed when they were moved to load the bottles of milk. In addition, there was a constant risk of repetitive strain injury or lifting injuries through repeatedly lifting and loading the products.'

Fortunately, research revealed that Mechelec Automation had already begun devising an automated solution to tackle the problems typically associated with the transportation of milk bottles from the end of a dairy's production line to the retail outlets.

The article explains the workings of the new system as follows:

'Bottles of milk are fed from a filling line through a conveyor system before passing into a multilane set up, which divides them into four lanes. They are then collated into the required format, with four lanes consisting of five bottles per lane. Two groups of five bottles are collated either side of the machine until there are twenty bottles either side waiting to be loaded onto two trolleys.

One group of five bottles is then pushed into the robot gripper which lifts and rotates them 180 degrees towards the first trolley. The trolleys have four shelves with the bottom shelf being loaded with the first twenty bottles. When all four shelves are full, the trolley is taken to the cold stores whilst the second trolley is loaded, and the next empty trolley is positioned, after which the process is then repeated.

Where previously it took four workers a minute to fully load two trolleys, the automated system has reduced it to forty seconds. As a result Tomlinson's productivity has improved by 50 per cent.

The jamming of the trolleys is no longer a problem because the bottles of milk are brought to the trolleys which remain at the same level. This contrasts with the previous approach when they had to be manoeuvred to fit in line with the loading system.

Health and safety has also significantly improved. With no need for manual packing of the milk bottles, the risk of repetitive strain injuries has been eliminated.'

The article concludes with a quote from John Salisbury, Mechanical Engineer for Mechelec Automation, as follows:

"If a customer wants an automation solution which can switch between products and work with various trolley types, we can pre-commission it so that the recipes are built into the system. The flexibility of production at a dairy goods manufacturer is significantly increased where the robot automation is installed due to the many capabilities and opportunities that the programming software provides."

When asked why he specifically chose an ABB robot his response was "there was no other robot which could handle 180kg at full speed with the reach of 3.15m".

ABB Robotics were an exhibitor at MACH 2018 and are located at Auriga House, Precedent Drive, Rooksley, Milton Keynes MK13 8PQ. Telephone: 01908 350 300. Email: abbuk@recall.com

CASE STUDY: ROBOFOLD

RoboFold is a design consultancy based in London which is using two ABB6400 robots, normally used in the metal industry for cast cleaning and pre-machining, to help architects and designers to explore new ways of bending and forming metal in order to create new possibilities for architectural and furniture design.

This novel application is described in the article 'Metalforming and Sculpting: RoboFold demonstrates the Art of Robotics' in the above publication as follows:

'Both six-axis robots are fitted with vacuum cups, which hold pre-scored metal sheets, ranging from 60 to 80 square centimetres up to 1.5 square metres, as they are curved and folded according to instructions supplied by RoboFold's own robotic CAD system. The CAD program dictates the movement of the robots, which move simultaneously according to the pre-determined trajectories needed to fold the metal into the desired shape or shapes. As all of the information for the folding is contained in the data from the CAD System, there is no need for any hard tooling.'

The article quotes RoboFold Proprietor Gregory Epps, who explained how this novel approach came to be realised:

"Before I bought the robots I had made previous attempts at developing my own machines that could bend metal along a curve. However, none of them could be readily adapted to handle different jobs."

The robots overcame this problem:

'All information about the shape and form for the metal is contained in the CAD instructions, which direct the movement of the robot to produce the object required. Furthermore, RoboFold also has the ability to simulate the process before it has been carried out, enabling any areas for fine-tuning to be identified and rehearsed before the physical process begins.'

Another problem that has been overcome is the need to produce a mould. This is a common problem in metals fabrication, but the ability of the robot to work directly from the CAD file removes it. Mr. Epps is again quoted:

"As almost all of the work we do is bespoke and non-standard, it would be both impractical and uneconomical to produce a mould for every object we make. With our robotic system, the CAD file is effectively the mould, but, unlike a traditional mould, it can be readily changed and adapted wherever necessary.

With the robotic system, we've really achieved the best of both worlds, coupling the accuracy, speed and capabilities of automation with the human appreciation of form and function. Using the robots has opened up a world of new possibilities for the way metal can be shaped, with an end result that looks much better than other products formed using alternative processes."

RENISHAW PIONEERS PRODUCTIVITY IN ADDITIVE MANUFACTURING

MACH 2018 exhibitor Renishaw has launched a pioneering additive manufacturing machine in the form of the RenAM 500Q. With four 500W lasers it is designed to greatly improve productivity in the most commonly used platform size in order to bring the benefits of additive manufacturing to a wider range of industries.

The article 'Pioneering Productivity in Additive Manufacturing' in the April 2018 issue of *Engineering Subcontractor* describes the technology:

'By speeding up the process by up to four times, the RenAM 500Q broadens the market appeal of metal additive manufacturing into applications that were previously uneconomic, driving the technology into new industries. By positioning the machine competitively, Renishaw has ensured the productivity benefits will reduce cost-per-part without compromising on the precision or quality of a single-laser system.

A critical technology at the heart of the RenAM 500Q is the optical system and control software. Laser beams enter the system via four channels, where they are dynamically focused and directed into a single, thermally controlled galvanometer mounting. The galvo mounting houses four pairs of digitally controlled guided mirrors, which can guide lasers to cover the entire working area of the powder bed.

The new system develops the safety and usability features of the single-laser RenAM 500M, incorporating dual SafeChange filters with automated change over to minimise manual intervention. Studies have shown an additional benefit, that powder condition is maintained for maximum reuse, further reducing part costs.'

The article quotes Robin Weston, Marketing Manager of Renishaw's Additive Manufacturing Products Division as follows:

"Renishaw's additive manufacturing machines are designed, engineered and manufactured in-house, giving us exceptional control over system performance. Using innovative design of the optical system and by incorporating digital controls and dynamic focusing, all four lasers can address the powder bed simultaneously, improving the speed, productivity and capability of the machine.

Additive manufacturing is a key enabler of the optical system. It allows tighter packaging of mirrors and the incorporation of internal conformal cooling channels to maintain precise thermal stability."

Further information may be obtained from Renishaw UK Limited, New Mills, Wotton-under-edge, Gloucestershire GL12 8JR. Email: uk@renishaw.com

FIRST 3D PRINTED COLLAPSIBLE CORE

What is thought to be the world's first 3D printed collapsible core, incorporating a spiral shaped cooling system for even heat dissipation, has been launched by Strack Norma.

The short feature in the March/April 2018 issue of *Mould Technology* (p.21) explains:

'In general, the use of collapsible cores particularly helps the demoulding of parts which may feature inner undercuts, caps and closures, for example.

The close contour cooling, only made possible through additive manufacturing, optimises temperature control to improve part quality and reduce cycle times. The collapsible core's inner core and the guide rings are also DLC-coated to reduce on-going lubrication; other special coatings are available depending on the processing requirement.'

John Applebee, Managing Director of Hales Tool and Die Limited, Strack Norma's representative in the UK, is quoted as follows:

"We are searching for reference partners to test the advantages of the printed collapsible cores compared to conventional collapsible cores. Of course, we will contribute to the costs in this test phase."

MANUFACTURING TECHNOLOGY CENTRE LAUNCHES ADDITIVE MANUFACTURING APPRENTICESHIPS

The Manufacturing Technology Centre (MTC) in Coventry has announced that it is to launch the UK's first apprenticeships dedicated to providing the skills required for additive manufacturing. The aim is to provide a 'pipeline' of technicians fully skilled in this fast-growing field of advanced manufacturing technology.

The Manufacturing Technology Centre houses the National Centre for Additive Manufacturing, which will be well-placed to provide training that goes beyond equipment use to cover the whole range of competencies that are necessary for specific occupations. It will also offer 'accredited curricula' short courses for the upskilling of existing staff.

Martin Dury of The Manufacturing Centre states:

"We are currently writing competency frameworks that will define the knowledge, skills and behaviour required to undertake various jobs in an 'end-to-end' additive manufacturing production environment. These frameworks will then form the foundation for the apprenticeship programmes and short course curricula."

It is aimed to launch these new apprenticeship programmes in September 2018 and anyone with additive manufacturing experience is invited to contribute toward the design of the competency frameworks.

The National Centre for Additive Manufacturing was an exhibitor at MACH 2018 and is located at Pilot Way, Austy Park, Coventry CV7 9JU. Email: info@the-mtc.org

Those looking to contribute to the apprenticeship programmes are advised to use ncamskills@the-mtc.org

DIGITAL POSITION CONTROLLERS IMPROVE PARTIAL STROKE TESTING OF VALVES

Testing the installed base is a highly important part of any valve monitoring programme and partial stroke testing (PST) offers both safety and cost-saving benefits. It offers, for example, extension of intervals between full stroke tests, planning of inventory for maintenance turnarounds and sometimes reduction of the need for redundant valve solutions. Unfortunately, however, from mechanical jammers and modulating valve controllers to solenoid valves and smart positioners, the PST methods available have hitherto been very limited, with each providing varying features that solve some problems but create others. Furthermore, these methods lack the ability to capture usable data that can be translated into valuable diagnostics.

In the Spring 2018 issue of *Valve User Magazine*, the article 'Digital Position Control Transmitters: The Smart PST Method' (p.96) explains how Westlock Controls, one of just a few digital position suppliers, has utilised smart technology in order to develop an automated PST method that offers much broader diagnostic capabilities, easier implementation and a more cost-effective maintenance programme.

The article states:

'The digital position control transmitter is based on solenoid valve (SOV) technology and is capable of testing the complete automated valve package, including the SOV, electronically measuring the valve's position and creating a feedback signal using analogue and/or bus technology to report the valve's true position to the plant's control system.

Unlike the PST methods of the past, digital position control transmitters can capture diagnostic information during the full stroke test, as well as an ESD event and translate that into predictive data that can be used to determine which automated/discrete valves are healthy and which are not during plant turnaround, before an emergency shutdown event occurs.'

Westlock offers this technology through its digital EPIC product line (versions 1 and 2), with the Digital EPIC 2 offering, additionally, reliable non-contact position feedback with digital communication via Hart® protocol in an integrated package, providing 4 to 20mA feedback so as to be confident that the valve not only shifted but went to the fully closed, tight shut-off position.

The Digital EPIC 2 can also store up to seven full stroke tests in non-volatile memory. Five of these are diagnostic tests, including baseline, dynamic baseline and maintenance signatures that can be reviewed on the user's host system via DD/DTM technology and used to make determinations on valve health and schedule maintenance accordingly. The remaining tests (integrator and installer) are used to document the function of the valve assembly, both at the automation supplier or OEM location, as well as after being installed in the field, assuring traceability along the entire valve package commissioning process.

Westlock may be contacted on 01892 516 277.

NEW SENSOR IMPROVES RELIABILITY OF MANUFACTURING GEARBOXES

The most common cause of gearbox failure is surface degradation, accounting for around 70 per cent of breakdowns. Much of this stems from either mechanical wear or metallic debris build-up in the lubricating oil. This build-up commonly arises from such factors as inadequate lubrication, contamination, bearing spalling, gear polishing, pitting and overload.

In order to try to reduce this Gill Sensors and Controls have developed a new kind of sensor that is designed to provide a much earlier detection of debris. The article entitled 'The Condition Monitoring Sensor' in the April 2018 issue of *Manufacturing Engineering Process Control Automation* (p.40) explains how it works:

'The sensor works by using a powerful magnet to capture ferrous metallic debris, monitoring both fine debris (wear particles from bearing and gears) and coarse debris (parts of a bearing, sheared teeth and parts typically 0.5 square millimetres upwards). An inductive coil within the sensor probe and Gill's innovative software enables the sensor to differentiate independently between the two debris types.

Installed in the bottom of the large speed reducer sump or directly into an oil flow, the sensor collects the ferrous debris within the oil. The sensor's voltage output increases when debris is detected on the magnet indicating a potential problem. This was proven when regular inspection of the sensor data readings alerted the manufacturer's engineers to a large amount of ferrous particles. On inspection gear flaking and cracking were found, caused by the early failure of a supporting roller bearing. As a result of the real-time detection,

engineers shut down the machine, during a planned maintenance period, to replace the damaged components before a catastrophic failure occurred.'

The article quotes Gill's Product Manager Simon Foulser as follows:

"The Condition Monitoring Sensor has numerous advantages over other monitoring approaches due to its continuous, real-time data. It can detect failure parts at a much earlier stage than the vibration sensors. It also eliminates the lengthy training required to remove the natural gearbox vibration from the data captured from the vibration sensor. Furthermore, because of the continuous nature of the Condition Monitoring Sensor, data is transmitted in seconds making it quicker than laboratory analysis."

VIBRATION TECHNOLOGY FOR PREDICTIVE MONITORING OF TRAIN DOORS

In Europe between 25 and 50 per cent of train defects relate to doors and across the globe around 70 per cent of passenger injuries have been due to mechanical damage to doors.

Now a consortium has been formed to pilot the use of vibration technology for the predictive monitoring of train doors in an attempt to reduce the present high levels of injuries and defects. The consortium comprises Hitex (UK and Germany), TWI Limited (UK), Transport Systems Catapult (UK), Transports Metropolitans de Barcelona SA (Spain), and Innovative Technology and Science Limited (UK), and together they will be working on the Vibration Analysis for Remote Condition Monitoring (VA-RCM) project.

The article 'Mind the Doors' in the April 2018 issue of *Condition Monitor*, the international newsletter of the British Institute of Non-Destructive Testing, states:

'The idea behind the functionality of the VA-RCM system lies on vibration analysis algorithms. Vibration takes place when there is either a defect present or a certain external stimulus.

Vibration analysis is a condition monitoring method, the principles of which are associated with the simplest mass-spring model and its deformation. Image recognition can be applied with a view to distinguish between doors that are either working properly or not. A real challenge for such a system is to not only classify the doors based on their operation, but also to predict their probability of failure.

The domain of predictive maintenance is of great importance because it can offer valuable information regarding the degradation of a system. As a result, performing targeted (predictive) maintenance will undoubtedly save costs when compared to performing a preventative one. The principles of vibration analysis and pattern recognition are applied on the signals that are received from the train doors and reported via the internet to a central location.

Statistical analysis classification of the train doors can take place based on their level of functionality and damage mechanism.'

The British Institute of Non-Destructive Testing was an exhibitor at Plant and Asset Management 2018. It is the professional institute for all those engaged in non-destructive testing and condition monitoring and membership provides opportunities for registration as a professional engineer with the Engineering Council (CEng, IEng,EngTech).

The BINDT may be contacted on 01604 438 300. Email:info@bindt.org

NEW METHOD FOR ANALYSING RAW MATERIALS UNDER LOAD

The Fraunhofer Institute for Structural Durability and System Reliability LBF has become the first to combine the mechanical testing of a component under realistic loads with a radiographic examination. This will help to characterise materials and make it easier to assess inclusions or damage to raw material with regard to their influence on durability and service life.

The article 'Computed Tomography analyses Damage to Raw Materials under Load' in the March 2018 issue of *Insight*, the official journal of the British Institute of Non-Destructive Testing, describes its principles:

'With the new test method, the tested component remains in the X-ray equipment during the mechanical load. As a result, the exact location of damage in the material can be observed and analysed throughout the entire load duration. Previous concepts were never able to achieve the necessary precision of just a few micrometres with the alternating insertion and removal of the sample with intermittent radiological examination.

With the most modern imaging processes, cracks and damage in the material can be illustrated vividly and three dimensionally, opening up many possibilities for analysis. With the use of a microfusion pipe, the X-ray equipment at Fraunhofer LBF has a high resolution capacity of just a few micrometres. In this way, it is possible to detect the smallest signs of damage even as it begins to occur, or determine that the slightest irregularities in the material are the point of origin for the damage. In the area of fibre-reinforced plastics in particular, the occurrence of damage on the fibre level can be studied.

With this knowledge on the cause of the error and the error sequence, developers, designers and manufacturers can now improve their materials, components and manufacturing processes even before a crack is macroscopically visible.'

The article quotes Oliver Schwarzhaupt, Research Associate in Function-integrated Lightweight Construction at Fraunhofer LBF as follows:

"Understanding how damage occurs to the material of a component while it is placed under realistic mechanical loads is one of the key questions in materials science, but it was previously not possible.

The new process represents a huge advance with regards to detail resolution and precision, as well as the retrievability of possible causes of damage.

Our concept makes a great contribution to the topic of material understanding and is clearly better able to meet customer-specific requirements in the area of material failures at an early stage."

The method is noted to be particularly well-suited for the examination of high-strength components made of carbon fibre, such as those used in aircraft construction.

PRIME MINISTER ANNOUNCES £20 MILLION INSTITUTE OF CODING

Theresa May has announced that the Government is to invest £20million in a new Institute of Coding, a consortium of over 60 universities, businesses and industry experts in an attempt to reduce Britain's digital skills gap. This is in addition to the Government's £30million investment in the testing of artificial intelligence and edtech in online digital skills courses.

The Government's £20million investment, which forms part of its Industrial Strategy and will be led by the University of Bath, will be matched by a further £20million from industry, including in-kind contributions such as training and equipment.

Universities Minister Sam Gyimah says:

"A world-class pipeline of digital skills is essential to the UK's ability to shape our future. By working together universities, employers and industry leaders can help graduates build the right skills, in fields from cybersecurity to artificial intelligence to industrial design.

The Institute of Coding will play a central role in this. Employers will have a tangible input to the curriculum, working hand in hand with universities to develop specialist skills in areas where they are needed most. As we have outlined in the Industrial Strategy, this is part of our ambition to embrace technological change and give us a more competitive edge in the future."

NEW MODEL UNIVERSITY TO FOCUS ON TECHNOLOGY OF THE FUTURE

A 'new model' university, to be known as MK:U, is to be established in Milton Keynes with the objective of focusing on the technology of the future, such as digitalisation, cybersecurity, robotics and artificial intelligence.

Milton Keynes Council has selected Cranfield University as the lead higher education provider.

Councillor Peter Marland, leader of Milton Keynes Council, stated:

"For a long time we've held aspirations for a bricks and mortar university in Milton Keynes to attract talented young people and for local students to attend, and this is a significant step towards the creation of MK:U. Through the MK Futures 2050 process, we identified how a university focused on technology could benefit our economy, especially coming alongside the development of the Cambridge-MK-Oxford corridor which holds great promise. This will be the first university anywhere designed as a response to the challenges facing cities today and in the future. We're delighted to be entering this next chapter with Cranfield University."

Developed in partnership with business, the new university will deliver a distinctive STEM-focused undergraduate curriculum.

SPACE TECHNOLOGY TO BE APPLIED IN NUCLEAR DECOMMISSIONING

Wood, a global leader in the delivery of project, engineering and technical services to energy and industrial markets, is now leading research to make nuclear decommissioning safer, faster and more cost-effective by innovatively applying new technologies developed in space exploration, car production and medicine.

The article 'Wood wins Government Backing to bring Space Technology to Nuclear Decommissioning' in the March 2018 issue of *ndt news*, explains:

'Leading one of five projects selected from a shortlist of fifteen, the company has secured approximately £1.5million funding from the UK Government's Department for Business, Energy and Industrial Strategy, the Nuclear Decommissioning Authority (NDA) and Innovate UK after winning a prestigious competition to find the best new ideas.

Wood and its supply chain will combine new data and control systems with state-of-the-art robotics to design a demonstrator system for cleaning and dismantling highly radioactive rooms or "cells" at Sellafield in Cumbria.

The technologies used in Wood's project include novel material handling solutions to reduce the risks associated with working at height, mixed reality headsets, a multi-fingered gripper which allows robots to grasp different objects, and a navigation system designed for missions to Mars which enables autonomous mapping where human access is impossible.'

Bob MacDonald, CEO of Wood's Specialist Technical Solutions business, is quoted as follows:

"Our innovative proposal for a fully remote solution removes the operator from a hazardous environment and is adaptable enough to tackle different tasks, many of which present unique challenges.

Wood's role is as an innovation integrator, bringing together ingenious ideas from industry and academia to define a new approach to the nuclear decommissioning challenge."

Wood's research partners are Airbus Defence and Space Limited, Clicks and Links Limited, Damavan Imaging SAS, Digital Concepts Engineering Limited, IS-Instruments Limited, I3D Robotics Limited, the University of Lancaster, the University of Salford, Kawasaki UK Limited, and TWI.